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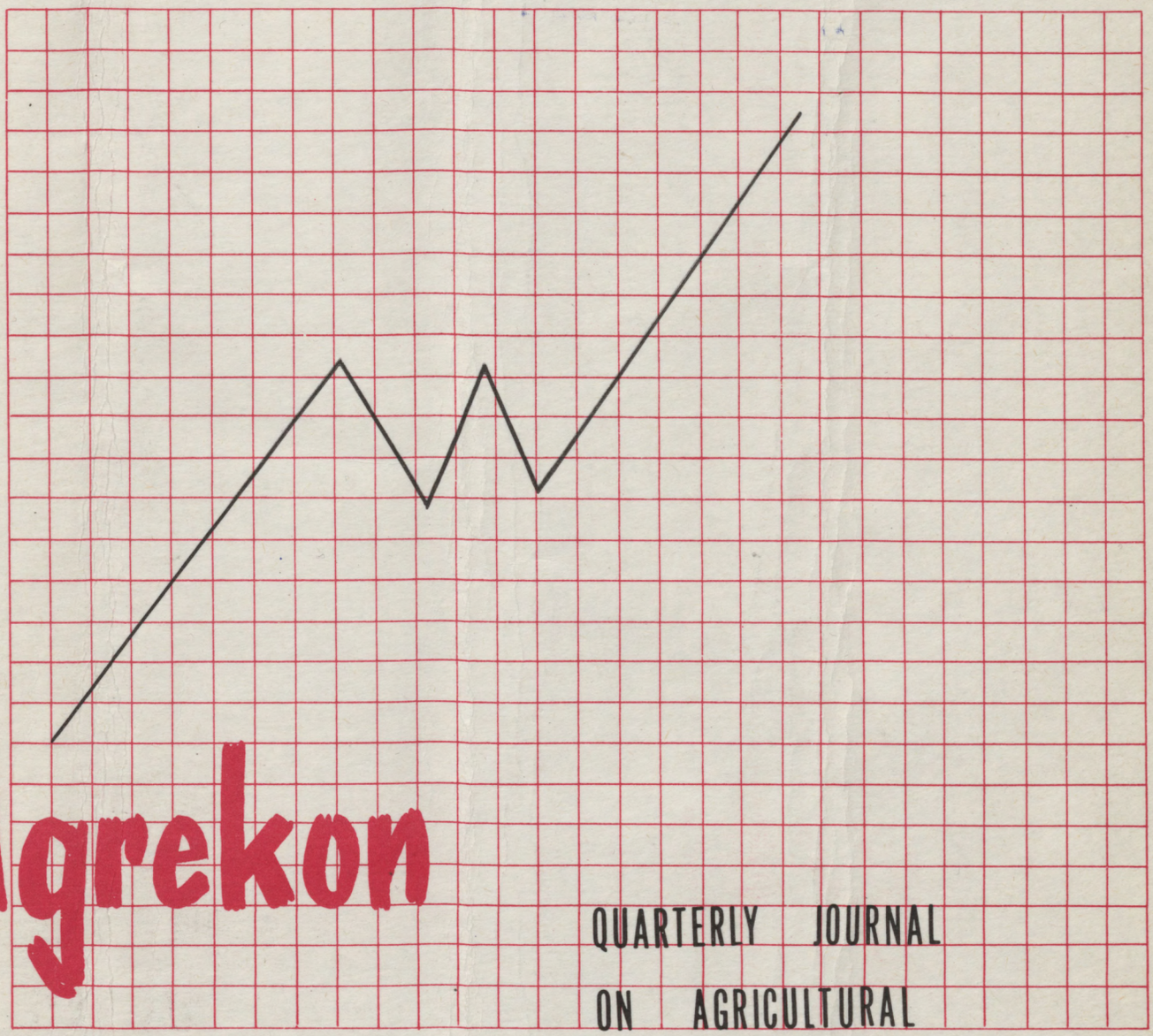

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AN APPROACH FOR THE DEVELOPMENT OF PLANNING STANDARDS FOR A HOMOGENEOUS FARMING AREA : PART II

by

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1. Introduction

The theory underlying the development of planning standards was discussed in Part I and the development of planning standards for a homogeneous farming area (the Clocolan District) will be considered next.

2. Sources of information and collection techniques used

Because the techniques of data collection are determined largely by the sources of information used, the two facets are discussed together.

To discuss the nature of the factors that influence planning standards for the area investigated and to be able to draw up field husbandry planning standards that would be reasonably reliable, various sources of information had to be used. All the main sources of information were used, namely published, unpublished and original reasearch information.

2.1 Published information

Various published sources of information were used.

To obtain information about the climate of the area under investigation, use was made, *inter alia*, of the information given in the annual reports of the Weather Bureau[1].

Information obtained from the Department of Agricultural Economics and Marketing's Farm Business Management Manual was used first to verify cost standards for tractors and implements in the area investigated and, secondly, to provide guidelines for drawing up the planning standards[2].

Yield standards for the various crops and soil types were estimated from information contained in a publication by the Fertilizer Society of South Africa[3] and from a publication in the magazine Farming in South Africa[4].

To obtain standards regarding the time inputs concerned in the harvesting and delivering of grain maize, the publication "Economic aspects of harvesting and delivering of maize"[5] was used.

In addition, information on the prices of some crops was obtained from the Short Abstract of Agricultural Statistics[6].

2.2 Unpublished information

Unpublished information includes both recorded and unrecorded information. Both of these sources were tapped. The recorded sources of information are dealt with first.

Joubert's thesis was used to obtain certain particulars regarding the climate, soil, form of ownership and level of management in the area investigated[7].

Additional information on the soil in the area investigated was also obtained from the Agricultural Research Institute for the Highveld Region at Potchefstroom[8].

Mail-in record results were used to obtain information on the relative importance of various farm enterprises and to determine certain of the fixed costs in planning standards[9].

In estimating the yield standards for grain, use was made, *inter alia*, of a circular entitled "Aan alle voorligtingskantore: Voorspelling van koringopbrengste"[10].

Particulars about farm feed prices were obtained from a pamphlet entitled "Plaasvoerpryse"[11].

Secondly, unrecorded information was collected as follows: information regarding farmers' knowledge about various soil types occurring on their farms, the various crops cultivated, various production practices followed in the cultivation of the various crops, the dates when the various practices are normally carried out and the inputs involved were obtained through personal interviews with a few farmers in the area investigated using a pre-prepared questionnaire. The questionnaire was completed at the start of the study. Ten farmers were selected at random from a larger selected group and questioned.

A further source of unrecorded information that was used was interviews with experts and organisations. Interviews were conducted with staff of the Field Husbandry Division of the Department of Agricultural Technical Services, Highveld Region (to obtain information on yield standards for various crops), staff of the Field Husbandry Department of the Faculty of Agriculture of the University of the Orange Free State (to obtain certain information on implements and input and

output standards), the extension officer of the Clocolan Agricultural Co-operative (to Obtain information on various aspects of field husbandry production in the area investigated) and organisation that provide agricultural production goods (to check the prices obtained from surveys among the farmers).

2.3 Original research information

After existing information was analysed, it was found that information on the following aspects was lacking:

1. The production potential of the various soil types in respect of various crops cultivated in the area under investigation.
2. The optimum management practices (such as the right levels of application of seed and fertiliser) for the various crops on the various soil types.
3. The labour, tractor and implement times per hectare needed to carry out the various production tasks.

To obtain the information that was lacking, it was decided to do case studies with a group of farmers[12]. Ten farmers were approached for this purpose. Each farmer had to keep a separate record of all production activities for each field for a full summer and winter growing season (1 August 1972 - 31 December 1973). A prepared record form was developed for this purpose and provided to the farmers. On the record forms information had to be given, among other things, about the various types of cultivation practices used, with the date of the cultivation, the quantities and types of production goods used and the yields obtained. The collaborating farmers were visited periodically by the researcher during the survey period to solve problems that had arisen and to see that the record forms were filled in properly.

After the survey year the record forms were collected and the questionnaire was completed with the collaborating farmers to collect missing information. Information collected at this time covered prices paid for production goods and prices received for products during their survey year. Details of the quantity and distribution of the rainfall during the survey year on the various farms of the collaborating farmers were also obtained.

It was also necessary to have a soil survey made of the collaborating farmers' drylands in order to identify the soil types occurring on each dryland. The survey was undertaken by the Department of Soil Science of the University of the Orange Free State.

In addition, a time and method study was carried out on a number of cultivation practices in the area investigated and these supplemented the time standards determined from the record form information from the collaborating farmers.

3. The nature of factors that influence planning standards in the area under investigation

An essential step in the development of comprehensive planning standards for a farming area is to describe fully the nature of each factor that influences planning standards. The description not only provides the basic information required for preparing planning standards, but also brings to the fore the most general and the exceptional characteristics of each factor[13].

Figure 1, which is an extract from the discussion on the technique factor, for example, illustrates the cultivation practices that occurred in the cultivation of maize during the survey year. With the help of the figure the most general set of practices and the departures from it can be determined. The figure also illustrates, among other things, the scope of the task of preparing comprehensive planning standards for a homogeneous farming area.

Table 1, which is also part of the discussion of the technique factor, shows, for example, the time standards in the harvesting of maize. The standards are required to calculate the harvesting process of maize for the relevant planning standard.

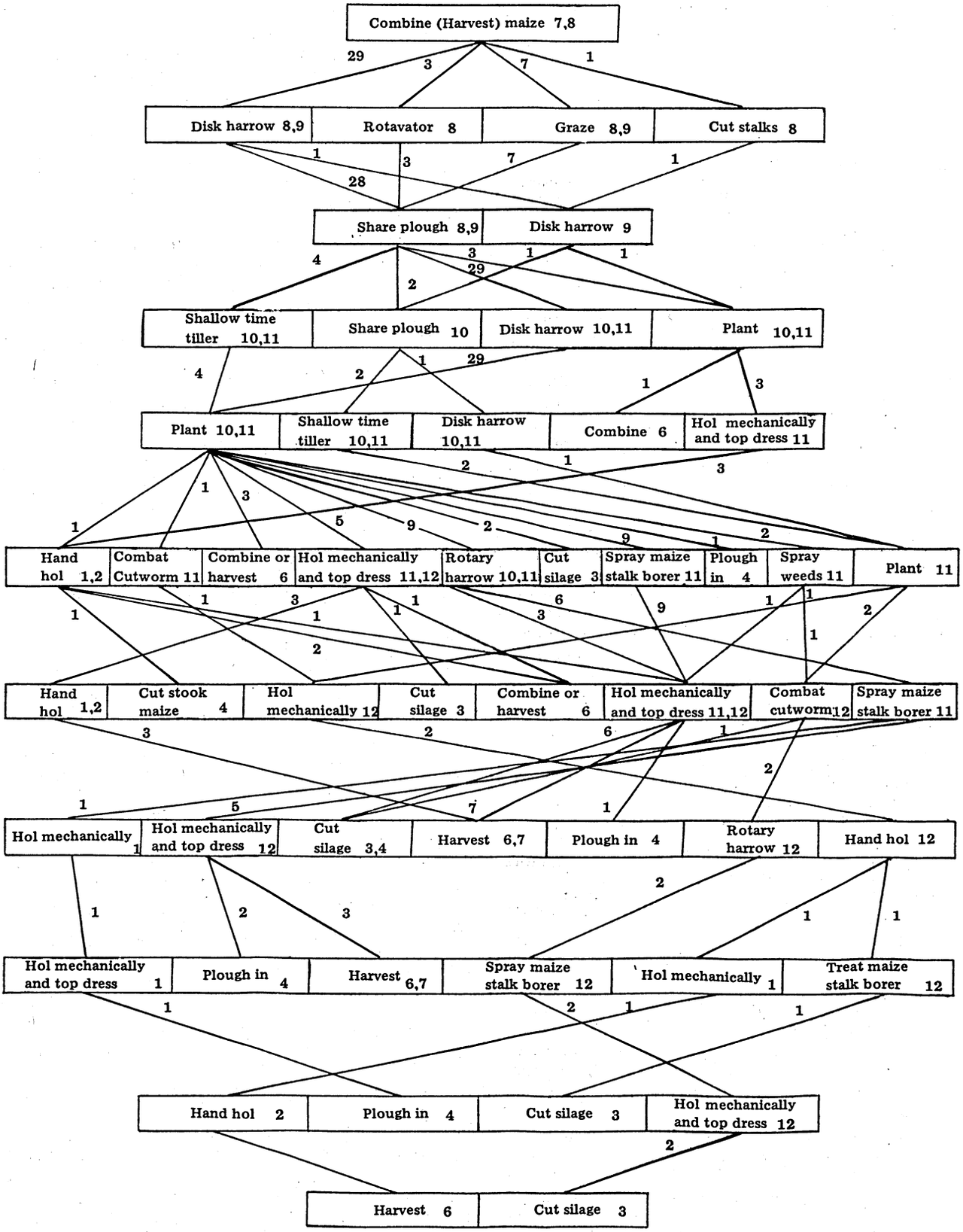
For every other factor the properties are also discussed systematically so that planning standards could later be drawn up fairly easily with the help of this information.

4. The implication of the nature of the factors that influence planning standards and the lack of a case study method for the development of planning standards for the area under investigation

From the analysis of the nature of the factors that influence field husbandry planning standards in the area under investigation the following deductions may be made in respect of the determination of field husbandry planning standards:

1. A large number of field husbandry planning standards will have to be prepared to cover all the combinations of levels or capacities of the characteristics found within the factors analysed. This is so because within each factor a variety of levels or capacities of the characteristics were found.
2. The information gathered on the lands in the area under investigation is incomplete and in certain respects unsuitable for the determination of field husbandry planning standards that meet *all* the requirements of practically usable planning standards. In order to meet the requirements field husbandry planning standards must first be prepared for all the various soil type-crop combinations (management classes) for each set of capacities or levels of the characteristics of the factors that influence field husbandry planning standards in the area under investigation. Secondly, they must be prepared in such a way that they will provide the economically optimal input-output relationships.

Figure 1- The cultivation practices for the lands on which maize was grown after maize according to information from collaborating farmers, Clocolan District, 1971/72 *



* a Figure in block indicates calender month(s) when specific practice occurred

b Figure next to line joining blocks indicates number of fields on which a specific sequence of practices occurred

TABLE 2 - Maize crop with a self-propelled four-row combine harvester (0,92 metre rows) at an average working pace and application of labour, Clocolan District, 1972/73 (a)

Yield per ha	Harvesting process			Delivering process		
	Bags of kernels per hour	Combine hours per ha	Labour hours per ha (b)	Tractor hours per ha (c)	Trailer hours per ha (d)	Labour hours per ha (e)
90 kg bags						
16	21,0	0,78	1,56	1,56	2,34	6,24
22	26,7	0,82	1,64	1,64	2,46	6,56
27	32,0	0,86	1,72	1,72	2,58	6,88
33	37,5	0,88	1,76	1,76	2,64	7,04
38	43,0	0,89	1,78	1,78	2,67	7,12
44	48,4	0,91	1,82	1,82	2,73	7,28
49	54,0	0,91	1,82	1,82	2,73	7,28

(a) The information in the table is based on information from collaborating farmers and information from Van Wyk, J.J., *Economic aspects of harvesting and delivering of maize.* Departement of Agricultural Economics and Marketing, Division of Agricultural Production Economics, Economic Series No. 73, 1970 (Pretoria).
(b) Two labourers involved with combine harvester.
(c) Two large tractors involved in delivery.
(d) Three seven ton trailers involved in delivery.
(e) One labourer on tractor and two labourers per trailer.

From the analysis and discussion of the factors for the area under investigation the following problems in determining ideal field husbandry planning standards may be identified:

(i) Management classes could not be drawn up for the area under investigation as a result of a lack of scientific knowledge about the classification into management classes of the soil types and crops that occur[14].

(ii) The information was collected on lands most of which showed soil types with radically differing properties. So even if management classes were drawn up, it appears that the greater part of the information collected would be useless for the determination of ideal standards. This is because it would not be possible to relate them to definite management classes to determine causal input-output relationships.

(iii) Even if it were possible to classify each of the lands on which information was collected into one management class per land, there would still not be enough lands available to obtain an adequate number of repetitions for the purposes of verification of the various sets of standard-determining levels or capacities of the characteristics found within the factors. Also, it was impossible to find two lands on which a given set of capacities or levels repeated themselves[15].

(iv) Because specific levels or capacities of characteristics of certain factors, such as capital availability and management level, were deliberately selected in the collection of the information, it follows that comprehensive planning standards could not in any case have been prepared for the area under investigation with the information collected.

(v) The levels at which the characteristics of certain factors occurred were unsuitable for the determination of usable planning standards. For example, the seasonal and annual average quantities of rainfall that fell during the survey year in the area under investigation were far below the long-term average of the region, so that crop yields occurring during the survey year were far below the long-term average yield (the yields required for the determination of suitable planning standards).

(vi) In measuring the levels of the characteristics of the various factors in practice various farmers used various tehniques of measurement. It was also not practically possible for the farmers to use very accurate techniques of measurement. Errors of measurement therefore occurred, which complicated drawing absolutely reliable conclusions for the planning standards with the information collected.

3. It follows from the above that the case study procedure, as applied to gather the information, was not able to supply information with which ideal (economically optimal) planning standards could be fully determined and verified. It is not simply clear whether this is a fundamental problem of the case study method. By making deliberate attempts to overcome the set problems it would probably be possible to obtain information with which ideal planning standards could be developed.

The following adjustments, among others, would have to be made to the present application of the case study procedure:

(i) A deliberate pre-selection of lands would have to be made in order to obtain only one soil type per land. This is particularly so because management classes according to which standards should be collected have not been identified.

(ii) The number of lands on which information is collected would have to be increased so that an adequate number of repetitions, for the purposes of verification, could be obtained of each of the various sets of the levels or capacities of the characteristics of the factors that influence field husbandry planning standards.

(iii) The collection of information would have to take place over a number of years so that information could be obtained that is based

on the long-term average climatic pattern and also to obtain an adequate number of repetitions of each of the various sets of the levels or capacities of the characteristics of the factors that influence field husbandry planning standards.

(iv) More consistent and more accurate techniques of measurement would have to be used. This would ensure that the information obtained from the various farmers would be comparable and it would also allow for the determination of accurate and more reliable input-output relationships.

Although these measures would increase the suitability of the case study method for collecting planning standards, the following problems would still have to be considered:

(i) It could happen that it would not be possible to obtain an adequate number of lands that are homogeneous in respect of soil type.

(ii) It also would be difficult (if not impossible) in practise to obtain an adequate number of repetitions of certain sets of levels or capacities of the characteristics of the factors concerned. For example, this would be the case with crops that are not generally cultivated in the region and for soil types that do not occur often.

(iii) Certain characteristics of factors might occur at such levels or qualities that it would not be possible to determine ideal standards with them, for example, an abnormal rainfall pattern or the fact fertiliser is not applied at desired levels.

(iv) It would be difficult to find an adequate number of suitable farmers who would be prepared to keep very careful records of the required information for a few years.

Given the possible obstacles in the way of obtaining ideal field husbandry planning standards, even with a more refined application of the case study procedure, the question arises whether there are no other research techniques with which ideal field husbandry planning standards can be determined. At the present stage it appears that the following techniques are the best alternatives for determining the desired planning standards.

The most suitable technique for determining optimal time standards (labour, tractor and implement time standards) is engineering, economic, time and method study procedures such as those given in the publication of Frazer and Lugg[17]. The proper technique for determining optimal physical input-output standards is technical-economic field experiments such as those described in the publication of Johansson, *et al*[18].

4. The information collected by the case study method, as applied in the study, is in fact suitable for developing factual planning standards. Factual planning standards are standards based on experience of the best production technique for use in practice. Until such time as planning standards that are verified for optimality become available, factual planning standards are the best standards for use in the economic planning of farming[19].

The information collected regarding the collaborating farmers' lands is presented in such a way in the discussion of the nature of the factors that factual planning standards can be developed from it very easily. For certain components of field husbandry planning standards, however, the required information cannot be obtained from the analysis, so that other sources of information also have to be used in determining factual planning standards.

5. Factual planning standards

In order to be able to draw up factual planning standards for crops in accordance with soil types it was also necessary to use information determined by earlier research. This was information in respect of potential crop yields and fertiliser and seed requirements for various crops in accordance with soil types. It was possible to obtain the information in respect of four crops cultivated in the area under investigation. These crops were grain maize, silage maize, grain sorghum and grain wheat. Tables 2 and 3, for example, show the supplementary information for grain maize.

After the supplementary auxiliary tables were drawn up the preparation of factual planning standards was begun. The assumptions made in respect of all the planning standards were the following:

1. The standards apply to drylands in the Clocolan Magisterial District.
2. The long-term average climatic pattern applies.
3. The occurrence of pests is as for a normal year.
4. Although only one cultivar is specified in a standard, so that cost calculations can be made, a standard applies (with small alterations) to various cultivars of a crop.
5. The planning standard for each crop is based on the system of practices applied most often by collaborating farmers during the survey year.
6. Except for the four crops for which levels of fertilisation and densities of plants were determined in accordance with soil types, the fertilisation levels and densities of plants used in the planning standards of the other crops are the average quantities used during the survey year by collaborating farmers. The underlying assumption in the case of the standards of the latter crops is that in the long term it is possible in the region to obtain various yield levels for a crop on the various soil types with a given production technique and levels of inputs.
7. The standards applied to farmers with an average to above average level of management in respect of field husbandry production.
8. The capital equipment used in the standards was chosen largely at random from that used by the collaborating farmers during the survey year.

TABLE 2 - Potential grain maize yields per hectare for various soil series and depth phases with average to above average management, Clocolan District, 1972/73*

Soil series	Depth phase							
	30 cm	40 cm	50 cm	60 cm	75 cm	90 cm	105 cm	120 cm
	Yield in units of 90 kg/ha							
Leksand	X	22,0	28,4	38,4	50,7	59,6	64,4	66,7
Bleeksand	X	22,0	28,4	38,4	50,7	59,6	64,4	66,7
Avalon	X	24,8	32,0	40,4	50,7	59,6	64,4	66,7
Soetmelk	X	24,8	32,0	40,4	50,7	59,6	64,4	66,7
Rutherglen	X	X	X	X	X	X	X	66,7
Annandale	X	X	X	25,6	34,7	41,8	49,3	54,2
Blinkklip	X	X	X	27,0	34,7	41,8	49,3	54,2
Southwold	X	X	X	27,0	34,7	41,8	49,3	54,2
Kroonstad	12,8	19,1	24,9	34,4	X	X	X	X
Waaisand	14,9	22,0	28,4	38,4	50,7	X	X	X
Estcourt	14,4	21,6	28,0	X	X	X	X	X
Westleigh	14,9	22,0	28,4	38,4	X	X	X	X
Rietvlei	16,8	24,8	32,0	40,4	X	X	X	X
Shorrocks	X	X	X	33,7	42,4	56,2	64,4	66,7

*(a) Source: Möhr, P.J. and van Niekerk, B.P., *Sleutel tot die gebruik van die mielieproduksie- en N.P.K.-rekenaar.* Pretoria, The Fertilizer Society of South Africa, 1972. Möhr, P.J., *Byvoegsel nr. 1 mielieproduksie- en N.P.K.-rekenaar.* Pretoria. The Fertilizer Society of South Africa, 1973.
(b) Eighty per cent of the yield as given in the maize computer is used.
(c) It is assumed that maize is cultivated after maize.
(d) Potential maize yield is calculated according to long-term average annual rainfall.
(e) Soil depth is assumed to be equal to root depth.

TABLE 3 - Plant stand and quantities of N, P and K required per hectare for different yield targets and soil series in the cultivation of grain maize, Clocolan District, 1972/73*

Item and soil series	Yield target in 90 kg bags/ha		
	16	33	49
Plant stand:			
All the series	10 000	20 000	27 000
N, P and K (kg/ha) for the following soil series:**			
Leksand, Bleeksand, Avalon, Soetmelk, Rutherglen, Annandale, Blinkklip, Southwold, Kroonstad, Waaisand, Estcourt, Westleigh and Rietvlei	11 kg N/ha 8 kg P/ha 4 kg K/ha	35 kg N/ha 14 kg P/ha 8 kg K/ha	65 kg N/ha 19 kg P/ha 12 kg K/ha
Shorrocks	11 kg N/ha 12 kg P/ha 8 kg K/ha	35 kg N/ha 20 kg P/ha 15 kg K/ha	65 kg N/ha 26 kg P/ha 23 kg K/ha

* Source: Plant populations obtained from Möhr, P.J., *Handleiding vir mielieproduksie- en die mielierekenaar*, Pretoria, The Fertilizer Society of South Africa, 1974, p. 27. N, P and K requirements from Möhr, P.J. and van Niekerk, B.P., *Sleutel tot die gebruik van die mielieproduksie- en N. P. K.-rekenaar.* Pretoria, The Fertilizer Society of South Africa, 1972.

** On the maize computer a P value of 15 parts per million and a K value of less than 150 parts per million are used. The degree of acidity is considered to be favourable. The K value is the average value according to the analysis of the soil samples of the collaborating farmers and the P value is an estimated value based on Crafford, D.J., *Oral communication.* Potchefstroom, Department of Agricultural Technical Services, 1975.

9. Operating capital is considered to be non-limiting.
10. The application of labour is according to the average pattern of collaborating farmers during the survey year.
11. The form of ownership that applies is that of owner-farmer.
12. Prices that applied in the area during the survey year were used.

By way of an example, the planning standard for grain maize is given in Table 4. In Figure 2 the net income for different yield targets, as obtained from Table 4, is shown. By making the information on yields from Table 2 apply to Figure 2 the net income can be determined for grain maize for the various soil series and soil depths. In a similar way the net income can be determined in accordance with soil series and soil depths for silage maize, grain sorghum and grain wheat.

By comparing the net income in accordance with soil series and soil depths for the four crops, as in Table 5, guidelines are provided that can be used for the long-term planning of these crop enterprises. However, when such information is to be used in practice, the underlying assumptions made in establishing it must always be adjusted.

Conclusion

Given the heterogeneity found within a homogeneous farming area in the characteristics of the factors that influence planning standards, the greatest value of planning standards based on the most general conditions (in addition to the fact that they provide a broad guideline for optimal land use in the region) lies in the fact that they serve as an example for the preparation of their own planning standards for individual farmers.

The provision of comprehensive supporting information, such as time standards, prices, fertiliser and yield norms, etc., to the farmers of a farming region together with a practical example of a planning standard can enable each farmer to develop his own planning standards for the unique conditions on his farm.

In view of the fact that the establishment of comprehensive planning standards for a farming area is a big, expensive and continuous task, the best practical alternative is obviously making available a comprehensive set of supporting information with the help of which each farmer in the area can prepare his own planning standards.

TABLE 4 - An average planning standard for grain maize according to soil series, per hectare, Clocolan District, 1972/73[a]

1. Cultivation practices

Practice	Date	Tractor size	Type and size of implements	Tractor and implement			Regular labour	
				Time per ha	Running costs per ha	Fixed costs per ha	Time per ha	Costs per ha
	Month	kW		Hours	c	c	Hours	c
Disc harrow	8,9	45-51	2,44 m	1,01	81,91	44,25	1,01	12,12
Disc plough	8,9	45-51	1,22 m	2,07	172,53	75,25	2,07	24,84
Disc harrow	10,11	45-51	2,44 m	1,01	81,91	44,25	1,01	12,12
Plant[b]	10,11	45-51	4-row	0,65	67,52	75,87	2,60	31,20
Spray maize Stalk borer	11	45-51	9,14 m	0,34	27,25	13,54	1,37	16,44
Hoe mechanically and top dress	11,12	45-51	3,66 m	0,97	76,82	34,29	4,85	58,20
Pre-harvest cost	**X**	**X**	**X**	**X**	**507,94**	**287,45**	**X**	**126,92**
Harvest and deliver[c]	6,7							
16 bags/ha		52-65	Seven - ton trailer	1,56[d]	179,86	95,36	6,24	74,88
33 bags/ha		52-65	Seven - ton trailer	1,76	202,93	107,57	7,04	84,48
49 bags/ha		52-65	Seven - ton trailer	1,82	209,85	111,23	7,28	87,36

2. Material used

Sort	Type	Quantity per ha	Costs per ha
			R
Weed killer	Atrasien	1 241 mℓ	4,27
Maize stalk borer killer	D.D.T.	614 mℓ	0,43

Fertiliser and seed

Name of soil series	Item	Yield (90 kg bags/ha) 16	33	49
Soil series group[e]	Quantity of N, P, K (kg)	11 N, 8 P, 4 K	35 N, 14 P, 8 K	65 N, 19 P, 12 K
	Cost[f] per ha (R)	5,57	12,99	21,24
Shorrocks	Quantity of N, P, K (kg)	11 N, 12 P, 8 K	35 N, 20 P, 15 K	65 N, 26 P, 23 K
	Cost per ha	7,48	15,98	25,05
All	Quantity of seed (kg)	3,3	6,6	8,9
	Costs[g] per ha (R)	0,53	1,06	1,43

3. Contract work hired

Type of work	Cost per ha
	R
Combine	8,75
Total	**8,75**

4. Other costs[h]

Item	Cost per ha
	R
Cost of fixed improvements	1,77
Vehicle cost (light truck and truck)	2,88
General farm work (tractor and labour)	1,48
Overhead costs (telephone etc.)	1,02
Total	**7,15**

5. Financial summary

Item	Yield (90 kg bags) 16	33	49
		R	
Gross income	65,52	135,14	200,66
Fixed cost	8,85	9,07	9,13
Soil series group			
Variable costs	26,43	34,61	43,33
Total costs	35,28	43,68	52,43

Tabel 4 continue	Yield (90 kg bags)		
	16	33	49
Item		R	
Gross margin	39,09	100,53	157,36
Net income	30,24	91,46	148,23
Shorrocks soil series			
Variable costs	28,34	37,60	47,11
Total costs	37,19	46,67	56,24
Gross margin	37,18	97,54	153,55
Net income	28,33	88,47	144,42

(a) Unless otherwise stated, the information applies to all the soil series concerned.
(b) At the same time as the seed is planted fertiliser is applied and weeds sprayed.
(c) The maize was combined by a contractor and delivered by the farmer.
(d) The figure gives the tractor hours for delivery; the trailer hours are tractor hours multiplied by 1,5.
(e) The soil series group includes the following soil series: Leksand, Bleeksand, Avalon, Soetmelk, Rutherglen, Annandale, Blinkklip, Southwold, Kroonstad, Waaisand, Estcourt, Westleigh and Rietvlei.
(f) Fertiliser cost is based on the following prices: 19,9 c/kg for N, 36,5 c/kg for P and 11,4 c/kg for K.
(g) The seed price is that of the cultivar SSM 40 at 16 c/kg.
(h) "Other costs" were calculated from mail-in record data from Clocolan for 1972/73 and are calculated as fixed costs.
(i) Gross income is calculated by allocating a price of R45,50 per ton to bulk maize.
(j) Interest was not taken into account in calculating the total cost.

TABLE 5 - Net income per hectare for four crops according to soil series and soil depth, Clocolan District, 1972/73

Soil series	Crop[a]	Depth phase 40 cm	50 cm	60 cm	75 cm	90 cm	105 cm	120 cm
					R/ha			
Leksand and Bleeksand	Grain wheat 1	91,40	98,70	106,30	117,70	119,80	121,10	121,10
	Grain wheat 2	70,00	84,70	94,60	102,00	110,60	122,10	122,10
	Grain wheat 3	65,80	74,60	82,00	93,10	97,20	114,80	114,80
	Grain maize	52,00	75,00	111,00	154,80	187,00	204,00	212,20
	Silage maize	127,50	153,00	193,80	240,00	267,50	290,00	301,00
	Grain sorghum	67,00	72,50	76,00	83,50	102,50	125,00	126,25
Avalon and Soetmelk	Grain wheat 1	91,40	98,70	106,30	117,70	119,80	121,10	121,10
	Grain wheat 2	70,00	84,70	94,60	102,00	110,60	122,10	122,10
	Grain wheat 3	65,80	74,60	82,00	93,10	97,20	114,80	114,80
	Grain maize	62,00	88,00	118,40	154,80	187,00	204,00	212,20
	Silage maize	146,50	175,00	204,00	240,00	267,50	290,00	301,00
	Grain sorghum	67,00	72,50	76,00	83,50	102,50	125,00	126,25
Annandale	Grain wheat 1	X	X	106,30	117,70	119,80	121,10	121,10
	Grain wheat 2	X	X	94,60	102,00	110,60	122,10	122,10
	Grain wheat 3	X	X	82,00	93,10	97,20	114,80	114,80
	Grain maize	X	X	64,90	97,80	123,20	140,90	167,50
	Silage maize	X	X	136,00	190,50	211,50	233,00	257,00
	Grain sorghum	X	X	76,00	83,50	102,50	125,00	126,25
Blinkklip and Southwold	Grain wheat 1	X	X	106,30	117,70	119,80	121,10	121,10
	Grain wheat 2	X	X	94,60	102,00	110,60	122,10	122,10
	Grain wheat 3	X	X	82,00	93,10	97,20	114,80	114,80
	Grain maize	X	X	70,00	97,80	123,20	149,90	167,50
	Silage maize	X	X	144,50	190,50	211,50	233,00	257,00
	Grain sorghum	X	X	76,00	83,50	102,50	125,00	126,25
Waaisand and Westleigh	Grain wheat 1	91,40	98,70	106,30	117,70	X	X	X
	Grain wheat 2	70,00	84,70	94,60	102,00	X	X	X
	Grain wheat 3	65,80	74,60	82,00	93,10	X	X	X
	Grain maize	52,00	75,00	111,00	154,80	X	X	X
	Silage maize	127,50	153,00	193,80	240,00	X	X	X
	Grain sorghum	67,00	86,00	110,50	147,50	X	X	X
Rietvlei	Grain wheat 1	91,40	98,70	106,30	X	X	X	X
	Grain wheat 2	70,00	84,70	94,60	X	X	X	X
	Grain wheat 3	65,80	74,60	82,00	X	X	X	X
	Grain maize	62,00	88,00	118,40	X	X	X	X
	Silage maize	146,50	175,00	204,00	X	X	X	X
	Grain sorghum	67,00	86,00	110,50	X	X	X	X
Shorrocks	Grain wheat 1	X	X	106,30	117,70	119,80	121,10	121,10
	Grain wheat 2	X	X	94,60	102,00	110,60	122,10	122,10
	Grain wheat 3	X	X	82,00	93,10	97,20	114,80	114,80
	Grain maize	X	X	91,00	121,50	170,50	199,70	207,80
	Silage maize	X	X	180,50	210,50	247,50	286,00	296,00
	Grain sorghum	X	X	108,00	144,50	178,00	211,00	213,60
Rutherglen	Grain wheat 1	X	X	X	X	X	X	90,10

Soil series	Crop	Depth phase 40 cm	50 cm	60 cm	75 cm	90 cm	105 cm	120 cm
					R/ha			
	Grain wheat 2	X	X	X	X	X	X	90,00
	Grain wheat 3	X	X	X	X	X	X	84,60
	Grain maize	X	X	X	X	X	X	212,20
	Silage maize	X	X	X	X	X	X	301,00
	Grain sorghum	X	X	X	X	X	X	213,60
Kroonstad	Grain wheat 1	66,20	72,20	78,10	X	X	X	X
	Grain wheat 2	48,70	60,50	68,00	X	X	X	X
	Grain wheat 3	44,50	51,50	57,80	X	X	X	X
	Grain maize	41,70	62,50	96,50	X	X	X	X
	Silage maize	108,00	147,00	188,50	X	X	X	X
	Grain sorghum	67,00	86,00	110,50	X	X	X	X
Estcourt	Grain wheat 1	66,20	72,20	X	X	X	X	X
	Grain wheat 2	48,70	60,50	X	X	X	X	X
	Grain wheat 3	44,50	51,50	X	X	X	X	X
	Grain maize	50,40	73,50	X	X	X	X	X
	Silage maize	125,00	150,50	X	X	X	X	X
	Grain sorghum	67,00	86,00	X	X	X	X	X

(a) Grain wheat 1 is grain wheat planted on 1 May, grain wheat 2 is grain wheat planted on 1 July and grain wheat 3 is grain wheat planted on 1 September

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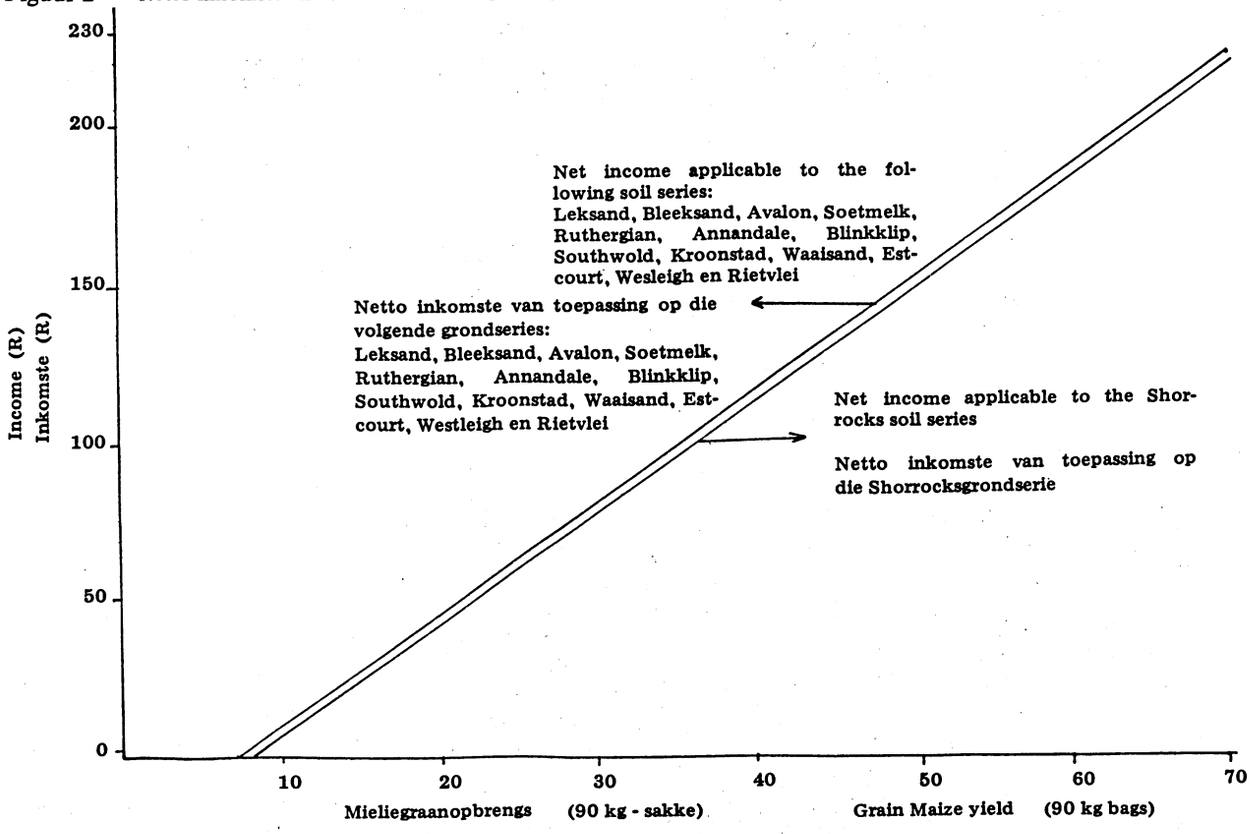
12. A motivation for this approach was obtained, *inter alia*, from the following publication, Johansson, O., *et.al., Co-operative research on input-output relationships in use of fertilizers in crop production.* Paris, André-Pascal, OECD, 1966, p. 69. "An easy way of collecting data appears to be to select an adequate number of farmers at random, sample their soils, have these tested (at no cost to the farmer) and persuade the farmer to keep reasonably accurate records of the amount of fertilizers used on each field, the crop yield and the size of the field. This method could serve as an alternative to the more laborious field experiments".
13. The nature of the factors is discussed in Chapter 3 of the thesis of Viljoen, M.F., *Die bepaling van standaarde met die oog op die ekonomiese beplanning van boerdery in die B3-agro-ekonomiese streek met spesiale verwysing na boerdery in die Clocolandistrik.* M.Sc.(Agric.) thesis, University of the Orange Free State, Bloemfontein, 1975.
14. A soil type refers to a soil unit with a given set of physical and physico-chemical soil properties; it includes properties such as slope, depth and those contained in the soil series name.
15. Even had more lands been included in the area under investigation to collect information, it is doubtful whether adequate repetitions could have been obtained of given sets of levels or capacities of the characteristic of the factors because a geographical extension would have resulted in an increase in the variation in the capacity of the characteristics of certain factors, for example, climate.
16. As a pre-requisite for a pre-selection of lands a soil chart on a suitable scale (1:6 000-9 000) of the soil types occurring on the various lands would have to be available. This information is still lacking for by far the majority of lands in the area under investigation.
17. Frazer, A.K. and Lugg, G.W. *Work study in agriculture.* Watford, Herts, Great Britain, Taylor Garnett Evans and Co. Ltd., 1962.
18. Johansson, O., *et al., op.cit.*

Figure 2 Net income for various grain maize yields according to soil series, per hectare, Clocolan District, 1972/73[a]

Figuur 2 Netto inkomste vir verskillende mieliegraanopbrengste ooreenkomstig grondseries, per hektaar, Clocolandistrik, 1972/73[a]



The figure is based on data in Table 5
Die figuur is op die data van Tabel 5 gebaseer

19. In view of the fact that the lack of knowledge regarding optimal planning standards cannot be nearly filled in the near future because it is too comprehensive, labour intensive, expensive and time consuming a task, factual planning standards will continue to play an important part in the economic planning of farming.