A LAND CAPABILITY CLASSIFICATION SYSTEM IN RELATION TO FARM PLANNING IN THE NATAL CANE BELT

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The sort of "planning" that has grown up with the Sugar Industry is a far cry from the concept of correct land use which is being implemented in many progressive agricultural communities. This paper is intended to show in broad outline exactly what is meant by Farm Planning. A land capability classification system will be described. No attempt will be made to demonstrate the details which will make up the planning of a cane farm or to evaluate the advantages thereof. The bold few who are demonstrating for themselves the value of planning have sufficient proof that a need for such planning exists and that the advantages are real. It is sincerely hoped that this paper will enable the neighbour and the rival alike to think it out for himself and to watch with greater understanding the changes that are taking place over the fence.

What is farm planning? The question is best answered by dividing it up into its five basic steps. These are: a soil survey, a land classification, an assessment of the possible courses of action, the actual planning and finally the implementation of that plan.

The soil survey is a factual assessment and definition of the broad soil groups. This gathering together of the facts is purely empirical and quite unrelated to farming practice. The initial part of this work has been admirably completed by Dr. Beater in his three volumes on the "Soils of the Sugar Belt". Any farmer wishing to avail himself of this work can do so.

Having defined the soil groups, they should be further assessed and classified into broad terms of land use capability dependent upon their inherent hazard of use. The farmer, who invariably knows more about his land than any one else, does this mentally but there are several scientific approaches which provide a more complete picture. A land capability classification system is suggested as the most efficient system for use in detailed farm planning, as the experience of the farmer coupled with the knowledge of a person trained in farm planning are used to gather all the required information. The Rhodesian system's use of aerial photography, coding of the various land and soil characteristics and its completely logical approach make it extremely practical. This system was first developed and used extensively in the United States of America. Improvements to the system made in the Federation of Rhodesia and Nyasaland make it capable of very wide application.

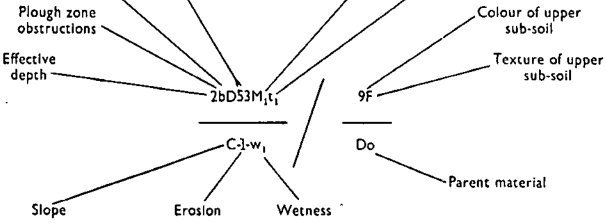
The Land Classification Method

1. *The Use of Aerial Photographs.*—Aerial photographs provide an extensive clear-cut view of ground conditions at the time of the flight. The scale of photography best suited to land classification is 1:20,000 9″ x 9″ formats, and photographs should be logotronically printed to provide even grey tones. Viewed stereoscopically and correctly interpreted, these photographs can be marked with the main topographical features viz. ridges, high points and drainage lines. Vegetation changes and soil changes (where visible) can be observed. Areas of steep, eroded, rocky, wet land and other significant features can also be observed and demarcated.

2. *Map making.*—All this information extracted from stereo pairs of a suitable scale of vertical photography can be transferred to enlargements or photographic mosaics of the area in question at a practical scale of between 1:5,000 and 1:10,000. This mosaic provides the basis of the land classification map. Before leaving the office for a ground survey of the area, suitable points on the mosaic should be selected along a fairly level straight road or path so that the distance may be chained and an accurate scale calculated.

3. *Pit siting.*—Exploratory soil pits should be provisionally sited using a stereoscope. The sites being selected within apparent homogeneous areas, to disdover soil variations to check the similarity of separate homogeneous areas. Naturally the number of exploratory soil pits will depend upon the uniformity of the area concerned but for practical reasons the number usually varies between twenty and fifty per 1,000 acres. Confirmatory soil pits and soil auger-borings are subsequently sunk to confirm soil changes and to locate soil boundaries.

4. *Coding Soil and Land Characteristics.*—All the various soil and land characteristics are described and coded. A brief tabulated summary of these characteristics and their codes is given in Appendix I of this paper. An example of the coded characteristics is described thus:



All soil characteristics are coded above the line and all land characteristics are coded below the line. The coded characteristics are always written in the same order so that the code can be readily understood by anyone knowing the symbols. In addition to the coded data a description of the soil profile, vegetation or cropping history and points of general interest should be made at each soil pit.

5. *The Land Classification.*—The land capability classes have been defined and each soil pit or auger-boring is allocated a class which is assessed by examination of the criteria and determining which characteristic is limiting. The criteria for each class has been arrived at by long use of the system and a sound application of practical farming. Brief definitions of the land capability classes and some of the important criteria are given in Appendix II. Once all homogeneous areas have been allocated classes and their boundaries checked, the areas of the land classes and mapping units are calculated in the office with a planimeter.

Discussion and Conclusion

The most important observation which can be made in considering the application of this system to cane farming is that cane farming is a class VI practice; i.e. being a perennial crop it is found growing at sustained productivity on classes I, II, III, IV, V and VI land. Sugarcane is also found on class VII land but the profitability of this practice may be questioned. Despite the fact that cane is found growing on most land classes the use of the land classification system is thought to be very worth while because the various land capability classes or grouped classes should be receiving different managerial treatments, and different soil and water conservation techniques.

To cite but a few obvious examples: classes I, II, III and IV land on slope are all capable of being worked by wheel tractors. Class VI land on slope invariably requires crawlers and class VII land would require animal draft. All class IVw and V land required for cane planting should be drained and will require the most careful layout and management. Classes II and III land on texture might be subject to wind erosion and therefore require special considerations when ploughing out and re-establishing cane. Different varieties will be found more suited to different land classes. Shallow soils will be more prone to drought and more difficult to irrigate.

The list is almost unending, but the important point is that only by mapping these land classes or at least recognising their existence can the remaining three basic steps in farm planning be efficiently carried out.

In the assessment of the possible courses of action the land capabilities must be considered; so too should the resources of labour, capital, markets, the findings of agronomic research, economics, possible trends in labour saving devices and mechanization. It is the farmer who should think on these things. The farm planner is there to help him and to see that all possible courses of action are covered. It is not his job to meddle or to take away the initiative and the individuality of the farmer, but rather that he should assist in developing the ideas of the farmer to best advantage. The farm planner should certainly inform the farmer of all the findings of agronomic research and draw on his own experience in assisting other farmers under similar conditions.

The planning should be done for sustained and economic production in a logical sequence of development. The plan should be within the capabilities of both the farm and the farmer. It should be flexible enough to be changed with changing economic conditions. All sections or enterprises within the farm should form an integral part of the whole. Each should pay its way. The individual farm plans should also form an integral part of a much broader regional plan.

All roads and other forms of access should be aligned on an efficient topographical layout. Water should be conserved and used where possible or provision made for its safe disposal.

The Government Soil Conservation Department provides loans and subsidies on numerous projects which, on a long term basis, are for the benefit of the land or the community that farms the land. Full advantage of this service should be taken at the planning stage so that deserving projects may be approved in good time. Legislation has also had to be introduced by the Government to safeguard the community and the land against known undesirable practices. Attention should be drawn to the existence of this legislation where applicable and the farm planned to respect the law.

The final stage of farm planning is the practical application of the plan in the field. It includes the correct phasing of the different stages of development and complying with the various conditions and specifications as laid down in the plan. No plan can be complete. Part of the implementation must be to keep abreast with the findings of research, modern trends and changing markets. The farmer should continue to plan ahead. He should improve the things he can improve, accept the things he cannot and have the wisdom to know the difference.

APPENDIX I

A Summary of the Fundamental Land and Soil Characteristics and their Code Symbols

A. Soil Characteristics

1. *Effective Depth.*—This is the depth of soil that can provide a medium for root development, retain available water and supply available nutrients.

Symbol	*Descriptive Term*	*Range*
1	deep	more than 60″
2	moderately deep	36″ — 60″
3	moderately shallow	20″ — 36″
4	shallow	10″ — 20″
5	very shallow	less than 10″

2. *Soil Texture.*—This is assessed by working the moistened soil in the hand.

Symbol	*Texture*	*Definition*
A	sand	more than 85% sand
X	loamy sand	80% — 85% sand
B	sandy loam	less than 20% clay 50% — 80% sand
C	sandy clay loam	20% — 30% clay 50% — 80% sand

Symbol	*Texture*	*Definition*
D	clay loam	20% — 30% clay less than 50% sand
E	sandy clay	more than 30% clay 50% — 70% sand
F	clay	30% — 50% clay
G	heavy clay	more than 50% clay

Where gravelly, stony, bouldery or rocky conditions in the plough zone hinder or prevent cultivation, the following symbols precede the surface texture symbol:

Symbol	*Description*	*Significance*
g	gravelly or stony	hinder cultivation
s	very gravelly or stony	prevent cultivation
b	bouldery	hinder cultivation
v	very bouldery	prevent cultivation
o	outcrops	hinder cultivation
x	extensive outcrops	prevent cultivation

3. *Permeability.*—The ability cf the soil to transmit air and water. It must not be confused with infiltration. Since it is not practical to measure permeability in every soil examined it must be assessed and described qualitatively by observing texture, colour and other soil properties.

Symbol	*Permeability*
1	relatively impermeable
2	severely restricted
3	restricted
4	moderately restricted
5	good
6	rapid
7	excessive

4. *Limiting Material.*—This refers to the nature of the material that limits the effective depth.

Symbol	*Description*
C	relatively impermeable clay
H	cemented hard pan or clay pan
L	laterite
M	periodically waterlogged horizon into which roots are unlikely to extend
Z	gravel
R	hard or relatively unweathered rock
W	weathered or partially weathered rock

5. *Physical Characteristics of the Surface Soil.*—This refers to soils heavier than a loamy sand, particularly those of unstable structure and porosity and greyish or yellowish in colour which frequently have a tendency to seal and compact at the surface under cultivation. High intensity storms and bad management can also induce these unfavourable physical conditions.

Symbol	*Description*
t_1	slightly unfavourable conditions
t_2	unfavourable physical conditions

6. *Colour of Upper Sub-soil.*—moistened reds of about ½" diameter should be compared with standard colours of a Munsell colour chart. The Munsell colours are grouped for coding.

Symbol	*Colour Description*
1	all reds
2	reddish browns
3	yellowish reds and reddish yellows
4	browns
5	grey browns
6	yellowish browns
7	yellows and olive yellows
8	mid grey
9	dark greys and dusky colours
10	all very pale colours

B. Land Characteristics

1. *Slope.*—Slope is measured with an abney level and is expressed as a percentage:

Symbol	*Percentage Slope*
A	0% — 2%
B	2% — 5%
C	5% — 8%
D	8% — 12%
E	12% — 17%
F	17% — 25%
G	25% and over

2. *Erosion.*—This term refers to accelerated erosion whether induced by man or resulting from natural factors.

Symbol	*Description*
1	no apparent erosion
2	moderate erosion
3	severe erosion
4	very severe erosion

3. *Wetness.*—Degrees of wetness are defined in terms of the expected frequency and severity of the wet conditions.

Symbol	*Description*
w_1	wet for relatively short and infrequent periods
w_2	frequently wet for considerable periods
w_3	very wet for most of the season

4. *Parent Materials.*—Symbols for all geological formations can be given, e.g.:

Symbol	*Parent Material*
Gr	granite
Do	dolerite
Sh	shales
Tms	Table Mountain sand stone
Al	alluvium

APPENDIX II

Brief Definitions of the Land Capability Classes and some of the Important Criteria

Class I.—*Land of stable structure that can be safely cropped annually for long continued periods.*

Soils must be moderately deep, well drained, sandy-loam or heavier with no limiting characteristics and on slopes between 0 per cent and 5 per cent.

Class II.—*Land that can be safely cultivated with protection measures or special management practices. It is subject to moderate limitations in use or risk of damage because of permanent land characteristics.*

Effective depth should be at least 20 ins. of sandy loam or heavier, well drained and on slopes not exceeding 8 per cent.

Class III.—*Land that can be cropped only in a fairly long rotation with a short cropping sequence, or land that requires elaborate conservation. It is subject to severe limitations.*

Sandy soils of adequate depth, severely eroded, wet for short periods, or slopes not exceeding 12 per cent.

Class IV.—*Land best maintained under perennial vegetation, but can be cultivated occasionally if handled with great care. It is subject to very severe permanent limitations.*

Shallow, severely eroded, wet or unfavourable physical conditions or slopes not exceeding 17 per cent.

Class V.—*Water courses or sources of water not normally subject to erosion. It is subject to very severe limitations and is best left under natural vegetation.*

Natural stream lines or land which is wet for most of the season.

Class VI.—*Land unsuitable for annual cropping.*

Very shallow, physical hazards such as boulders, uneveness, very severe erosion and on slopes not exceeding 25 per cent.

Class VII.—*Hill or Mountain land which can only be used for rough grazing or in some instances for forestry.*

Ploughing is prevented due to physical limitations or the land is on slopes in excess of 25 per cent.

Class VIII.—*Non-agricultural land.*

Very steep hills, rocks, sponges, etc. Suitable only wild life.

Dr. Cleasby said the paper introduced a new and very important subject. Each farmer knew his lands, but only when these lands were classified on paper could the farmer begin to realise their true potential.

He asked if this classification could be extended to help farmers to know the best lands for the different varieties.

Mr. Mann said if the classification was complete it should be possible to determine which land was suitable for sugar as against that which was unsuitable for this crop. If we map and describe every variable soil and land characteristic on any piece of land, then in the future we would find that one variety was more adaptable to a certain range of conditions.

Dr. Brett remarked that soil type was only one of the factors that influenced the choice of variety. For example, disease prevalence, proneness to flowering, and the use of irrigation were all factors influencing the choice of variety, and these factors were not themselves necessarily correlated with soil type.

Mr. A. C. Barnes said it was obvious that climatic considerations entered into planning of this description as also did exposure, which was not mentioned in the paper. Farm planning was the final stage of regional planning. Following on regional planning one came to district planning and finally to the individual farm planning. He asked the author to state, from his experience in Rhodesia, to what extent regional planning had been investigated in advance of land classification in relation to farm planning.

Mr. Barnes went on to say that he had previously called attention to the fact that the collection of essential data in relation to regional and farm planning was short of what was desired. The data was available from different institutions on each aspect and the planner had to visit each in order to prepare his final scheme. He therefore suggested a central organisation for collecting this essential data.

Mr. Mann said that a certain amount of the effects of climate were revealed in the soil type formed under the various climatic conditions. All climatic data at our disposal was used when thinking of the final farm plan. Aspect was clearly demarcated on every farm plan and after studying the photos stereoscopically, drainage channels, high points and so on were transferred onto the plan. By merely looking at the final mosaic one could see what the aspect was and if one had a pit close at hand the slope was revealed as well.

Regional planning has only been done in those areas of Africa which were relatively undeveloped as far as access facilities were concerned. This regional planning was followed up as stated by Mr. Barnes by district planning and finally by farm planning. In a developed community as on the Natal coast where every farm was developed we had to accept the regional plan as it was. There might be isolated places where the plan could be improved but largely we were limited to planning each individual farm, and then integrate each farm plan into some sort of regional plan.

Mr. Wilson (in the Chair) referred Mr. Barnes to a recent Rhodesian Agricultural Journal in which was published a very comprehensive article on the Rhodesian regional planning.

Mr. Grice felt there was much room in the Industry for the use of much of the information given by the author. Another important question which was not mentioned, was the moisture retaining quality of the soil relating ultimately to the use of fertilisers and of course to the crop produced. The moisture retaining quality should be added for the guidance of those engaged in fertiliser advisory capacities.

Mr. Wilson said he considered that although farm planning as outlined in the paper might seem to appear far distant from our general practice in the Cane Belt, there was considerable scope for going through the routine of land classification and assessment of the potentials of the land in the Cane Belt. Until this was done, we did not know whether we were now making the best use of the land or not.

Growers possibly could make more money by going in for diversification, in which farm planning would be very valuable. The Experiment Station hoped to start next year to carry out individual planning investigations in a modest way in keeping with existing of equipment and staff although these limiting factors would no doubt be overcome in future. A private consultant was offering such a service but he felt the Experiment Station should eventually provide this service for the Industry as a whole if the demand arose.