PROGRAMME PLANNING : A STEP TOWARDS IMPROVED SUGARCANE PRODUCTION

By G. D. THOMPSON and P. K. MOBERLY

South African Sugar Association Experiment Station, Mount Edgecombe

Abstract

Most of the technology required to produce sugarcane yields approaching the climatic potential under South African conditions is known to many growers. Average sugarcane yields in the industry nevertheless remain well below the commercially attainable objective primarily because it is difficult to employ to the maximum advantage the complex combinations of manpower, equipment and material resources which are needed to achieve this objective. Programme planning on an annual basis for the work to be completed during each month of the ensuing year should enable growers to contend with their difficult task satisfactorily and thereby to increase significantly their crop yields and the profitability of their farming operations.

Introduction

The S.A.S.A. Experiment Station has been promoting the concept of programme planning for a number of years through its extension and advisory services. Comprehensive programme planning is not new to the industry, having been introduced on one estate as far back as 1958, and described by Sheppard.[1] Furthermore, programme planning has been practised to some extent by cane growers ever since crop estimates have been prepared, and harvesting and planting programmes will always constitute the main basis for comprehensive programme planning. The concept as it is held today may perhaps be described most simply as "an attempt to plan the use of all manpower, materials and equipment resources on a cane farm for an ensuing year". The purpose of programme planning is to ensure the most efficient use of available resources, and to provide a simple and logical basis for managing cash flow and finance on the farm, thereby increasing productivity and profitability.

Annual programming — the basic procedures

Programme planning has been adapted and simplified to meet the requirements of individual growers and estates, but the following is a description of the most complete exercise that has been conducted so far. The programme plan covers an ensuing year, and this may either be a calendar year or a budget year. The latter has obvious advantages regarding finances, and is therefore generally recommended. In the exercise described here, a budget year from 1st April to 31st March will be used. This has the added advantage that an entire harvesting season is contained within the planned year.

Step 1

The first step comprises little more than the procedure required for the first crop estimate. It is simply necessary to identify the fields on the farm due to be harvested during the ensuing season, and to estimate the yields that will be obtained. To facilitate the estimating process, it is advisable to establish approximately when each field will be cut. This can be done by establishing the sequence of fields to be harvested, and then determining when each should be due for cutting. Once the yields have been estimated, the total crop weight from each field can be calculated. A hypothetical exercise is shown in Table 1. If the mill crushing season is planned to be 200 days, then it becomes possible to fix more firmly the proposed harvesting schedule. A total crop of 8 000 tons will have to be cut at a rate of 40 tons per day, and the harvesting duration in days for each field can be calculated by dividing total field yield by 40. If the season is due to start on 3rd May 1976, and harvesting operations are to proceed for 6 days per week, then the proposed harvesting dates for each field can be established (see final two columns of Table 1).

Step 2

The second operation to be pre-planned is planting. In this exercise let it be assumed that Field 5 is to be re-planted. The yield from this field is relatively poor and with re-planting in mind it was scheduled for harvesting at the beginning of the season. From past performance on the farm, an average planting rate should be estimated. This might be 0,4 ha per day, and it would then take 36 working days to complete the planting operation.

TABLE 1

A hypothetical harvesting programme for a farm producing 8 000 tons of sugarcane over a milling season lasting 200 days

Field No.	Area (ha)	Harvest sequence	Est. yield tc/ha	Total yield tons	No. of days to harvest	Harvest Period	
						Start	Finish
1	10,3	3	95	979	24	16 July	12 Aug.
2	16,8						
3	12,9						
4	10,2	5	110	1 122	28	1 Oct.	2 Nov.
5	14,3	1	75	1 072	27	3 May	2 June
6	16,1	4	105	1 690	42	13 Aug.	30 Sept.
7	8,4						
8	11,2	6	90	1 008	25	3 Nov.	1 Dec.
9	14,8	2	100	1 480	37	3 June	15 July
10	5,7	7	115	656	17	2 Dec.	21 Dec.
11	9,3						
Total	130,0			8 007	200		

TABLE 2
A hypothetical fertilizer programme

Field No.	Area (ha)	Stage at fert.	Type of Fertilizer	Placement	kg/ha	Total Tons	Total pockets
1	10,3	3R	4:1:6	Top dress	1 000	10,30	206
2	16,8	—	nil	—	—	—	—
3	12,9	—	nil	—	—	—	—
4	10,2	2R	4:1:6	Top dress	1 000	10,20	204
5	14,3	P	Single supers	Furrow	800	11,44	229
			1:0:1	Top dress	500	7,15	143
6	16,1	2R	4:1:6	Top dress	1 000	16,10	322
7	8,4	—	nil	—	—	—	—
8	11,2	3R	4:1:6	Top dress	1 000	11,20	224
9	14,8	1R	1:0:1	Top dress	500	7,40	148
10	5,7	1R	1:0:1	Top dress	600	3,42	68
11	9,3	—	nil	—	—	—	—

Step 3

The fertilizer programme for the year is relatively easy to prepare. Soil samples should be despatched to the Experiment Station Fertilizer Advisory Service well in advance, so that recommendations are on hand when programme planning begins. An example of a proposed programme is given in Table 2.

Although a similar programme could be prepared at this stage for herbicide usage, it would usually be wiser to compile this summary only after completing Step 6, because timing of operations and other considerations are critical when selecting the chemicals to be used.

Step 4

The procedure for this step is firstly to list all *operations* which are carried out at any time on a cane farm. These are listed in the second column of Appendix 1 and may comprise the following:

(i) Land clearing
(ii) Land preparation
(iii) Soil conditioning
(iv) Planting
(v) Top dressing
(vi) Weed control
(vii) Harvesting
(viii) Infield transport
(ix) Trash management
(x) Cleaning breaks
(xi) Drainage
(xii) Road maintenance

Secondly, the individual *components* of each of these operations must be listed. These components are shown in the third column of Appendix 1. As an example, land preparation may be broken down as follows:

(*a*) Cleaning up
(*b*) Ploughing
(*c*) Harrowing
(*d*) Ripping
(*e*) Ridging
(*f*) Farm planning
(*g*) Conservation structures, machine
(*h*) Conservation structures, labour
(*i*) Waterways, machine
(*j*) Waterways, labour

Finally, it is necessary to compile a list of standards for each component of each operation. Some hypothetical resource standards are listed in Columns 4 and 5 of Appendix 1, the standards required for components of land preparation being:

(i) man days/ha for cleaning up
(ii) tractors hours/ha for ploughing
(iii) tractor hours/ha for harrowing
(iv) tractor hours/ha for ripping
(v) tractor hours/ha for ridging
(vi) man days required per 10 ha for farm planning
(vii) metres of conservation structure/tractor/day
(viii) metres of conservation structure/man/day
(ix) metres of waterway/tractor/day
(x) metres of waterway/man/day

The provision of these standards facilitates subsequent planning but does not prescribe the resources required for an operation under all circumstances. The standards will vary according to conditions such as field shape, land slope and soil type.

Step 5

At some time prior to 1st April, a detailed survey is carried out for each field on the entire farm. In the first instance this should be done in the field by a group comprising, let us say, the grower, his Extension Officer and a clerk. There is considerable advantage to be gained from working in the field because most of the problems and obstacles on the land are then visually apparent. An important function of programme planning is to encourage the recognition, and thereby the solving of the many large and small factors which continue to restrict sugarcane production on most farms today.

The survey of each field is recorded on a standard form such as that shown in Appendix 2 (stocks of these are available from the Experiment Station). General details regarding the field are recorded at the top of the first page, and these should be completed carefully for each field from farm records in the office prior to starting the survey in the field.

The example given in Appendix 2 refers to Field 5, which is to be harvested and re-planted within the programme year. It therefore represents the most extensive type of field plan likely to be required. By comparison, plans for Fields 2, 3, 7 and 11, which are not to be harvested during the year, would be very short.

The survey team should proceed to a vantage point from which all or as much as possible of Field 5 can be seen. The exercise is then to imagine for each month of the ensuing plan year, from April through March, what operations will need

to be carried out. As shown in Appendix 2, the only operation to be done in April is to make breaks for the burn on the evening of 2nd May or the morning of 3rd May. Reference to the standards in Appendix 1 shows that one man is required for this task for the 80 tons of cane to be burnt every other day.

During May the first 1 000 tons of cane is harvested, and the remainder during the first two days of June. As shown in Appendix 2, provision is made for cutting breaks, for cutting and stacking burnt cane, for mending stacks, and for hauling and trans-shipping 8 loads per day.

When harvesting is complete in June, land preparation can begin. Advantage is taken of the dry period to lay the necessary drains, and not only can decisions be made about the dimensions of the trenches to be dug, but also the type and amount of drainage pipe required can be determined. Shaping the outflow of drainage lines is a labour intensive task that should not be neglected.

In July filtercake may be delivered to the field, a harrowing can be completed, the farm plan can be laid out (usually by the grower himself with a few labourers), and the conservation works can be installed. The daily task of 20 m per man per day on the waterways would include planting grass and revetting.

During August, land preparation would continue and field roads would be repaired in preparation for planting traffic. September would see a final harrowing and planting would ensue for about 36 days. The final decisions regarding the variety to be planted and the source of seedcane are made here. In practice, the cane haulage tractor would probably be used at some time of the day to deliver one load of seedcane to Field 5 for the following day's planting. If this decision is taken, then it is not necessary to show any separate tractor/driver requirement for this task. Similarly, the daily ridging of 0,4 ha would probably be done by the tractor being used for harrowing operations, and no additional resource requirement therefore needs to be indicated.

A pre-emergence herbicide combination, such as Lasso and Atrazine, should follow within a day or two after planting and this could reasonably be expected to control weeds for two months. The next operation after planting has been completed in October should be the fertilizer top-dressing towards the end of November, followed shortly afterwards by an inter-row cultivation which will flatten the ridges formed at planting and control any weeds in the inter-row. A hand-weeding may be necessary in December to remove weeds in the row which escaped the pre-emergence herbicide treatment. In early January a directed post-emergence herbicide application would probably be required to control weeds until full canopy is achieved. Allowance should also be made for a final light hand weeding in March, using only 3 men per hectare.

Once the principles involved in programme planning become familiar to the team doing the survey in the field, a programme such as that for Field 5 can be completed well within the hour. Bearing in mind that the plan for this field is unusually complicated, there is no reason why a year's pre-planning for a 130 ha farm should not be completed in a single day. The fields are planned in succession, always from vantage points where the crop, topography and peculiar problems in each field can be seen clearly. If conditions within a field vary to the extent that different parts have to be treated differently, this problem can be accommodated easily on the plan by indicating the actual area which is to receive a particular treatment. Thus, in Field 5, if 10 ha were to be sprayed with herbicide in October by knapsack, and the remainder by tractor, there would simply be two entries as follows:

Code No.	Operation	Component	Standard	Tractor / Implement	Materials		Man Days	Tractor Days
					Type	Total Amount		
29	Weed control	Herbicide knapsack (10,0 ha)	2,5	Knapsack	Lasso (4 ℓ) + Atrazine (2 ℓ)	40 ℓ + 20 ℓ	25	—
30	Weed control	Herbicide boom (4,3 ha)	1,0	MF 135 + Boom	Lasso (4 ℓ) + Atrazine (2 ℓ)	18 ℓ + 9 ℓ	—	1

When programme planning becomes a familiar exercise, and the clerk has mastered all of the procedures involved, the grower will be able to plan each field simply by referring to each month in succession, calling out the operation and the component to be filled in by the clerk, and then relying on the clerk to call out the heading of each subsequent column of the Field Plan shown in Appendix 2.

As an example, the dialogue for November in Field 5 would be:

Grower: November, Code number 23, top dressing, hand application (referring to Appendix 1).
Clerk: Standard?
Grower: 8 pockets/man day (by reference to Appendix 1 or equivalent)
Clerk: Tractor and implements?
Grower: Nil
Clerk: Type of material?
Grower: 1:0:1 fertilizer mixture (by reference to Table 2 or equivalent)
Clerk: Amount per hectare?
Grower: 500 kg (Table 2)
Clerk: Total amount?
Grower: 143 pockets (Table 2)
Clerk: Total man days?
Grower: 18 (143 divided by 8 calculation)
Clerk: Tractor days?
Grower: Nil

TABLE 3

Summation of resource requirements for a single hypothetical field for a full year

Month	Man days	Machine operator days	Material requirements					
			Fertilizer		Herbicide		Other	
			Type	Amount tons	Type	Amount	Type	Amount
April	1	—	—	—	—	—	—	—
May	420	25	—	—	—	—	—	—
							Sand	15 m³
June	184	13	—	—	—	—	Plastic drain	450 m
							Stone	18 m³
July	102	17	—	—	—	—	F/cake	143 t
Aug	20	15	—	—	—	—	Gravel	100 m³
Sept	344	3	Single supers	8,0	Lasso Atrazine	40 ℓ 20 ℓ	Seedcane	71 t
Oct	149	1	Single supers	3,4	Lasso Atrazine	17 ℓ 9 ℓ	Seedcane	30 t
Nov.	104	—	1:0:1	7,15	—	—	Mules	43 days
Dec.	86	—	—	—	—	—	—	—
Jan.	36	—	—	—	Diuron MCPA	36 kg 58 ℓ	—	—
Feb.	—	—	—	—	—	—	—	—
Mar.	43	—	—	—	—	—	—	—

Grower: November, Code number 28, weed control, mule cultivation
Clerk: Standard?
Grower: 0,33 ha/mule/day
Clerk: Tractor and implements?
Grower: Uba cultivator
Clerk: Type of material?
Grower: Mule
Clerk: Total amount?
Grower: 43 days
Clerk: Total man days?
Grower: 86 (leader + driver per mule day)
Clerk: Tractor days?
Grower: Nil

To accomplish some of the more complicated arithmetic it would be advisable to have a pocket calculator available in the field. In practice the grower may find it more convenient to state only the sequence of operations, the standards to be used and the types of material required, and the clerk may then calculate the totals required at a later stage in the office.

Step 6

This step is carried out entirely in the office and can be done by a competent clerk. It involves the summation and collation of all of the information accumulated on the individual field plans. The exercise for Field 5 is given in Table 3. For each month the manpower, machine and material resource requirements are summated. Machine operator and tractor driver requirements will invariably be the same as the number of tractor and machine day requirements, but provision must be made separately if "conductors" or trainee drivers are also employed. Categories such as clerks, overseers, stable cleaners and pump operators are considered to be "fixed labour", and are excluded from the total man days required.

When a summary has been produced for each field, the total resource requirements for all fields for each month are determined. This immediately provides the following estimates:

(i) labourer man days/month
(ii) machine operator days/month
(iii) a distribution of monthly fertilizer requirements
(iv) a distribution of herbicide requirements and the amounts needed
(v) a catalogue of all other resource requirements, be they drainage pipes, filter cake, stone, gravel, sand, seedcane or mules.

Step 7

At this stage in the South African sugarcane industry's development, manual labour remains the most common and important resource that is used on a cane farm. Step 7 therefore involves an assessment of the apparent total monthly labourer requirements throughout the year, the data having been provided in Step 6. A possible distribution is shown in Figure 1. For simplicity, let it be assumed that the normal available labourer force is 48 men per day throughout the year. The average requirement for the whole year, from the data provided in Step 6, might be 51 men per day. It would therefore be necessary to:

(i) reduce the average labour requirement by about 6%
(ii) re-organize the monthly distribution of the work load so that peaks and troughs are eliminated as thoroughly as possible.

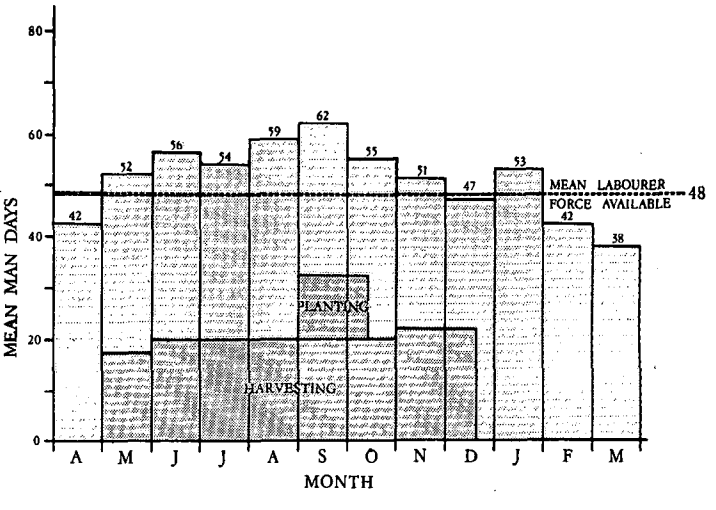

FIGURE 1 Mean man days required each month to perform labourer tasks.

There is a considerable number of ways in which these two objectives can be attained. One immediately obvious method is to mechanize the cane loading operation. This would reduce the labour demand from May to December, whilst helping to eliminate the fairly continuous peak during this same period. Also, it is a normal situation to be confronted with an accumulated weeding programme in January after harvesting has been completed, with a dwindling demand in February and March. This situation might be alleviated by using more herbicides in November, December and January, and by looking forward to the next year's programme to see whether or not future drainage, road maintenance, land clearing, and other tasks cannot be brought forward into the later months of the current programme. Labour requirements for hand planting are generally very high, and the efficiency of this operation can invariably be improved. Consideration might be given to planting by machine on land that is reasonably flat.

By exploiting the most economical and convenient alternatives, it should be possible to modify the programme of work so that the predicted labour demand deviates only moderately from the acceptable average. On estates where seasonal labour availability fluctuates quite radically during the year, this particular task becomes rather more difficult. However, the exercise is always worth while, since it not only promotes the exploitation of all possible remedies, but also highlights the unavoidable problem periods well in advance.

When the labour requirements have been adjusted to the optimum limit, an exercise may then be conducted to ensure that the required amounts of machinery and equipment, and the necessary numbers of skilled operators, will be available when required. Although this exercise may be considered as relatively minor in comparison with the estimation of labour requirements at this stage of the industry's development, the time will inevitably come when mechanized operations will be more important and extensive than manual operations. Programme planning should then fulfil perhaps an even more important function in establishing primarily the adequacy of resources other than manpower.

Step 7 completes the first phase of programme planning, and a grower at this point should have a clear idea of:

(i) how much work and what kind of work needs to be done
(ii) when the work should be done
(iii) what resources in terms of manpower, machinery, equipment and materials will be required
(iv) what his operations during the year are likely to cost him, and what his income is likely to be.

Monthly Programming

To complete an annual programme by means of the seven steps described above is an exercise well warranted in itself, but it would be a pity not to proceed to the second phase by comparing actual performance with the programme plan at the end of each month during the year. Short of doing this, the annual plan may lose its entire value if actual performance is allowed to deviate widely and unwittingly from the plan. Nevertheless, it *must* be appreciated at the outset that monthly programmes will deviate from the annual plan, and progressively more so as the year proceeds, because:

(i) weather conditions and milling performance will interfere unpredictably
(ii) the plan will be inadequate to the extent that a grower did not foresee his requirements sufficiently accurately.

Despite these unavoidable limitations, the annual plan remains the one good yardstick against which to measure actual performance.

At the end of March, the annual programme for April should be used in the field as an initial basis for the monthly programme. If the annual programme is completed in February/March, only minor changes should be necessary. It is particularly necessary to check the priority of fields to be weeded, and to establish more accurately, in the light of actual weed growth, the manual labour requirements for each task. Herbicide treatments may also be modified in the light of actual weed populations and species present in a field.

After observing *in the field* all of the work that should be done during April a revised programme is prepared to exploit efficiently the actual labour and other resources available, i.e. if the available labour force is only 46 men per day, the work load must be reduced accordingly; if a required herbicide is not available, an alternative weed control method must be introduced. When the planned work load has been matched to the available resources, a few additional high priority tasks should be listed at the end of the programme. This will ensure that, should the work be done more efficiently than planned, or should it not be possible to perform some planned operation, there will be no doubt as to which items should be added to the programme.

During April a complete and accurate record of resource usage must be kept. This should substitute for any previously used method of recording, i.e. programme planning can scarcely be expected to warrant itself if it is carried out in addition to existing procedures. At the end of April, actual performance is compared carefully with the monthly plan. Deviations are questioned and not treated lightly. It should normally be possible to plan sensibly for one month ahead, and only inexperience should lead to serious errors.

Work unavoidably left over from the April plan normally becomes incorporated as a high priority in the May plan. When the May plan is prepared in the field, again using the annual plan as a guide, slightly wider differences between annual and monthly plans are likely to appear, and such differences will increase still further in the succeeding months. This presents a problem, and care must be taken that actual performance does not fall so far behind the annual plan that unplanned financial stress is incurred. A monthly work programme for May is given in Appendix 3. Harvesting is the most important operation in this month, with some weeding and cleaning of breaks to be completed. Advantage should be taken of the dry weather to dig drains, complete road repairs for the new milling season and, if possible, clear stones from the fallow part of Field 11. The monthly record sheet allows for the estimate of resource requirements to be indicated, the actual resources used during the month to be recorded, and the "variance" to be calculated. Having planned the work required to be done for the month a summary of the planned labour usage can be made, indicating the likely total labour complement, the fixed "non-field" labour, the likely absenteeism, and by difference the labour available to do the planned work.

An example might be as follows:

Item	Men/day	Man days/month (25 days)
Total complement	47	1 175
Fixed and non-field labour . .	11	275
Predicted absenteeism	1	25
Net available field labour . . .	35	875
Planned requirements	40	991
Excess/deficit (+/−)	−5	−116

The reduction in the planned work load for the month can probably be effected most logically by reducing the amount

of work done on removing stones from Field 11 (Code No. 2), as this job can still be completed satisfactorily later in the year. Assuming that this remedy is chosen, a summary such as that shown in Table 4 may then be prepared, and at the end of the month the actual performance for each component of operation can conveniently be compared with the planned performance. Hypothetical data have been inserted in Table 4 to show that all of the planned work was completed, and that 21 man days were available in excess of those predicted (875). Minor "variances" for individual operations show that planning was particularly accurate.

TABLE 4

Summary of planned and actual field labour usage for the month of May, 1976

Code No.	Operation–Component	Total Man Days		
		Planned	Actual	Variance
2	Removing stones	84	90	+ 6
26	Handweeding	138	150	+12
31	Making breaks	12	12	—
33	Cut and stack	333	311	−22
36	Mending stacks	25	25	—
37	Infield transport	—	—	—
38	Trans-shipping	50	50	—
43	Cleaning breaks (hand)	30	30	—
45	Cleaning breaks (knapsack)	20	15	− 5
46	Digging drains	50	60	+10
48	Deliver sand	—	—	—
49	Laying and filling	30	38	+ 8
50	Deliver stone	—	—	—
51	Shaping outflow	3	3	—
52	Deliver gravel	—	—	—
53	Repair roads	100	112	+12
		875	896	+21

TABLE 5

Monthly labour usage summary for May, 1976 (25 days)

Labour utilization	Per day	Total per month		
	Predicted	Predicted	Actual	Difference
Total complement	47	1 175	1 200	+25
Fixed and non-field labour	11	275	275	—
Absenteeism	1	25	29	− 4
Labour available	35	875	896	+21

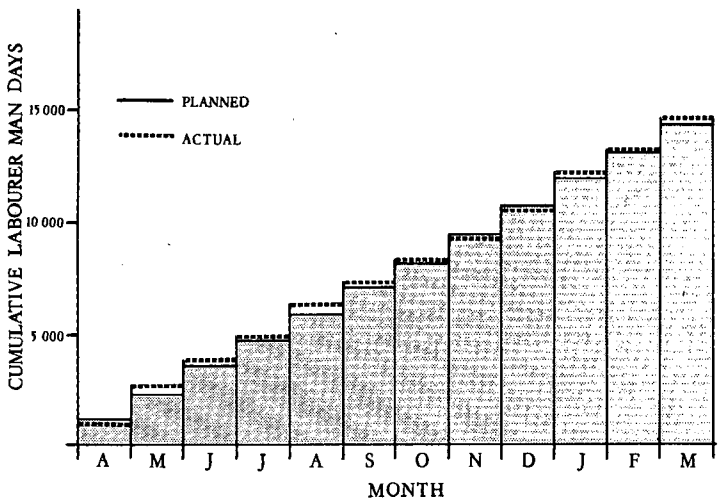

FIGURE 2 Hypothetical data for planned and actual cumulative labour usage.

A further small table can be completed each month to compare actual and predicted labour usage in all categories. An example is shown for the month of May, 1976, in Table 5. To monitor continuing performance, charts may be prepared for each resource for the full year, showing the cumulative planned resource usage from the *annual* plan. By plotting cumulative actual resource usage on the same chart, excesses can be identified at an early stage and remedial action can be taken in good time. Figure 2 shows a histogram which illustrates a hypothetical labour usage situation.

It might occur that in July the mill breaks down and harvesting operations have to be suspended for five days. There need be no undue concern. The unexpectedly available labour proceeds automatically to help with the other planned tasks for the month. If, as should happen, the planned work is completed before the month end, the other high priority tasks listed at the end of the programme are then done. The effect of such mill delays must eventually lead either to an increase of daily allocation or an extension of the season. Both of these eventualities can be absorbed in progressive monthly plans. Only in a chronic situation should it become necessary to introduce entirely new items into the programme of work. A limited alternative is to revert from chemical to manual weed control, thereby avoiding a planned expense.

Since annual programme planning can only be carried out with an "average" year in mind, the monthly plans for January, February, March and April will differ from the annual plan according to the vagaries of the weather, but a really experienced cane farmer who has used programme planning for a number of years may be surprised at the accuracy of his predictions, even for these months.

For an average sized farm, annual planning should not take more than a day to complete. Monthly plans should be completed in a few hours at the most, and an assessment of the previous month's performance should not take any longer. At the end of the year, therefore, the time spent making a thorough assessment of the deviations of actual performance from the annual plan and from monthly plans should be well spent. To a large extent the deviations will constitute a measure of the grower's ability to manage his complex resources.

Conclusion

The climatic sugarcane yield potential in Natal is considerably in excess of the approximate figure of 50 tons per hectare per annum that is currently being obtained as an industrial average. Our observation is that most growers are aware of most of the agricultural technology required to realize the yield potential. The major problem appears to be the co-ordination of the many operations that need to be carried out, in such a way that they are timely and effective. We believe that programme planning or its equivalent is mandatory if the objective is to be achieved.

We are satisfied that programme planning as described in this paper adequately meets all the requirements for efficient cane farming. The only argument against it could be that it is too intricate. In fact it comprises very little more than the work done by every farmer at one time or another. By carrying out one entire exercise at set times, and recording all of the required information systematically in programme planning, the same amount of work becomes very considerably more effective.

To recapitulate, Step 1 comprises little more than the first crop estimate. Step 2 concerns the planting programme which has to be settled at some stage. Step 3 is the fertilizer programme which must be prepared in order to buy the required kinds and amounts of fertilizer. Step 4 is the listing of all

operations, their components and the resources required to complete them, and the estimated standards for each component. This is a salutary exercise in any event, and only needs to be done once, with slight subsequent modifications. Step 5 is the detailed field survey. It contains little if anything that is not a conscious thought in a grower's mind at some time during the year. This step simply constitutes the opportunity to plan systematically. Steps 6 and 7 are the new and important steps, involving a few hours of desk work that are very rewarding. Since steps 1 – 5 are already common in one form or another on many farms, the advantages to be gained from steps 6 and 7 seem to us to be very well worth while.

Monthly programming may seem to be an unnecessary adjunct to the grower's normal activities. However, it is a simple method of recording which has the distinct advantage that actual performance can be measured against some logical yardstick. There seems to be very little reason why a supervisor, "nduna" or "sirdar" cannot be trained to carry out the monthly programme plan with little if any reference to the grower. In such circumstances the grower should be in the fortunate position of being able to manage his farm to maximum advantage, without personal involvement in operations except when unforseen problems arise that only he can deal with.

REFERENCE

1. Sheppard, G. C. (1960). Systematic planning and scientific control of field operations. SASTA Proc **34**: 128–133.

APPENDIX 1

Code Nos., operations, components and standards

Code No.	Operation	Component	Resource Unit	Standard
1	Land clearing	Mechanical	Tractor hrs/ha	8,0
2		Manual, or removing stones	Man days/ha	60
3	Land preparation	Cleaning up	Man days/ha	1
4		Ploughing	Tractors hr/ha	3,5
5		Harrowing	Tractors hr/ha	2,0
6		Ripping	Tractors hr/ha	3,0
7		Ridging	Tractors hr/ha	3,0
8		Farm planning	Man days/10 ha	2
9		Conservation structures:		
		Machine	Metres/tractor day	350
		Labour	Metres/man day	35
11		Waterways		
		Machine	Metres/tractor day	200
12		Labour	Metres/man day	20
13	Soil conditioning	Carting filtercake		
14		Machine	Tons/tractor day	25
		Labour	Tons/man day	5,0
15		Spreading filtercake	Tons/man day	3,0
16		Delivering lime		
		Machine	Tons/tractor day	20
17		Labour	Tons/man day	5,0
18		Spreading lime		
19		Machine	Tractor hrs/ha	2
		Labour	Man days/ha	1
20	Planting	Cutting seedcane	Tons cut/man day	2,0
21		Carting seedcane	Loads/tractor day	3
22		Planting	Man days/ha	25
23	Top dressing	Hand application	Pockets/man day	8
24		Tractor application	Tractor hrs/ha	1,0
25	Weed control	Plant hand weeding,		
		1st weed	Man days/ha	15
		2nd weed	Man days/ha	10
		3rd weed	Man days/ha	8
26		Ratoon hand weeding,		
		1st weed	Man days/ha	12
		2nd weed	Man days/ha	8
27		Tractor cultivation	Tractor hrs/ha	1,5
28		Mule cultivation	Ha/mule/day	0,33
29		Herbicide, knapsack	Man days/ha	2,5
30		Herbicide, boom	Tractor hrs/ha	1,0
31	Harvesting	Making breaks	Men/day	0,5
32		Cut only	Tons/man day Burnt	7,0
			Trash	4,0
33		Cut and stack	Tons/man day Burnt	3,0
			Trash	2,5
34		Mechanical stacking		
		Machine	Tons/machine day	40,0
35		Labour	Stacks/man day	1,5
36		Mend stacks	Men/day	1
37	Infield transport	Tractor/trailer	Loads/tractor/day	8
38		Trans-shipping	Men/day	2

Code No.	Operation	Component	Resource Unit	Standard
39	Trash management	Spread trash	Man days/ha	3
40		Part trash	Man days/ha	4
41		Line trash/hand	Man days/ha	6
42		Line trash/mech.	Tractor hrs/ha	2,0
43	Cleaning breaks	Hand work	Metres/man day	100
44		Mowing	Metres/tractor day	4 000
45		Herbicide, knapsack	Man days/ha	2,5
46	Drainage	Hand digging	M/man day	6
47		Mech. digging	M/machine day	50
48		Delivering sand	M^3/tractor day	20
49		Laying and filling	M/man day	10
50		Delivering stone	M^3/tractor day	6
51		Shaping outflow	M^3 stone/man day	1
52	Road maintenance	Delivering gravel	M^3/tractor day	25
53		Repair	M^3 gravel/man day	5

APPENDIX 2
Annual field plan for 1976/77

Field 5
Soil type . . . . . Middle Ecca
Previous crop harvested in . . . . . December 74
Previous yield tc/ha 85
Estimated tc/ha at harvest 75
Estimated total yield 1072
Harvesting rate . . . . . 40 t/day
Harvesting duration . . . . . 27 days

Variety . . . . . NCo 376
Stage 4R
Area, ha 14,3
Harvest dates . . . . 3 May – 2 June

Month	No. of days	tons
May	25	1 000
June	2	72

Month	Code No.	Operation	Component	Standard	Tractor/ Implements	Materials		Man Days	Tractor Days
						Type	Total Amount		
April	31	Harvest	Making breaks	0,5	—	—	—	1	—
May	31	Harvest	Making breaks	0,5	—	—	—	12	—
	33	„	Cut and Stack	3,0	—	—	—	333	—
	36	„	Mend Stacks	1	—	—	—	25	—
	37	Infield transport	Tractor/ trailer	8	MF 135	—	—	—	25
	38	„	Trans-ship	2	—	—	—	50	—
June	31	Harvest	Making breaks	0,5	—	—	—	1	—
	32	„	Cut and Stack	3,0	—	—	—	24	—
	36	„	Mend stacks	1	—	—	—	2	—
	37	Infield transport	Tractor/ Trailer	8	MF 135	—	—	—	2
	38	„	Trans-ship	2	—	—	—	4	—
	3	Land prep.	Cleaning up	—	—	—	—	15	—
	4	„	Plough	3,5	Ford 5 000/Disc	—	—	—	7
	46	Drainage	Digging	6	—	—	450 m	75	—
	48	„	Deliver sand	20	MF 135/trailer	Sand	15 m^3	—	1
	49	„	Lay and fill	10	—	50 mm PVC	450 m	45	—
	50	„	Deliver stone	6	MF 135/trailer	Stone	18 m^3	—	3
	51	„	Shape outflow	1	—	Stone	18 m^3	18	—
July	13	Soil conditioning	Cart filter-cake	25	MF 135/trailer	F/cake	143	—	6
	14	„	„	5,0	—	„	143	29	—
	5	Land prep.	Harrow	2,0	Ford 5 000/Disc	—	—	—	4
	8	„	Farm plan	2	—	—	—	3	—
	9	„	Conservation	350	Ford 5 000/Grader	—	1 400 m	—	4
	10	„	„	35	—	—	1 400 m	40	—
	11	„	Waterways	200	Ford 5 000/Grader	—	600 m	—	3
	12	„	„	20	—	—	600 m	30	—
Aug.	4	Land prep.	Plough	3,5	Ford 5 000/Disc	—	—	—	7
	5	„	Harrow	2,0	Ford 5 000/Disc	—	—	—	4
	52	Roads	Deliver gravel	25	MF 135/trailer	Gravel	100 m^3	—	4
	53	„	Repair	5	—	„	100 m^3	20	—

Month	Code No.	Operation	Component	Standard	Tractor / Implements	Materials		Man Days	Tractor Days
						Type	Total Amount		
Sept.	3	Land prep.	Harrow (10,0 ha)	2,0	Ford 5 000 /Disc	—	—	—	3
	7	„	Ridging (10,0 ha)	3,0	Ford 5 000 /2-furrow	—	—	—	—
	15	Soil cond.	Spread filtercake	3,0	—	Filtercake	100 t	34	—
	20	Planting	Cut seedcane	2,0	—	NCo 376	70 t	35	—
	21	„	Cart seedcane	3	MF 135 /Trailer	—	—	—	—
	22	„	Planting	25	—	Supers (800 kg /ha)	8,00 t	250	—
	29	Weed control	Herbicide	2,5	Knapsack	Lasso (4 ℓ) + Altrazine (2 ℓ)	40 ℓ + 20 ℓ	25	—
Oct.	5	Land prep.	Harrow (4,3/ha)	2,0	Ford 5 000 /Disc	—	—	—	1
	7	„	Ridging (4,3/ha)	3,0	Ford 5 000 /2-furrow	—	—	—	—
	15	Soil cond.	Spread filtercake	3,0	—	Filtercake	43 t	15	—
	20	Planting	Cut seedcane	2,0	—	NCo 376	30 t	15	—
	21	„	Cart seedcane	3,0	MF 135 /trailer	—	—	—	—
	22	„	Planting	25	—	Supers (800 kg /ha)	3,44 t	108	—
	29	Weed control	Herbicide	2,5	Knapsack	Lasso (4 ℓ) + Altrazine (2 ℓ)	17 ℓ + 9 ℓ	11	—
Nov.	23	Topdress	Hand applcn.	8	—	1:0:1 (500 kg /ha)	143 pkts	18	—
	28	Weed control	Mule Cult.	0,33	Uba	Mules	43 days	86	—
Dec.	25	Weed control	Hand weed	6	—	—	—	86	—
Jan.	29	Weed control	Herbicide	2,5	Knapsack	Diuron (2,5 kg) + MCPA (4 ℓ)	36 kg + 58 ℓ	36	—
Mar.	25	Weed control	Hand weed	3	—	—	—	43	—

APPENDIX 3

Monthly work programme Month: May

Code No.	Operation Components	Field	Area (ha) or Distance (m)	Standard	Tractor / Implement	Materials		Tractor Days	Man Days
						Type	Amount		
31	Making breaks	5	13,3	0,5	—	—	—	—	12
	Actual								
	Variance								
33	Cut and stack	5	13,3	3,0	—	—	1 000 t	—	333
	Actual								
	Variance								
36	Mend stacks	5	13,3	1	—	—	—	—	25
	Actual								
	Variance								
37	Infield transport	5	13,3	8	Ford 5 000 /Mascane	—	—	25	—
	Actual								
	Variance								
38	Trans-ship	5	13,3	2	—	—	—	—	50
	Actual								
	Variance								

Code No.	Operation Components	Field	Area (ha) or Distance (m)	Standard	Tractor / Implement	Materials		Tractor Days	Man Days
						Type	Amount		
26	Handweed	2	16,8	7	—	—	—	—	118
	Actual								
	Variance								
26	Handweed	11	4,0 (part)	5	—	—	—	—	20
	Actual								
	Variance								
43	Cleaning breaks	5, 6, 7	3 000 m	100	—	—	—	—	30
	Actual								
	Variance								
45	Cleaning breaks	8, 9, 10	3,0	2,5	Knapsack	Gramuron @ 4 ℓ	12 ℓ	—	20
	Actual								
	Variance								
2	Removing stones	11	5,0 (part)	40	—	—	—	—	200
	Actual								
52	Deliver gravel	—	—	25	MF 135 /trailer	Gravel	500 m³	20	—
53	Repair roads	—	—	5	—	Gravel	500 m³	—	100
	Actual								
	Variance								
46	Digging drains	11	300 m	6	—	—	—	—	50
	Actual								
	Variance								
48	Deliver sand	11	—	20	MF 135 /trailer	Sand	12 m³	1	—
49	Laying and filling	11	5,0 (part)	10	—	50 mm PVC	300 m	—	30
	Actual								
50	Deliver stone	11	—	6	MF 135 /trailer	Stone	3 m³	1	—
51	Shaping outflow	11	5,0 (part)	1	—	Stone	3 m³	1	3
	Actual								
	Variance								
	TOTAL PLAN				Ford MF 135			25 22	991
	TOTAL ACTUAL								
	VARIANCE								