SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

Programme for Annual Meeting
Wednesday, 16th October, 1974

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| 9:00 a.m. | Chairman's report.<br>General. |
| 9:30 a.m. | Programme planning<br>- Dr. G.D. Thompson. |
| 10:15 a.m. | Tea |
| 10:45 a.m. | Management of large sugar estate operations<br>- John Hill. M. G. OB. |
| 11:30 a.m. | The integration of mechanization, field layout and conservation<br>- Gerhard de Beer and Bunny Fourie. Phil Lowdey |
| 12:15 p.m. | Training and maintenance systems to prepare for mechanization<br>- Dick Statham. |
| 12:45 p.m. | Lunch |
| 2:15 p.m. | Weed control : recent developments in the U.K. and Europe.<br>- Graeme Iggo. |
| 3:00 p.m. | The value of collated agricultural data.<br>- Mert Murdoch. |

SOUTH AFRICAN SUGAR INDUSTRY

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ANNUAL MEETING, OCTOBER, 1974

# PROGRAMME PLANNING

G.D. Thompson

In the Experiment Station context, the term "Programme Planning" includes the following:

1. The pre-planning of all agricultural operations for an ensuing year in order to assess the resources required to operate a farm for maximum economic benefit.

2. A revision, if necessary, of the pre-plan in order to cope with limited resource availability.

3. Monthly pre-planning of all agricultural operations, based initially on the annual plan, but generally deviating from it progressively more as the year proceeds, and as actual requirements cumulatively differ more from predicted requirements.

4. An assessment at the end of each month of actual performance in relation to planned performance, with a view to remedying identifiable deviations from the plan.

5. Gaining experience in the management of varied agricultural resources so that future planning and operations may become progressively more efficient.

Resources may be classified into three major categories. They are:

1. Labour or personnel
2. Mechanical equipment
3. Chemicals

## The Annual Plan

It is our contention that there is merit in generating the annual pre-plan from the basic elements of individual field operations. In this way, and at relatively little cost in time and effort, the people involved in managing resources are obliged to consider the primary factors upon which their livelihood is based. This not only promotes positive decision-making by the grower or estate manager, but it also provides the ideal opportunity for considering improvements to operational procedures. As an example, let us say that a grower intends to replant a field of Fernwood sand on his farm during the ensuing year. He can plan the timing and method of plough-out based on experience, but when it comes to re-planting, his traditional procedure is to place 10 tons of filter cake per hectare in the furrow. Should he not now convert to using Temik? If this is perhaps one

John Deere

50 ha / tractor hours

80 ha / tractor

Principles

Long term → short term planning

reacting deviations - detailed short planning

Master planning - actual planning - contingency planning.

of a conservatively estimated dozen practices that he might consider changing, at what other stage or in what other way can he realistically expect to take each of these seriously and genuinely into account?

By pre-planning on a field-by-field month-by-month basis, a first estimate of the variation in resource demand with time is automatically produced. We cannot support the contention that predicted labour requirements are valueless because of the seasonal and variable labour supply. Trying to modify a labour requirement plan to fit a predicted labour supply pattern is a first step towards controlling one's own destiny, which is approximately what management is all about. Furthermore, it is difficult to imagine an alternative method of assessing the extent to which one resource, e.g. herbicides, should supplant another resource, e.g. hand labour, with anything like the same accuracy and degree of logical assessment which programme planning provides.

In our attempts to implement programme planning in the industry to date, perhaps our least success has been obtained in predicting tractor and transport requirements. In general, we no longer attempt to pre-plan tractor usage, since tractor/trailer/transport availability appears to be adequate (if not excessive). However, as time proceeds, costs will rise, equipment will be in shorter supply, and eventually this apparent sophistication will probably be re-introduced.

The timing of operations may also be adjusted, in the light of the first annual pre-plan, so that the programme can be carried out within the year, whereas under other circumstances this might not be possible. An example is the replanting of a particular field. Pre-planning included provision for a great deal of drainage in the lower-lying areas. Harvesting was not planned until September, because the cane was rather young. Re-planting was scheduled for October/November. Obviously, time between harvesting and planting would not allow for adequate drainage to be installed. An assessment of the crop showed that little would be lost by harvesting the low-lying areas in May-June. Increased hand labour utilization could be obtained by draining in June/July/August, and re-planting could proceed on schedule.

The Monthly Plan

If, for example, the annual programme runs from 1st May to 30th April, then the programme for the month of May should be essentially that proposed in the annual plan. But as the year progresses, vagaries of the weather, unpredicted variations in labour supply and poor estimates of operational efficiency all lead to deviations from the long-term plan. Thus the April monthly plan is unlikely to resemble the annual plan for that month very closely. Thus regular monthly planning based on actual field conditions is absolutely essential.

In fact, to avoid confusion between the annual plan and monthly plans, I would as lief separate the two entirely. The annual plan provides a pre-assessment of resource requirements and the opportunity to do long-range planning. The monthly plan is for operational control and efficiency.

The monthly plan involves adjustments to fit resource availability. If labour requirements for weeding exceed labour availability, alternative procedures have to be considered. Weeding may be placed on a priority basis, e.g. leave over the least weedy fields for next month, or hand-weeding may be

Records Fiddly field? OR operations

What operations can be changed? Ploughing, drainage, removing stone (Land preparation)
what " cannot - harrowing, trash mon, fertility, weeding.
long periods (Feb. Mark April) Mg
Standards - Affecting factors

abandoned in favour of herbicides in some instances. A third alternative may be to stop planting or some other operation to provide labour for weeding. But it is most important in preparing the monthly plan, to do so in the field, and to include every operation that needs to be done during the ensuing month. (Incidentally, it is also much more satisfactory to do the annual plan in the field than in the office). When the resource requirements for all required work have been calculated, they must be adjusted by accepting alternative procedures so that they fit available resources.

As monthly planning proceeds through the year, a point is often reached when the long-term plan must be changed. The area to be planted may require revision or the amount of cane to be harvested may change. This really detracts little from the value of the original plan, which was the best prediction possible at the time it was made.

When programming for an individual month, it is necessary to remember that:

1. work left over from the previous month must receive priority.
2. All work needing to be done during the month ahead must be listed.
3. When the final plan has been made to fit available resources, be optimistic and include a short list of additional items which can be catered for if you actually get ahead of programme.

At the end of the month, the plan is only exploited to its full potential if actual performance is carefully compared with planned performance in close detail. Where deviations occur, these should be studied to determine the cause. If unavoidable, they can simply be added to the store of experience to improve future predictions, but where deviations are not logically acceptable, they can be used to motivate immediate improvements in control of operations.

General

An unexpected and seemingly illogical problem that we have encountered in the implementation of programme planning is the disinclination of people to allocate a non-European clerk permanently to the clerical work involved. Programme planning itself invariably exposes a number of unwarranted posts which have only tradition to support them, but the thought of creating a new post to help obviate such waste rarely seems to be acceptable.

In general, however, our experience is that those who are prepared to persevere with programme planning for a full year in conjunction with ourselves are very likely to continue with it in some form on their own. The form usually changes to suit the conditions and people directly involved, and the preference is invariably for "simplification", in an attempt to reduce the amount of clerical work involved. My own conclusion is that "simplification" constitutes an attempt to cater for the apparently widespread distaste which agricultural operators have for paper work. If "simplification" is the thin edge of the wedge, used in order to introduce a new and not wholly acceptable principle gradually, it could well be useful. On the other hand, if it is used to an extreme which negates the fundamental purpose of programme planning, perhaps it would be better to remain with crisis management.

# ENTREPRENEURSHIP AND THE UTILISATION OF LABOUR IN AGRICULTURE

BY

J.N.S. HILL

## INTRODUCTION

One of the problems facing world agriculture today is the low income of farmers. This, and other problems have led to a migration of farm-workers to the cities, with a resultant increase in farm size.[1,2,3)]

This move towards larger agricultural operations will result in farmers playing the role of manager rather than owner-operator. It is suggested that herein lies the danger of further economic decline in agriculture, something that is already noticeable in the general lack of economies of scale now being exhibited on many large farms.[4)]

The writer feels that this situation could be due to:-

1. The lesser motivation or degree of entrepreneurial spirit of the farm worker and manager compared to the owner-operator.

2. The serious lack of management skills on the part of most farmers, who are generally poorly educated.

Recent work conducted in the Agricultural Division of Tongaat Sugar Limited suggests that both the motivation and managerial skills of managers of large agricultural sections can be significantly improved. This paper summarises the results obtained when a participative management style, in the form of management by objectives (MBO), was introduced to a sugarcane agricultural enterprise. An attempt will be made to illustrate the improvement

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in motivation of Section Managers with the adoption of MBO to agriculture, by reference to reduced tractor operating costs. The development of managerial skills of Section Managers will be illustrated by reference to greatly improved utilisation of labour resulting directly from the application of the management principles of planning, organising, motivating and controlling.

## 1 ENTREPRENEURSHIP OR MOTIVATION IN AGRICULTURE

### 1,1 Entrepreneurial spirit

The Oxford Concise Dictionary defines an entrepreneur as "a person in effective control of a commercial undertaking; or a contractor acting as an intermediary". However, this definition ignores the risk element in business, which is considered by many writers to be a fundamental part of entrepreneurship.[5,6,7,8)]

McClelland[9)] summarised fifteen years of research into the human motives responsible for economic growth, and concluded that economic success and technological advancement depend on achievement motivation. He found that people with a high need for achievement (nAch) pursued challenging goals involving moderate risks and that their reward was a job well done. However, people with low nAch tended to be interested in peer acceptance, security, money and material possessions, and tended to avoid risks. There is much common ground in the findings of McClelland with other social scientists such as Maslow,[10)] whose well known hierarchy of needs has been useful in explaining motivational forces of subordinates, and Herzberg[11)] now famous for his work on motivation - hygiene theory.

According to Ardrey[12)] the entrepreneurial spirit in agriculture is fostered in a system of private enterprise. In the USA, one farm worker produces food for himself and almost 12 more people in the city; 92% of all Americans are fed by a rural 8%, who also produce a food surplus of politically embarrassing dimensions. On the other hand, in the Soviet Union one worker in the

field feeds one worker in the factory, whilst in China, under even more extreme Communist direction, it takes six men in the field to feed one man in industry. Ardrey also points out that the small remnants of private property remaining in Russia, which today average only one half of an acre in size, and which comprise only 3% of the total cultivated land in the USSR, nevertheless produce nearly half of the meat, milk and cheese production, three quarters of the eggs and two thirds of the Russian staple food, potatoes. Ardrey also describes the kibbutz in Israel as the only successful collective farm in the history of modern agriculture. However, he points out that a private farm only a few miles from one of the oldest and most respected of Israeli kibbutzim produced the same yields per acre with less than half the labour - and attributed the differences to the greater efforts by the owners.

Thus the formation of larger farm units may result in sub-optimum levels of efficiency because they can lead to loss of personal ownership and also require high managerial skill. This can be expected because first, farm managers will probably be less motivated than owner-operators, and secondly, larger farms will require greater management skills;which are already lacking in the general farming population.[13,14)]

1,2 Motivation by participative management

It is well known that farmers exhibit particularly strong desires for independence. The farmer is almost notorious for his need to "do his own thing". It has been pointed out that workers who exhibit strong tendencies towards independence or who are themselves strongly autocratic, will respond well to participative management.[15,16)] The particular characteristics of the participative management style have been noted by Greiner.[17)] These include participative setting of objectives, decentralisation of authority, intermediate job reviews and rewards based on performance.

In the Agricultural Division of Tongaat Sugar Limited, Section Managers have a particularly strong desire for independence. For this reason, a participative management style in the form of

management by objectives (MBO) was introduced as a strategy to improve poor agricultural profits. Now in its third year of operation, signs of the success of MBO are clearly visible.

Perhaps the best example of success is the recent reduction in tractor operating costs. Prior to the introduction of MBO in the Agricultural Division, Section Managers would send their tractors to a central garage, where highly skilled mechanics carried out preventative maintenance servicing and all repairs. All actual tractor operating costs were charged to a "tractor pool account". A "recovery rate" was debited to each section account on the basis of a standard cost per litre of fuel used by tractors on the section. The recovery rate was calculated each year to balance the actual costs of the tractor pool account. The identity of each section was therefore concealed in the "pool". In figure 1, the actual increase in tractor operating costs and the projected increase for the season 1973/74 is presented.

With the introduction of MBO, the concept of responsibility accounting was introduced on sections. The central tractor pool account was eliminated and each Section Manager became responsible for his own tractor operating costs which were charged to a section tractor pool account. In addition, servicing facilities were installed on each section, so that each Manager then became responsible for his maintenance and servicing system. Section Managers were given budget guidelines for the 1973/74 season and, through complete participation in the setting of their budgets, committed themselves to an average tractor operating rate of 43 cents per litre. This rate was equal to the previous season's actual operating cost. This new target was set in spite of warnings that the most severe inflation was expected.

At the end of the 1973/74 season, the average actual rate for all sections was 35 cents per litre! Since approximately one million litres of fuel were consumed, this reduction amounted to R80 000 on the budgeted cost (43 - 35) and perhaps could be viewed as a reduction of R140 000 on the expected cost (49c - 35c). This reduction was achieved with very little capital expenditure. Only R12 000 was spent to equip the service bays on all sections. In

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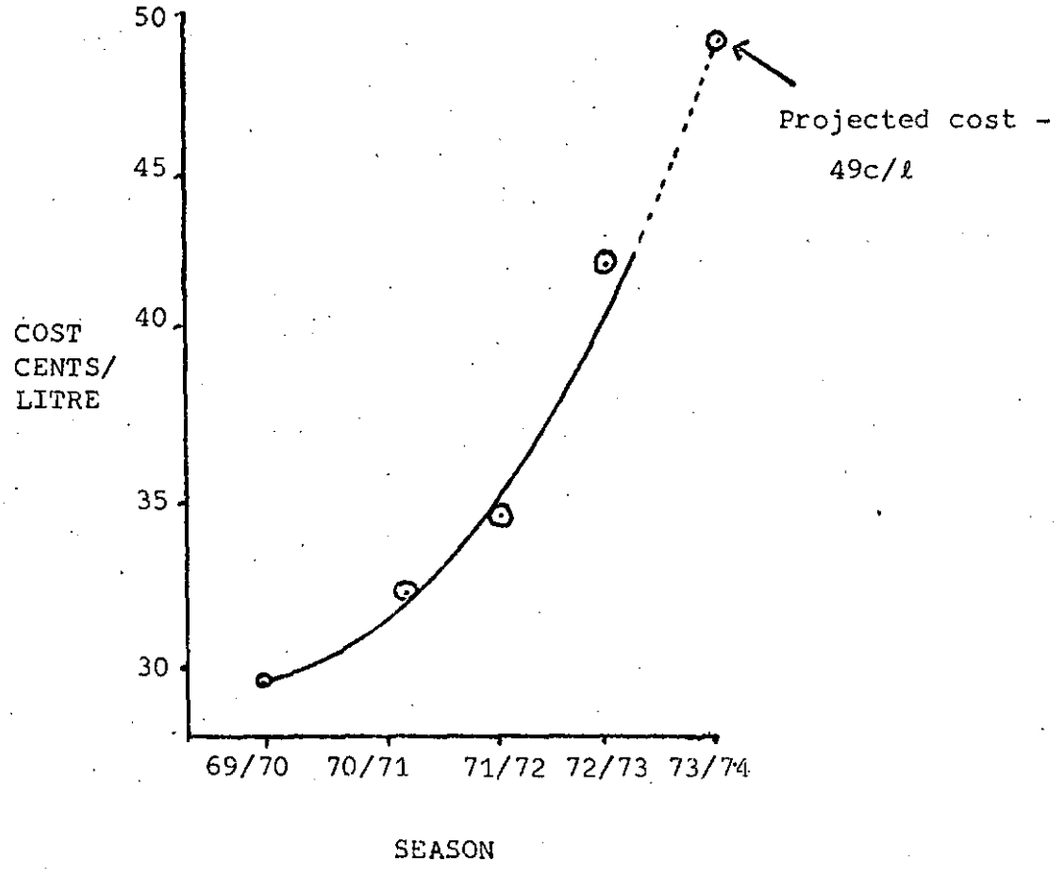


FIGURE 1 Actual and projected tractor operating costs at Tongaat

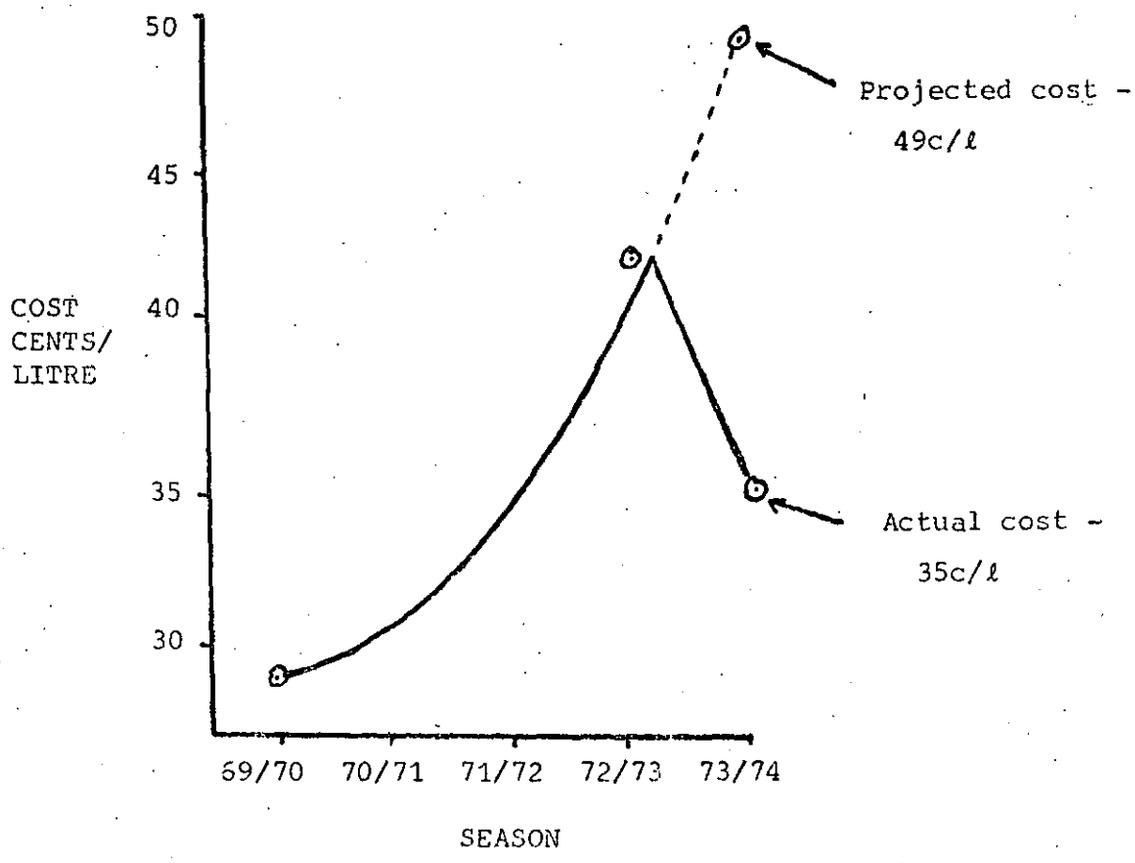


FIGURE 2 Saving in tractor operating costs

addition, a qualified trainer mechanic was employed to train and upgrade the service mechanics. The total cost of training staff and equipping service bays amounted to less than R30 000. Thus it is evident that MBO, by the decentralisation of authority and by participative goal setting, has resulted in a positive saving of more than R50 000 in one year. This outstanding improvement in tractor operating costs is illustrated in figure 2.

## 2 MANAGERIAL SKILLS FOR EFFECTIVE UTILISATION OF LABOUR

If an entrepreneur is a person in effective control of a commercial undertaking, then another aspect of entrepreneurship is managerial skill. Burger[18] constructed and evaluated a scale to measure managerial aptitude. He concluded that competent farmers could be recognised by their ability for long term projection and conceptual planning, and for short term organisation. In a review of the quality of farm management in South Africa, Groenewald[19] concluded that farm management ability was low, and that the average formal education level of South African farmers was also low - two thirds having less than a standard 8 qualification. At Tongaat, the average formal education level of the 18 Section and Department Managers in the Agricultural Division was standard 9, which equalled the average found by Cownie[20] for the Sugar Industry. However, these managers have been successfully trained to understand and apply the management processes of planning, organising, motivation and control. The improvement in management skill of Section Managers at Tongaat is illustrated by the success with which they have implemented modern management processes to improve the utilisation of labour for their sugarcane operations.

### 2,1 Planning labour utilisation

Labour constitutes the major resource in sugarcane farming, accounting for almost half of total expenditure. By far the greatest difficulty experienced by farmers has been the matching of the seasonal workload with labour availability. Traditionally, the planting of sugarcane commences in the spring and every effort is made to complete the planting programme by the end of November.

However, during this period, weed competition, not only in the replanted fields, but also in all the harvested ratoon fields, becomes a very serious limiting factor and hence reduces crop yields. Nevertheless, the sugar farmer gives priority to his planting operation, turning a "blind eye" to the very serious weed infestation problem. Once the harvesting season is completed in January, he will direct all labour previously occupied on harvesting, to weed control in very heavily infested ratoon fields. The loss of yield has occurred and labour output in heavily infested fields is now ridiculously low. However, by the middle of the following winter, his weeds are well under control and his overall labour utilisation has been fairly reasonable. Little cognisance, however, is taken of the effects of weed competition on the growth of sugarcane and the large yield losses which have resulted. An illustration of this traditional workload pattern is presented in figure 3. It is only when actual crop production is compared with the potential, that the consequences of this pattern are revealed.

Once Section Managers at Tongaat understood the concept of planning as it applied to their operations, and once they appreciated the usefulness of planning in their everyday work situation, attempts to match the seasonal workload with labour availability were very successful. By the use of filtercake as a seed-covering medium for "out-of-season" planting, and the judicious programming of irrigated or sandy fields to be planted in the winter season, managers found that they were able to complete the bulk of their planting programme before the onset of the spring rains and higher temperatures. The remainder of the planting programme was then postponed until the end of the harvesting season, in order to occupy labour which was previously weeding infested fields. This planning for improved crop management and utilisation of labour, is illustrated in figure 4. Previously, only 50% of all labour mandays utilised for cultivation operations was available for weed control in the spring and in summer, half of the year. This percentage has rapidly changed so that 66% of the labour usage is now allocated to this vital time of the growing season. The result is less weed competition, lower weed control costs and higher yields, which in turn lead to improved profit. These improvements outweigh by far the extra cost of planting with

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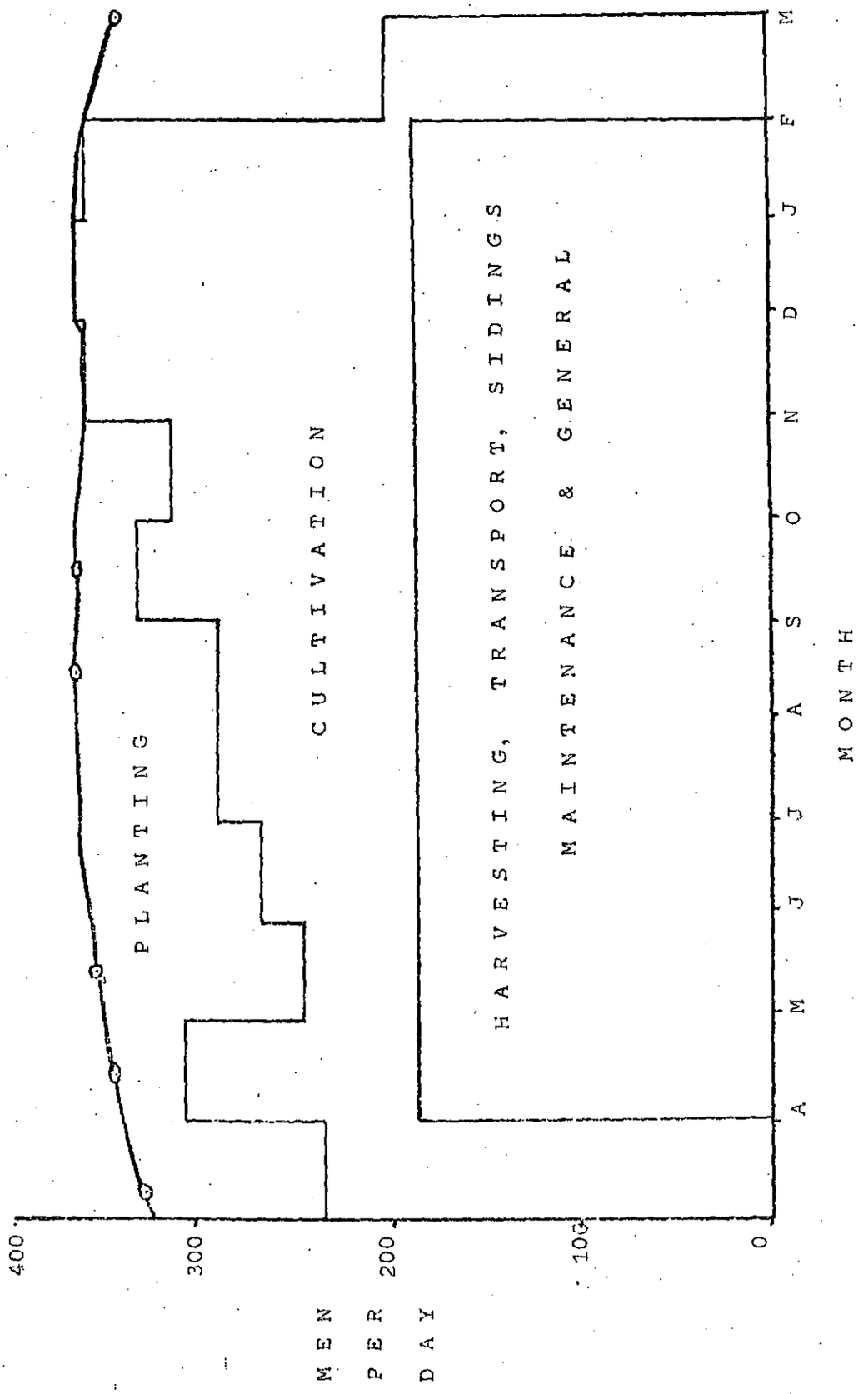


FIGURE 4 Readjusted seasonal labour requirements on the sugarfarm

filtercake, as a covering medium to ensure good crop establishment in winter.

In addition to the above illustration of planning labour utilisation through the season, the Section Manager is also required to plan his total labour requirements, his tractor operating costs and his materials such as fertilizer, herbicides and general stores. Furthermore, he is responsible for planning his long term operating and capital requirements, based on definite strategies and action plans to counter escalating costs of labour, machines and materials and to maintain Section profits.

## 2,2 Organising farm work

Parsons[21] recently defined organisation as "determining which activities are necessary for any purpose or plan and arranging them in groups which may be assigned to individuals". Tongaat Section Managers are now familiar with the basic theory of organisation, communication, job instruction and the delegation of responsibilities. Once managers appreciated the technique of drawing organisation charts "from the bottom upwards", commencing with grouping of operations for optimum supervision, success was rapidly obtained. Managers were then able to delegate responsibility and therefore hold subordinates directly accountable for groups of operations. A typical Section organisation chart, developed by a Section Manager, is presented in figure 5. This section, with 1 200 hectares under cane, is managed by a Section Manager, who is assisted by a Section Supervisor, a Maintenance Foreman and a Field Assistant. The manager has a semi-skilled staff of thirty and a labour force of three hundred men.

Having grouped activities and assigned these to Supervisors, delegating authority and communicating instructions at the same time, the manager has almost completed the process of organising. It remains however, to ensure that the size of any particular group of workers is within the capabilities of those given responsibility to complete the job. There is a limit to the supervisory capacity of any one person, and if this is exceeded, quality and progress checks by that person become superficial and hence unreliable.

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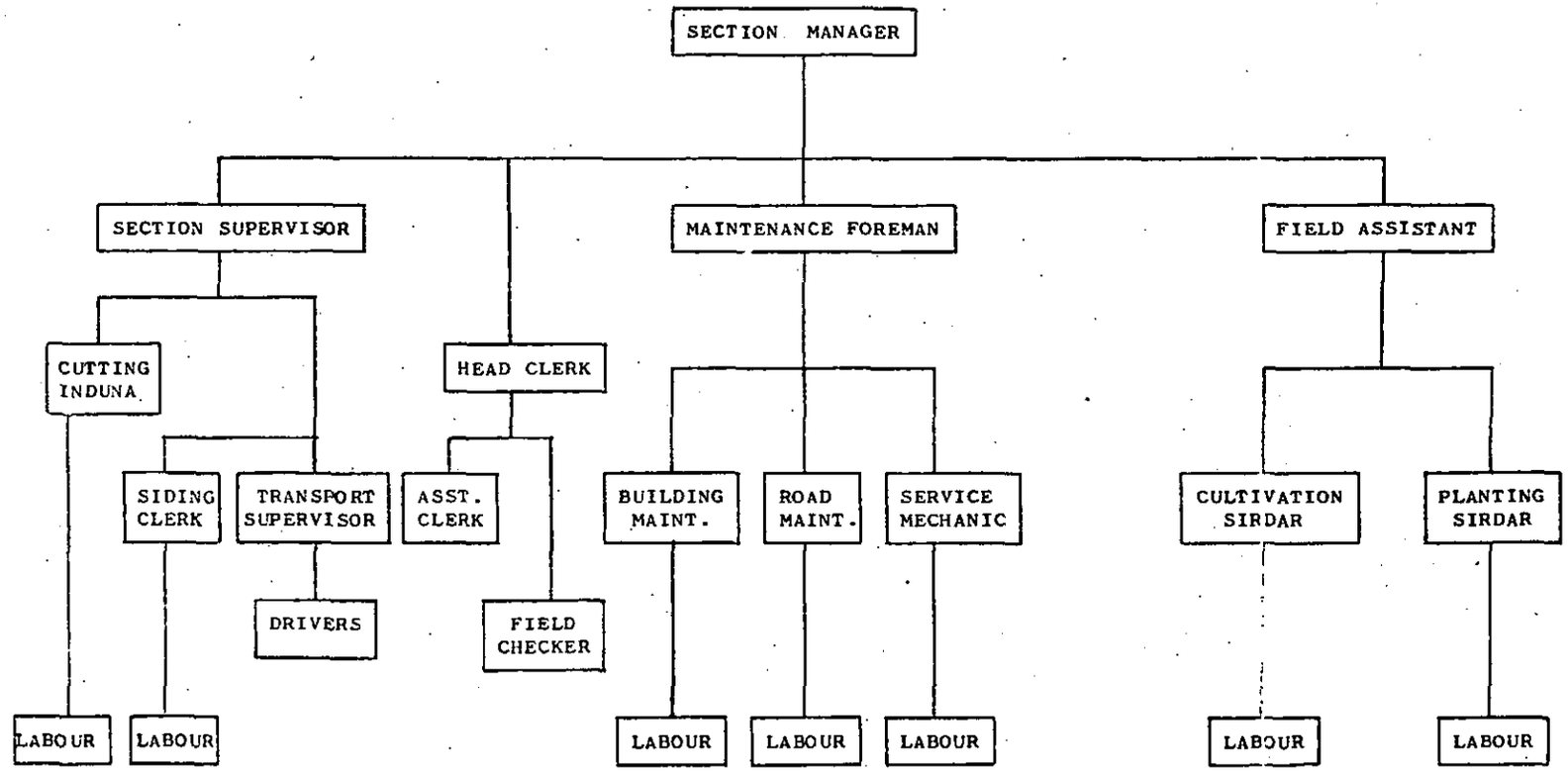


FIGURE 5 Section Organisation Chart at Tongaat

In supervising labour on the sugar farm, limitations to supervisory capacity will change with the complexity of the operation as follows:-

1. If the task is simple and repetitive, a Supervisor can handle a large number of labourers, perhaps as many as fifty. This applies in particular to work that is easily measurable, and in which quality control is either unimportant relative to output (quantity), or is comparatively easily checked. An example is cane harvesting, where the daily output of each cutter is measured and quality controls are relatively simple to apply.

2. If quality control is important, then even though the operation might be simple, it becomes increasingly difficult for the Supervisor to effectively control larger gangs of labourers. An example is hand weeding, where optimum gang size varies between 10 and 20 labourers depending on conditions, such as size of crop, density of weeds, etc.

3. When the operation is more sophisticated and it involves the use of expensive materials or specialised equipment, the Supervisor can effectively control only small numbers of workers. Typical examples are fertilizer application by hand and chemical weed control using knapsack sprayers. At Tongaat, it has been found that the optimum ratio of Supervisor to Operators for these operations is approximately 1:6.

It is the Section Manager's responsibility to ensure that supervisory staff also follow these guidelines. Generally, the Manager trains his Section Supervisor and Field Assistant in the skill of assessing optimum gang size for various operations and for differing conditions. The Supervisor usually proposes the size of gangs and work priorities required the following day and the Section Manager either approves or alters the arrangements.

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## 2,3 Motivation of labour

Although Section Managers have received formal training in the principles of motivation, it has not been feasible to measure any tangible improvements in this management skill. The motivation of labour remains the one management process urgently requiring much closer study. At Tongaat, motivational systems directed towards satisfying labourers' identity, stimulation, or security needs, are used either separately or in combination. Motivational systems include job and pay grades, incentive bonuses, induction, selection, training, correct feeding and incentives for leisure time.

## 2,4 Control of labour

The most important written control system developed at Tongaat is known as the Tongaat Daily Diary, which has been described by the writer.[12] On each day, the utilisation of labour and tractors is recorded and submitted to the data processing centre. One copy remains on the section as a record of daily activities. At the central data processing department, the daily data are processed by computer and performance reports on resources utilised and monthly cost reports are generated for management information purposes. By means of computer programmes, comprehensive fields records and fields performance history files are kept up to date. Exception reports and more detailed analysis of resources utilised are also possible. Unfortunately, these reports only become available in the last week of the following month. For timely control of performance, supplementary control systems are used.

In addition to the standard procedure of recording resource utilisation and activities in the daily diary, the Section Manager obtains factual reports from his subordinates, either on a daily basis, or when a particular operation is completed. One example is the daily record of individual cane cutter performance, together with total tonnage harvested, tonnage delivered to the trans-shipment siding (loading zone) and tonnage delivered to the factory. Another example is the completion of a performance graph when a field is being planted. Here the Supervisor responsible for planting graphically monitors actual labour utilisation each day against the standard agreed with his manager, for a particular field. An example of such a planting performance graph is presented in figure 6.

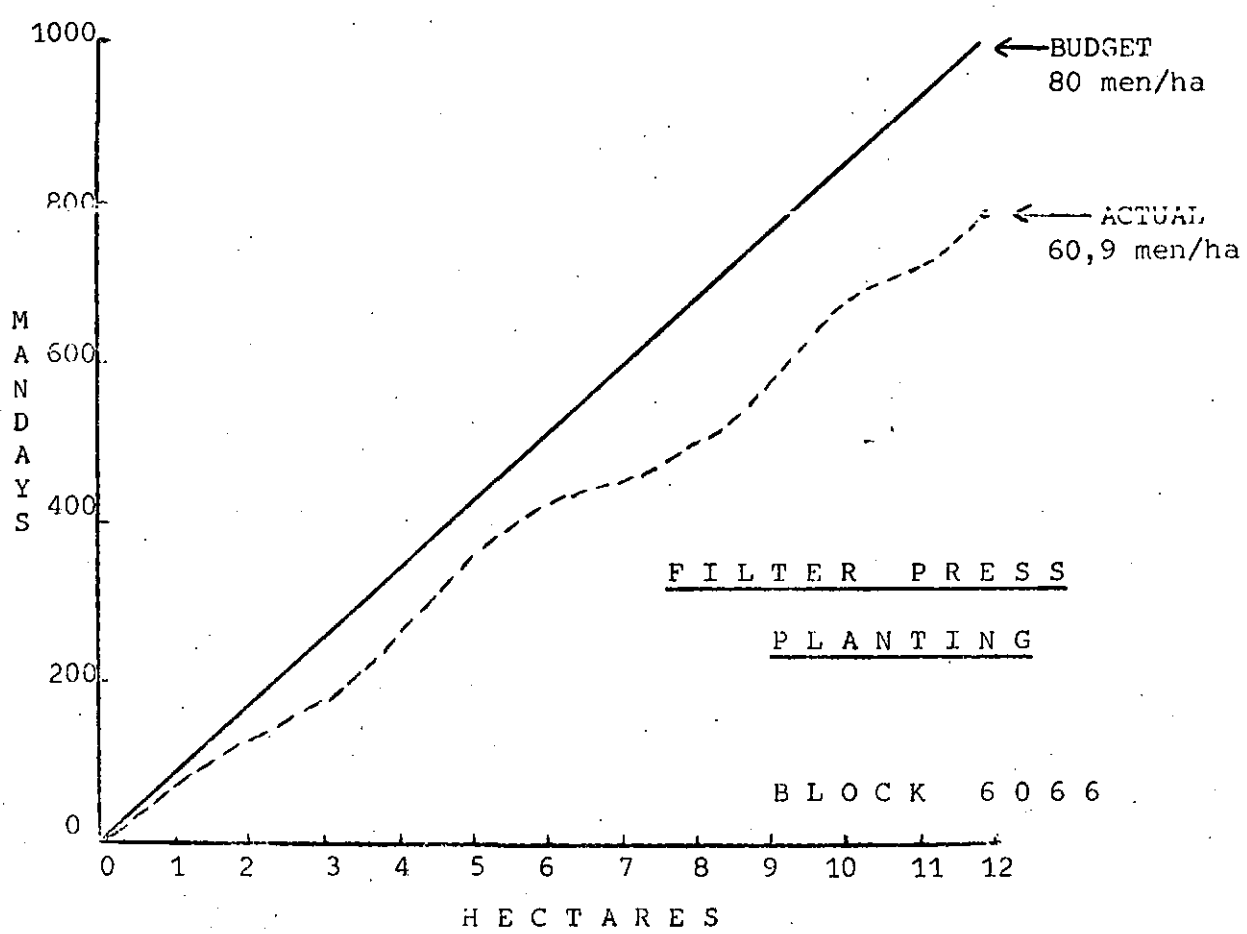


FIGURE 6 A labour utilisation graph for a particular field showing the target or budget allowance and the actual labour utilisation monitored.

The Section Manager also monitors performance of major resources used on each main operation by means of "control graphs". These are displayed in each Section Manager's office and depict at a glance the state of each operation on the section. However, the "vital few" principle is adhered to; that is to say, only major resource utilisation is monitored. Generally this includes the monitoring of labour usage against hectares or tons or time, depending on the type of operation concerned.

These control systems have enabled Section Managers to take timely corrective action in order to meet their objectives. At the same time supervisors, in submitting regular reports, have benefited because they have committed themselves to achieving clearly understood and attainable targets.

## 3 CONCLUSIONS

It is now the third year since the introduction of MBO to the Agricultural Division of Tongaat Sugar Limited. It is believed that this participative management style has resulted in an improvement in the motivation of Section Managers. MBO when used in the appropriate managerial situation, is a useful technique for obtaining commitment to purpose, and for providing directed and controlled action towards specific targets. If MBO is used in conjunction with managerial development programmes, positive improvements to farm business results can be obtained.

At Tongaat, after MBO had been implemented for only two years, agricultural performance showed unmistakable signs of improvement. Improved motivation of Section Managers led to a great improvement in the management of machines. Development of managerial skills, on the other hand, has led to the solution of a common labour-management problem. The management principles of planning, organising, motivating and controlling have been successfully used to evolve systems for the effective management of large sugar farms.

J.N.S. HILL

14/8/1974

JNSH/SC

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# LAND PREPARATION FOR MECHANICAL HARVESTING

by A.G. de Beer and H.K. Durandt

Mechanical harvesters introduced to the average cane farm without effective land use planning and adequate preparation may appear to operate reasonably well, but utilization and throughput are likely to be so poor that their introduction could end in economic disaster. Experience has taught that successful mechanical harvesting usually depends primarily on proper land preparation, and this preparation must start before the cane is planted. As long ago as 1964 it was found at the Experiment Station that the output of chopper harvesters increased as much as three-fold when field conditions were improved.

The purpose of field preparation is to provide the harvester with cane which is grown as uniformly as possible. That is, there must be a minimum of variation between the width and height of stools, and the difference in height between the row and the interrow must be constant throughout the field. To achieve these objectives, land planing is almost certainly a prerequisite. It is not necessary to level the field, but the surface must be smoothed to remove major depressions and humps. An additional advantage of land planing is that wet areas which might be a cause of 'bogging', especially for the infield transport, will largely be avoided.

After land planing, the seedbed should be prepared to a uniform depth. Ideally, planting should be carried out mechanically to ensure that the ridges and furrow bottom are at constant levels and fertilizer is applied uniformly throughout the field. In this way germination and stool development will be regular with uniform stalk growth. A further advantage of mechanical planting is that the rows will be parallel - a requirement which in any case should be satisfied, whether mechanical planting is employed or not.

Cultivation carried out subsequent to planting should always be done with the object in mind of keeping the interrow smooth and at constant height relative to the cane row. In particular, the last cultivation should be done mechanically to ensure a smooth interrow. At harvest time the field should be flat or, preferably, the cane should be on a slight ridge, 100 to 150mm in height and never more than 300mm high.

Most commercially available harvesters are designed for a row spacing of 1,5m. In flat fields with parallel and straight rows and where the stools are fairly narrow, row spacing can be reduced to 1,3m. Some experimental harvesters are able to handle 1m row spacings, but it is not certain when or even if these machines will be commercially available.

For maximum throughput, cane rows must be as long as possible. However, to allow for access by infield transport, cane blocks should be approximately 400m long. The ideal length will, in fact, be determined

by the yield and the capacity of the infield trailers. Rows from adjacent blocks must be aligned so that the harvester can travel from one block to another without stopping. Allowance must be made for turning and for access by the infield transport at breaks between blocks. Short rows should be eliminated whenever possible, as these are prime causes of poor machine utilization.

Fields should ideally be rectangular in shape and individual blocks should provide for two days' cutting. Irregularly shaped blocks and small patches of cane should be avoided. Adequate headlands, 5 to 7m wide must be provided for turning. If headlands are to be used as waterways, they must be very shallow to allow unimpeded travel by machine.

Fields must, of course, be free of large stones, stumps and other physical obstructions. Stones can and do cause considerable damage to the base cutters and the chopping mechanisms of harvesters. This can result in high maintenance costs and loss of operational time. Open drains and ditches are to be avoided, but if some open drains are necessary, these should run parallel to the cane rows at a distance of at least one full row width away from the nearest row.

The practice of throwing weeds and other waste material into the field when weeding and cleaning breaks, should be stopped. Clumps of weeds formed in this way tend to choke the machine and make base cutting difficult.

Stool pruning must be done in those old ratoons where stool widths become excessive. The maximum permissible stool width depends on the throat dimension of the harvester, and this can be as narrow as 550mm. Stool pruning has the added advantage of straightening the rows and providing interrows of constant width for such other mechanical operations as cultivating.

Entry and exit from every row must be unhindered. This means that rows must not terminate in a bank, ditch, or in another row. If rows cross soil conservation structures, these structures must be so designed that they afford unimpeded passage to the harvester and supporting equipment.

Always keep in mind that if fields are replanted, say once every ten years, then a field planted today without appropriate preparation cannot be harvested mechanically for the next ten years - unless of course, it is prematurely ploughed out and specially prepared for mechanical harvesting.

Advantages gained from better performance and utilization of machines are valid not only for large-scale harvesting equipment, but also for such relatively simple implements as cultivators. Even if the grower does not intend to harvest mechanically for the forseeable future, these very distinct immediate advantages can be gained by preparing fields along the lines described.

To summarise, the following must be aimed for:

Smooth land surface

Uniform cane

Parallel, straight rows

No short rows

Row spacing of 1,5m

Smooth interrows at constant level relative to the cane rows

Headlands 5 to 7m wide

No physical obstructions such as open drains, large stones or stumps

Easy entry and exit from all cane rows

Narrow cane rows obtained by stool pruning.

# The Integration of Mechanization, Field Layout & Conservation

by J.P. Fourie & O.P. Landrey

The advent of mechanical harvesting might be regarded as the final phase in mechanization of field operations in the production of sugarcane. This does not mean that the final word has been said with regard to other field operations; these will have to be revised, modified, and adapted continually. By virtue of its size complexity and cost, the mechanical harvester must be considered to be the most sophisticated of field machines. If provision is made for the efficient operation of this machine, it can be assumed that all other field operations could be carried out at least as efficiently.

The concept of total mechanization thus forms a basis for planning field layout.

The criteria for planning field layout should include:

1. Utilization of soil and water resources for continued optimum crop production.

2. Optimum operational efficiency of field operations.

3. An efficient road network.

4. That the best interests of mechanization and conservation be served without bringing them into conflict with one another.

Until recently the physical planning of farms has been conservation orientated, without catering specifically for ease of machine operation. This approach has resulted in layouts which have not necessarily made mechanized operations easy. The adaptability of the manual labourer has compensated for in-field irregularities and poor accessibility but higher labour costs and diminishing availability necessitates a higher degree of mechanization which, due to its high cost structure, demands efficient utilization.

Ideally for mechanization,

(a) Land slopes should not exceed 21% or $12^{\circ}$.

(b) Land slopes should be uniform

(c) Crop rows should be long, straight, parallel and uninterrupted.

(d) There should be no in-field obstructions to machines such as ditches, banks or uneven ground.

(e) Crest roads or waterways should not have sharp cambers or be sharply indented to obstruct machines crossing.

Sound conservation practice, is aimed at limiting runoff water velocity and volume to a permissible maximum, depending on slope and soil erodibility. This is achieved by:

i Limiting the distance of flow of water in any one direction.

ii Reducing the length of slope between terraces.

iii Controlling the gradient of in-field terraces.

iv Reducing flow depth in vegetated waterways.

From these two apparently contradictory sets of criteria a layout planning approach for total mechanization emerges as:

1. Plan according to topographical units, to ensure minimum variation in layout design.

2. Straighten in-field terraces as much as gradient limits will allow to obtain maximum parallelling of terraces on hillslopes.

3. Use correction-strips (in which all the short lines in the field are concentrated) to correct gradient unevenness beyond the allowable limit.

4. Use underground mains with perforated risers to replace or supplement vegetated waterways. Use waterways wherever water concentrates in depressions which cannot be eliminated by land planning.

5. A pre-requisite of layout is careful attention to land surface management as a smooth, even surface is a pre-requisite to both efficient mechanization and good conservation.

A land plane should be as common on cane farms as a plough or a harrow.

It is easy enough with a contour map, to design a layout which meets with the above requirements, but the crunch comes in putting it on the ground. Basically it consists of laying out the flatter crest tops either straight or parallel to the crest or both, then selecting a key terrace line. This key terrace is pegged carefully and straightened where possible and the curves evened out. Terraces are then pegged parallel up and/or downslope from the key terrace. It is imperative that these should be precisely parallel to the key terrace as failure to do this will result in short lines which defeats the whole object of the exercise. These parallel terraces must then be checked for gradient as it would be disasterous if water accumulated where there is no provision for disposing of it or if water ran in the wrong direction.

That, in a nutshell, is the simple, common sense procedure for the integration of mechanization, field layout and conservation.

In irrigated areas mechanization planning can be tailored to fit the requirements of irrigation.

JPF/OPL/PMO
9th October, 1974

SOUTH AFRICAN SUGAR INDUSTRY AGRONOMISTS' ASSOCIATION

ANNUAL GENERAL MEETING 1974

# TRAINING AND MAINTENANCE SYSTEMS TO PREPARE FOR MECHANISATION

by

R.N. STATHAM

## INTRODUCTION

Until as recently as 1972, Tongaat's tractor and implement servicing system was cumbersome and carried out in a haphazard fashion. Breakdown time, expressed as a percentage of total monthly available time, was in the region of 16%.

Tractor running costs were high and implements seldom worked a full day without a serious breakdown. With Section Managers becoming more reliant on efficient mechanical operations, something had to be done to reduce the high downtime and running costs.

## 1. THE PROBLEMS

1,1 No planned servicing and preventative maintenance.

1,2 Tired and unskilled drivers, attempting daily maintenance at the end of a day's work.

1,3 Section Managers not motivated to reduce running costs because tractors were costed on a 'pool' basis and 90% of the repair work was carried out at the central garage.

1,4 Section workshops were badly designed and poorly equipped.

1,5 Drivers were inadequately trained and not concerned with machinery care.

## 2. ACTION TAKEN

2,1 A new tractor servicing schedule to provide the following:

2,1,1 A simple visual chart.

2,1,2 Include all makes of tractors at Tongaat.

2,1,3 Servicing to be carried out on a time basis, to enable accurate programming.

2,1,4 A periodic garage inspection.

2,1,5 A preventative maintenance check.

2,1,6 A follow-up and record system.

2,1,7 A trailer service guide and check list.

2/...

2,2 The tractor pool costing system was dropped to achieve the following:

2,2,1 Provide responsibility accounting on each section.

2,2,2 The Section Manager becomes responsible for the maintenance of his machinery.

2,2,3 Machines proving expensive to run could no longer be 'hidden' in the pool.

2,3 Upgrading of section workshops, tools and equipment, by:-

2,3,1 Redesigning existing workshops into more effective work places with correct storage for fuels, oils, tyres and spares.

2,3,2 Providing the correct tools and equipment to carry out the necessary work.

2,3,3 Providing a section workshop job description.

2,3,4 Insisting on basic safety measures.

2,4 The Training of Section Managers and their Assistants, by:-

2,4,1 Introducing the new service schedule and insisting on a planned service plan for each tractor, implement or trailer.

2,4,2 Educational film shows.

2,4,3 Talks and discussions on basic management principles, e.g. planning, motivating, organising and control.

2,4,4 Constructive demonstrations by machinery salesmen on the correct procedures for operating and maintenance of equipment.

2,4,5 Compiling and circulating a manual of procedures on machinery maintenance policies.

2,4,6 Insisting that every piece of machinery bought into Tongaat was accompanied by an operator's hand book.

2,4,7 Individual attention by the Trainer Mechanic.

2,4,8 Learning the job in the field.

2,4,9 Providing a means of measuring his performance.

3/...

2,5 The training of Section Servicemen by:-

2,5,1 Employing a Trainer Mechanic.

2,5,2 Having an annual training programme for the Trainer.

2,5,3 Holding combined training courses for Servicemen.

2,5,4 Providing individual attention where needed.

2,5,5 Handing out useful literature.

2,5,6 Monitoring the progress of Servicemen.

2,5,7 Providing an incentive to improve.

2,6 The training of Drivers and Operators:-

2,6,1 Selecting suitable personnel.

2,6,2 Training in basic machinery operating principles and care of machinery.

2,6,3 Training in driving techniques.

2,6,4 Continued training on the section.

## 3. RESULTS

The described system has now been functioning for 18 months. The breakdown time has dropped by 43% to an average of 9% of total monthly available time. Tractor running costs have accumulated a saving against budget of approximately R60 000 to date over the past 18 months. Productivity of drivers and operators has improved considerably and in one particular case, the output per day increased by 220%.

## 4. THE FUTURE

Some points that will have to be considered by the various levels of management and workmen with increasing mechanisation.

4,1 The A.M.C. (Agricultural Management Committee)

4,1,1 Section size to achieve profitable mechanisation.

4,1,2 Speed at which to move towards further mechanisation influenced by:

(i) Increased profits
(ii) Labour availability
(iii) Improvement in farming standards
(iv) Eliminating drudgery
(v) Reduction of operating costs.

4/...

4,1,3 Housing and living standards of future workmen.

4,1,4 More accurate records of productivity improvement.

4,1,5 Training for better mechanisation management.

4,2 The Section Manager

4,2,1 Field size, shape and layout.

4,2,2 Type, number and size of machinery and equipment.

4,2,3 Timeliness of field operations.

4,2,4 Increased labour productivity and improved quality.

4,2,5 Reduction in operating costs.

4,3 The Servicemen

4,3,1 Be trained to cope with more sophisticated machinery.

4,3,2 Take on further responsibility.

4,4 The Operator

4,4,1 Improve his operating skill to increase productivity.

4,4,2 Improve his care of machinery.

4,4,3 Carry out the basic servicing of his machine.

R.N. STATHAM

26th September, 1974
RNS/SC

# Weed Control : recent developments in the U.K. and Europe

by Graeme Iggo

One may think that the United Kingdom is an unusual place to attend a course on Tropical Weed Control, but considerable time and effort is being spent by the universities and the Weed Research Organisation on the problems associated with controlling weeds in tropical climates. This research is mainly directed to Commonwealth countries.

As a result of attending the course and making visits to various organisations I learnt the following information which may have some relevance to the South African sugar industry.

## Herbicides

The current world shortage of pesticides is likely to continue well into next year and it has been estimated that in 1975 there will be a world shortfall of 30%. The shortage is a result of increased demand from developing countries.

During my trip I learnt of no new herbicides, for possible use in sugarcane, which the Experiment Station had not evaluated or was not aware of. In fact we are currently testing several compounds that many people in Europe had not even heard of, which indicates that the Experiment Station is kept to the fore of herbicide developments.

It was evident from speaking to research workers in Europe that glyphosate (ROUNDUP) is the most exciting herbicide development to occur in recent years. The product is being sold commercially in the U.K. this season for the control of Agropyron repens. A rate of 4 litres per hectare is recommended with the chemical costing R11,60 per litre. Based on this price it would cost R116 per hectare to kill sugarcane using 10 litres of glyphosate/hectare.

## Crops as weeds

At this year's British Weed Control Conference one session is being devoted to "Crops as weeds", which illustrates the growing awareness in Europe of the problems associated with crop volunteers. In the Netherlands the potato volunteer is considered to be their greatest weed problem because of its ability to carry nematodes from one crop to the next. Currently, hand roguing is the only reliable means of control but the use of herbicides is being investigated with hope being placed on glyphosate. It seems that they are facing a problem which we in the sugarcane industry have had for years.

Minimum tillage

In 1972 there were 100 000 acres directly drilled (i.e. no tillage before planting) in the U.K. and in 1973 this rose to 250 000 acres. Three million acres of maize was directly drilled in the U.S.A. in 1973. Obviously the concepts of minimum tillage and no-tillage are fast becoming modern farming practice and could well have important implications for our own sugar industry. Rising fuel and labour costs are reasons given for the trend towards reduced cultivation. This is supported by the fact that the yields achieved compare well with those when conventional land preparation techniques are used. Paraquat is the herbicide most widely used to destroy the old vegetation, but with its continual use perennial grasses are building up. In these situations glyphosate will play an important role.

Application equipment

Development of herbicide application equipment in the U.K. is being directed towards low volume applicators. (i.e. 10-50 litres per hectare). One of the problems associated with low volume spraying is obtaining an even distribution of the spray diluent. Conventional spray nozzles are unsuitable as they produce relatively few droplets of a large diameter. For low volumes a large number of small droplets is required and this is being achieved by the recently developed centrifugal nozzles.

At the Imperial College, Silwood Park, they have tested the wear on nozzles made from different materials and have shown that plastic nozzles wear less than brass or stainless steel. Plastic nozzles are of course less expensive than the metallic types. At the time of my visit they had not tested the "Desmarquest" nozzles.

GAI/RDM
7 October 1974.

1:150

1:75

(title outlet towns)

Tongaat
Gledhow
Natal Estates.
{ New Guelderland.
{ Illovo

~~Valuation~~

Value

(Central Board)

# THE VALUE OF COLLATED AGRICULTURAL DATA

M.G. Murdoch

The question of what value there is in collating agricultural data seems to need examination. The data has some value simply as a description of, for example, what average yields are being achieved, yields of crops of various ages, crop stages, on various soil types, etc. Whether useful comparative interpretations can be made from such data needs more careful consideration.

At present, individual field data submitted by the estates is simply being sorted by age, stage and variety, and the associated yields calculated. No attempt has yet been made to combine data from different estates.

The initial concept was that with the large numbers of combinations of factors involved it is desirable to have data from as many estates as possible so that any particular combination of factors is not represented by data from only a few fields. It was hoped that this data could then be likened to the results of a 'grand experiment'.

## 1 Factors for classifying fields

It has been suggested that individual field results could be classified according to the following factors:

1. Variety
2. Age at harvest
3. Stage of crop
4. Month of harvest
5. Month of start of crop (previous harvest)
6. Trashing or burning at previous harvest
7. Age of previous crop
8. Soil type
9. Ecotope
10. Altitude
11. Aspect

One would also include some further characteristics of fields such as terrain, valley bottom or hillside, whether drained or conserved, etc, etc.

## 2 Interpretation of results

It is probably worth emphasising the obvious point that the field yield data are obtained from the process of commercial production, and that there are unlikely to be many deliberate attempts to vary levels of factors, such as age, etc, to obtain meaningful comparisons. The variations that occur in the levels of factors are simply those 'thrown up' by production system practised.

This, of course, has an effect on what interpretations can be safely made. One point of view is that this type of data is not suitable for drawing any conclusions regarding the relative merits of the levels of factors.

A few examples are as follows:

Varieties: If particular varieties tend to be grown in particular fields because they are known or assumed to be more suitable for the conditions prevailing, then direct comparison of variety yields is of doubtful value. It may be difficult to ensure that all conditions which effect the decision of which variety to grow, eg. soil type, aspect, time of harvest, etc, are 'equalised' so that the comparisons can be fairly made.

Age at harvest: Attempting to draw conclusions regarding optimum age at harvest seems particularly hazardous. Generally, crops harvested at young ages are likely to be those which have produced a harvestable tonnage quickly because of being located in favourable fields and the reverse applies to crops which are old at harvest. Young crops and 'good' fields will tend to be confounded. Quantitatively correct data for comparative purposes is unlikely to be obtained.

Stage of crop: Fields which are ratooning (good) are likely to be ploughed out early so that old ratoons are only represented on 'good' fields. Yield results of an individual season seem unsuitable for determining the fall-off in productivity with increasing ratoon with quantitative accuracy.

It seems that for hardly any of the factors listed are results likely to be free from other effects such that completely reliable quantitative comparisons can be made.

## 3 Value of the results

What then is the value or purpose in obtaining these data? Although quantitatively correct comparisons may not be possible, some comparison of a more 'qualitative' nature may still be of value. I would regard the value as primarily the descriptive nature of the data. With the aid of the computer classifying field according to a large number of factors is relatively easily done. Factors such as month of harvest and month of start of crop are not ones for which data is commonly available. Some of the combinations of factors could throw up yields which are particularly low or high and give rise to the question of why this is so. If nothing else, it would give a more complete description of what yields are being achieved under various conditions. The question is whether this is worth having for the effort involved.

## 4 Data collection

Some of the factors by which fields can be classified are permanent features of the fields. With an efficient system it should only be necessary to have to record these once. There is a real possibility of the Control Board computer system being able to record most of the other factors automatically after being fed the initial information once. Rainfall data could also be dealt with. The data to be supplied by the estates could be reduced to changes in area of field harvested, information about new planting, irrigation water, burning and trashing, and fertilization, if this is to be continued with. Thus the burden of supplying data could be considerably reduced. The processing of the rainfall data to give effective rainfall becomes practical.

5 Combining data from different estates and sections

With different average levels of productivity there is some difficulty in combining data so that results are still meaningful. Obviously, simply 'throwing together' the individual field results from different estates and sections would be unsuitable. Adjusting the results of each section to a standard, say, percentage of the average yield for the section may be helpful for some purposes.

6 Measurement of productivity

Measurement of yield in terms of tons sucrose per 100mm water should be included as well as tons of cane and sucrose per hectare and per hectare per month, and tons cane per 100mm. This is necessary to allow for differences in sucrose percentage between varieties, ages, times of harvest, etc. Use of yield per unit of water is dependent on the representativeness of the rainfall recording stations. There are likely to be fields for which the rainfall used is not very well applicable, but hopefully this measure will still be an improvement on yield per unit time.

MGM/DC/
15 October 1974

Ralfo Stewart
John Boyce

70 cm. Steel framing