XII. Fertility-Capability Classification

12.1. INTRODUCTION

Soil assessment is one of the important requisites in agricultural development. The suitability of the soil often determines the types of crop that can be cultivated successfully. Traditionally, the term "suitability" has been used in preference to the terms "fertility" and "productivity". The latter terms imply that adequate experimental and analytical information about the soils is required for assessment. Analytical data are relatively easy to obtain, but experimental data to correlate such information are gravely lacking. Hence soil assessment has been based mainly on field observations made by soil surveyors in the course of their surveys. The observations were mainly on the physical properties of the soils. Understandably, the system generated criticisms among the soil fertility specialists. However, in view of the various constraints which existed, the system has continued to be adopted by the majority of soil scientists working in the country.

This paper briefly reviews the evolution of the existing practices in soil suitability evaluation and suggests the use of more chemical data to supplement physical data as a future approach. An attempt to adapt the Fertility Capability Classification of Buol *et al.* (1975) to local conditions is made.

12.2. SOIL SUITABILITY EVALUATION – PAST, PRESENT TREND

Studies on soil classification in Peninsular Malaysia dates back to the early years of this century. However, it was in the 1950s that Coulter *et al.* (1956) and Acton (1966) and others from the Department of Agriculture conducted soil surveys with the objective of assessing their suitability for a particular crop prior to development. They assessed some of the major swamps and other areas for rice cultivation. Soil maps showing the principal textural groups were produced to accompany their finding.

Up to 1964, recommendations on soil suitability were mostly done on an ad hoc basis by soil surveyors familiar with the soils on which the crop was to be grown. The scheme of soil suitability evaluation then was necessarily broad in approach because it was based on data collected from schematic reconnaissance soil surveys. It was aimed primarily at assessing suitabilities for the main economic crops of the country at that time. There were insufficient information to predict satisfactorily for crops with special requirements, such as padi and other short term crops. Certain assumptions were made in establishing the classification. The most important of these was that deficiency of any plant nutrient in the soils could be readily corrected by fertiliser application. However, nutrient deficiencies which were very acute, usually involving minor as well as major nutrients, were included in the classification as a limitation. This was because such conditions were regarded as far more difficult to diagnose and correct than the normal situation.

The soil suitability classification was mainly based on soil physical properties, such as the occurrence of massive laterite, rockiness, drainage status, consistency, structure etc. The soil chemical properties usually considered were pH, acid sulfate conditions and salinity, but the limits of these properties were not properly defined. Limitations to the suitability of the soils for agricultural development were divided into three groups viz. very serious, serious and minor limitations.

On the basis of criteria defined under each group, five classes of soils were established with respect to their suitability for development under agriculture.

By 1969, it was obvious that the system had to be expanded to accommodate more crops, particularly padi, oil palm, coconuts and cocoa. For a more comprehensive classification, the soil criteria for optimum crop growth on a sustained yield basis had to be reviewed in the light of more agronomic data. For this, a seminar was organised by the Economic Planning Unit of the Prime Minister's Department to discuss proposals for a soil suitability classification for Malaysia. As a result of the seminar, a soil suitability classification system was produced by the Department of Agriculture in 1970 (1970). The system was tested and found to be adequate for broad regional agricultural planning. However, refinements in soil parameter definitions had to be done in order for the system to be used for evaluating the suitability of a soil for particular crop or group of crops requiring similar field management. This led to the establishment of the

"Soil-Crop Suitability Classification for Peninsular Malaysia" (Wong, 1974). The classification was again based mainly on soil physical limitations (7 criteria out of 10) as these were felt to be generally more permanent and difficult to modify. The system is currently still in use by the Department of Agriculture. As most soil scientists in the country have been exposed to it, no attempt will be made here to describe the classification.

12.3. FERTILITY-CAPABILITY CLASSIFICATION

Soil surveyors in this country have been playing the dominant role in soil evaluation; employing the classification systems described above. Soil fertility specialists, on the other hand, prefer to evaluate the potential of the soil for crop production through soil tests and field experiments. The two groups of soil scientists have tended to mutually exclude each other thus resulting in different approaches to soil evaluation.

The major difference between the soil surveyors and the soil fertility specialists appears to be one of emphasis. Soil Surveyors place considerable importance on sub-soil features as these provide the major diagnostic criteria in the taxonomic systems being used in soil classification. The fertility group in general confines soil sampling to the plough layer or the upper 25 cm of the soil profile. Thus the two groups really see two different soils, while examining the same pedon. In North Carolina, USA, it has been found that 70% of the crop's yield variability due to soil could be attributed to topsoil properties. Similarly, there is a wide variability in the yield and performance of wetland rice within different soil classes of the Muda Plain in Malaysia. Very often, the variation in yield between mapping units was less than that within a single mapping unit. Such variations could be attributed to variations in the topsoil characteristics of the soils rather than to differences in subsoil features used by the soil surveyors to differentiate soils. This finding is not surprising with rice soils. The impervious plough pan developed in these soils due to the mode of cultivation, reduces considerably the subsoil influence on the performance of the crop.

Soil surveyors normally collect information to serve the needs of all potential land users over several decades, while the soil fertility specialists attempt to evaluate the soil with regards to the fertility needs of a crop or groups of crops for one to a few years. Thus the information required by the latter group is only a fraction of the total data gathered by the soil surveyors. Buol *et al.* (1975) therefore proposed the concept of the soil fertility capability classification to bridge the gap between the two sub-disciplines.

As part of the approach to soil evaluation in future, the authors attempted to adopt the classification of Buol *et al.* (1975) for Malaysian soils and have placed some of the common soils mapped in Peninsular Malaysia into the classification. It should be pointed out however, that the levels for the different criteria used in this exercise will be as given in Buol's paper. For local use, levels appropriate for Malaysian conditions should be used. These levels are presently not yet determined for most crops. It is also probable that the levels used should depend on the crop for which it is being considered.

12.3.1. Concept

A technical soil classification system, such as a fertility-capability system should be treated in the same manner as the land capability grouping, the engineering classification, wild-life suitability, woodland suitability and septic tank suitability soil classification systems. It is therefore one of the many possible interpretations which can be made from a soil survey report and map which is therefore the basic resource inventory. The National Soil Survey Section, Department of Agriculture, is currently preparing guidelines for the interpretation from the soil survey report of these different classifications. It must be emphasised that in no way does the Fertility-Capability Classification (FCC) replace or conflict with the various natural systems of soil taxonomy used in different parts of the world. It is designed to group soils of an area according to criteria that appear to have direct influence on the interactions of applied fertilisers and closely related fertility management practices.

It must be recognised that this technical grouping is limited in its use to the purpose it was established for and as such, should not be used for other purposes. The classification only provides a framework within which soils are grouped according to a few of their characteristics that have been selected to reflect their relevance to soil fertility management.

It is important that the technical system be simple. It has to be specific and concise enough to be easily understood. Hence only those factors considered to play a direct role in the interaction of fertilisers and soil materials are included. Factors such as rockiness, slope and presence of stone layer which may be important in cultivation practices are not considered.

The Fertility-Capability Classification (FCC) should not be used as the primary basis for soil mapping. Soil surveys should continue to provide the basic inventory from which the technical groupings can be made. The criteria used in the Fertility-Capability Classification of Buol *et al.* (1975) are so defined that soils can be grouped from their existing taxonomic placement in the Soil

Taxonomy (Soil Survey Staff, 1975) and from most other soil classification systems.

Since it is anticipated that the primary use of the FCC will be by soil fertility specialists in extrapolating their results from one field to another, an attempt has been made to provide guidelines that can be determined either in the field or with a minimum of laboratory work. Since it is obvious that many of the criteria are mutually exclusive, it should be pointed out that it is impractical to expect that all of the criteria will need to be tested at each site.

12.3.2. Format

Type and Substrata Type

The system consists of three levels, namely Type, Substrata Type and Condition Modifiers, (Table 12.1). The "Type" is the highest category. It is determined by the average texture of the plough layer or the surface 25 cm whichever is shallower. The particle size class used in the Field Legend for Soil Surveys in Malaysia (Paramananthan, 1987) which follows that used at the family level in the Soil Taxonomy (Soil Survey Staff, 1975) is used to define this category.

Although laboratory data is used to define the "Type", a field estimate of the textural class is adequate. The "Type" is denoted by the capital letter used in the Field Legend for the particle size class. The "Type" is thus the sixth symbol in the Field Legend.

The "Substrata Type" is the average texture of the subsoil that occurs within 50 cm of the surface. It is only used if the subsoil texture differs from that of the surface (Type) within the defined limits. If the texture of the plough layer and that of the subsoil to 50 cm belong to the same particle size class, then only the surface texture symbol (Type) is given. For example, if a soil had a sandy loam topsoil and sandy clay loam texture within 50 cm, then it would be designated AM (sandy loam over sandy clay loam). If however, the texture to 50 cm or more was uniformly sandy loam, then the soil would be designated A (sandy loam). The Substrata Type is the second symbol in the Field Legend.

Condition Modifiers

The "Condition Modifiers" indicate specific fertility and management limitations with different possible interpretations. Unless otherwise defined, the "condition modifiers" in general, refer to chemical or physical properties of the plough layer or upper 25 cm whichever is shallower. The upper 25 cm of the soil is used since most crops even perennial crops like rubber, oil palm and coconuts have most of their feeder roots within this depth.

Although the definition of these modifiers is written in rather specific terms, it is not necessary to obtain the characterisation with that degree of precision in order to use the system. The values assigned to each "condition modifier" may be changed according to the crop. Thus, for example, while most annual crops do not perform well when the aluminium saturation is over 60%, tapioca seems to adapt rather well to this limitation.

"Condition Modifiers" are used as lower case letters for coding the soils. The following discussion attempts to explain the rationale for each modifier and serves as a guide to the placement of soils when insufficient data exists. The lower case letters used have been selected hopefully to provide easy association with the condition described. The condition modifiers are not discussed in order of importance, but in alphabetical order.

- a: This modifier refers to high concentrations of aluminium which may be toxic to most crops. It also implies a high degree of phosphorus fixation by aluminium (Kamprath, 1970; Woodruff and Kamprath, 1965). Although 60% Al saturation is used to define this modifier, lower value should be used for crops which are sensitive to aluminium. Since the aluminium saturation is often altered by liming, the soil should be examined to a depth of 50 cm. This modifier will reflect the amount of liming required.
- d: This modifier refers to an annual period during which the soil is dry. It is defined to roughly correspond to the Ustic or marginally Ustic soil moisture regime. Sandy and loamy soils, which occur in areas where periods of low rainfall occur, are particularly prone to such conditions. The management of such soils would involve special techniques as they can become hard and massive when dry and are also prone to severe erosion if heavy rains occur immediately after the drought. The significance of this modifier to fertility management is not fully recognised, but there are indications of several consequences regarding nitrogen response and planting date relationships at the onset of the rains following the dry period (Hardy, 1946).
- e: This modifier is used to indicate soils having a very low cation exchange capacity in the plough layer. Depending on the method of determination used, three levels are indicated. Very low cation exchange capacities can be related to cation leaching and the absence of minerals having a reserve of nutrients. This modifier would also be related to the amount of liming the soil would require.

Table 12.1. Definitions of type, substrata type and condition modifier.

TYPE

Average texture of the plow-layer or surface 25 cm (10 inches) whichever is shallower.

S = Sandy topsoils – sands and loamy sands.
A = Coarse loamy topsoils – sandy loams
M = Fine loamy topsoils – sandy clay loams and loams
T = Silty topsoils – silt, silt loam, silty clay loam and silty clays
C = Fine clayey topsoils – sandy clay to clay
H = Very fine clayey topsoils – heavy clays (>60% clay)
O = Organic soil material to more than 50 cm depth

SUBSTRATA TYPE

Average texture of the subsoil to 50 cm (20 inches). This is only used if there is a textural change or hard root restricting layer is encountered within 50 cm (20 inches).

S = Sandy subsoils – sands and loamy sands
A = Coarse loamy subsoils – sandy loams
M = Fine loamy subsoil – sandy clay loams and loams
T = Silty subsoils – silt, silty clay, silt loam and silty clay loam
C = Fine clayey subsoils – sandy clay to clay
H = Very fine clayey subsoils – clay < 60%
R = Rock or other root restricting layer

CONDITION MODIFIERS

Determined in the plow-layer or surface 25 cm (10 inches) whichever is shallower unless otherwise specified (*).

R = Rock or other root restricting layer
a* = (Al toxic)
>60% Al saturation of CEC by (bases + unbuffered Al) within 50 cm.
>67% Al saturation of CEC by (cations at pH 7) within 50 cm.
>86% Al saturation of CEC by (cations at pH 8.2) within 50 cm or pH 5.9 in 1:1 water except in organic soils.
d* = (Dry)
Ustic or marginally ustic soil moisture regime, dry 60 consecutive days per year within 25-50 cm depth or less than 10 cm (4 inches) rainfall for two or more consecutive months.
e = (Low CEC)
<4 cmol/100 g soil by bases + unbuffered Al
<7 cmol/100 g soil by bases at pH 7
<10 cmol/100 g soil by cations + Al + H at pH 8.2
g* = Gley
Dominant soil chromas of ≤ 2 within 50 cm of the surface and below all A horizons, i.e. G or Gg occurring within 50 cm of the soil surface (Drainage classes 0, 1, 2 and 3) or saturated with water for 60 consecutive days in most years.
i* = (Fe – P fixation)
*Free Iron/% clay > 0.2 or hues redder than 5YR and granular structure within 50 cm of the surface.
k* = (K – deficient)
< 10% weatherable minerals in the silt and sand fraction within 50 cm
or exchangeable K < 0.2 cmol/100 g soil
or exchangeable K < 2% of Σ bases, if sum of bases >10 cmol/100 g soil
n = C/N Ratio
C/N Ratio of greater than 12 in the topsoil or upper 25 cm whichever is shallower.
s* = (Salinity)
> 4 dS/m of saturated extract at 25°C within 50 cm of the soil surface.
t* = (Thionic – Acid Sulfate)
pH in 1:1 water < 3.5 after drying and jarosite mottles with hues of 2.5Y or yellower and chromas of 6 or more within 50 cm.

Table 12.2. Fertility-capability evaluation of some Malaysian soils.

No.	Soil Series	Rating	No.	Soil Series	Rating	No.	Soil Series	Rating
1.	Ambun	CHaeik	51.	Kangkar	CHaik	101.	Pohoi	MCaek
2.	Anderson	Oak	52.	Kangkong	Tg	102.	Prang	Caek
3.	Apas	CHaeik	53.	Karamatoi	Saek	103.	Rasau	SMaek
4.	Apek	AMaek	54.	Katong	MCaek	104.	Rengam	Caek
5.	Baging	Sekn	55.	Kechai	Tg	105.	Rompin	Sekn
6.	Bakau	Hg	56.	Kemuning	MCaek	106.	Rotan	THg
7.	Baling	MCaek	57.	Kening	MCaeik	107.	Rudua	Sek
8.	Bangawat	Tgk	58.	Kranji	Hgns	108.	Rusila	Ogkn
9.	Batang Merbau	MCaek	59.	Kuala Barang	MCaek	109.	Sabrang	Tag
10	Batu Anam	Tae	60.	Kuala Kedah	Hg	110.	Sagu	Heik
11.	Batu Hitam	Tag	61.	Kuala Perlis	Cgkn	111.	Sahabat	MCk
12.	Bedup	MCaek	62.	Kuantan	Haeik	112.	Sedaka	THg
13.	Bekenu	Maek	63.	Kulai	T	113.	Sedu	Tagknt
14.	Benta	MC	64.	Kumansi	Cak	114.	Segamat	Haeik
15.	Bernam	Hg	65.	Kundor	Tg	115.	Selangor	Hg
16.	Beserah	Caek	66.	Laka	SMaek	116.	Sembrin	Ck
17.	Binjai	Hagk	67.	Lalat	Caek	117.	Semporna	CHk
18.	Briah	Tg	68.	Lambak	MCaek	118.	Senai	Caeik
19.	Bukit Temiang	AMae	69.	Lanas	AMa	119.	Serdang	Maek
20.	Bukit Tuku	AMaek	70.	Lanchang	CHak	120.	Serkat	Tgt
21.	Bungor	MCaek	71.	Langkawi	Hk	121.	Sibuga	Saek
22.	Buran	MCgk	72.	Lating	Tak	122.	Silimpopon	Saek
23.	Carey	Magk	73.	Linau	Hagknt	123.	Sitiawan	MCa
24.	Chat	TCa	74.	Loc Sambuang	Ck	124.	Sogomana	CHagkn
25.	Chempaka	Tak	75.	Lubok Itek	Hgk	125.	Stass	CHak
26.	Chengai	Tg	76.	Lubok Kiat	MCek	126.	Stom	MCak
27.	Dent	MCk	77.	Lubok Sendong	Hagk	127.	Subang	CAegkn
28.	Durian	Tae	78.	Luk	Oak	128.	Sungai Amin	Hegk
29.	Gading	Maek	79.	Lumpongan	Ck	129.	Sungei Buloh	Saek
30.	Gajah Mati	CRaei	80.	Lunas	AMaegk	130.	Sungei Mas	Haeik
31.	Gong Chenak	MCae	81.	Lundang	Ck	131.	Table	CHaek
32.	Guar	Tg	82.	Lunparai	Ck	132.	Tai Tak	MCaek
33.	Halu	Mg	83.	Malacca	CRaeik	133.	Talid	MCk
34.	Harimau	MCaek	84.	Malau	Aaek	134.	Tampin	Caek
35.	Hatton	Mk	85.	Marang	Maek	135.	Tampoi	MCaek
36.	Holyrood	AMaek	86.	Masai	MCaek	136.	Tandak	Haek
37.	Hutan	MCaek	87.	Merapoh	Tk	137.	Tangga	Haek
38.	Idris	CHag	88.	Merit	MCak	138.	Tanjong Lipat	Mak
39.	Jabil	Hagk	89.	Miri	Saek	139.	Tarat	Haeik
40.	Jakar	Cai	90.	Mukah	Oak	140.	Tebengau	Hg
41.	Jarangan	CHa	91.	Munchong	Caeik	141.	Telemong	Mek
42.	Jawa	Tgn	92.	Musang	Tae	142.	Telok	Cagk
43.	Jebong	Maek	93.	Nobusu	Ck	143.	Tepus	Tagk
44.	Jempol	Ca	94.	Nyalau	Aaek	144.	Tok Yong	Ck
45.	Jeram	MCaek	95.	Parit Botak	Tagkt	145.	Tongkang	Tag
46.	Jerangau	Caeik	96.	Pasir Puteh	Mek	146.	Tualang	Tag
47.	Kaki Bukit	CHak	97.	Patang	Ceik	147.	Tunggal	CRaek
48.	Kala	MC	98.	Penor	Oa	148.	Ulu Dong	MCaeik
49.	Kampong Kolam	Haeik	99.	Penyambong	TR	149.	Ulu Tiram	AMaek
50.	Kangar	Hg	100.	Pinianakan	97	150.	Yong Peng	Hak

g: This modifier reflects the general moisture content or drainage class in the soil. Soils having low values and chromas within 50 cm of the soil surface are subject to a high water-table or frequent flooding. Such soils should benefit from drainage. Such soils however, would be better suited for rice cultivation. The availability and loss of some nutrients would in some cases be affected by the moisture condition of the soil. The definition used roughly coincides with the Aquic soil moisture regime of the Soil Taxonomy.

i: This modifier is used to separate soils where phosphorus fixation by iron (and aluminium) compounds is of importance. The iron/clay ratio is normally used when chemical data is available but in the field, the hue and structure may be used. Very often, soils which are able to fix large amounts of phosphorus also have a low value and chroma. Most Oxisols particularly the Acorthox should fall into this category.

k: Soils having very low amounts of potassium bearing minerals could be improved by the addition of potassium fertilisers. This modifier attempts to separate such soils where potassium fertilisation would be beneficial.

n: This modifier separates those soils having a C/N ratio of more than 12 from those having a value less than 12. Soils having a high C/N ratio could give rise to the unavailability of added N by fixation due to microbial activity.

s: This modifier separates those soils with sufficient salinity to present problems for most crops. This criteria is based mainly on that by the U.S. Salinity Laboratory (1954).

t: This modifier is used to separate soils having acid sulfate characteristics within 50 cm of the soil surface. This corresponds approximately with the Sulfaquepts of the Soil Taxonomy.

Although only nine condition modifiers have been described, other additional modifiers can be used if

Table 12.3a. Summary of fertility ratings.

Number of soils having combinations of Type and Substrata Type (Possible Combinations)

Type and Substrata Type	No. of Profiles[1]	(%)
S	8	(5)
A	2	(1)
M	10	(7)
T	24	(16)
C	23	(15)
H	23	(15)
O	5	(3)
MC	28	(19)
AM	7	(5)
TC	1	(1)
CH	10	(7)
SM	2	(1)
TR	1	(1)
TH	2	(1)
CA	1	(1)
CR	3	(2)
	150 Profiles	(100%)

Table 12.3b. Summary of fertility ratings.

Number of soils having Condition Modifiers

Condition Modifier	No. of Profiles[1]	(%)
a	98	(65)
d	None	–
e	70	(47)
g	41	(27)
i	19	(13)
k	105	(70)
n	10	(7)
s	1	(1)
t	4	(3)
None	4	(3)

Table 12.3c. Summary of fertility ratings.

Number of profiles having Combinations of Condition Modifiers

No. of Combinations	Combination	No. of Profiles[1]	(%)
1.	None	4	(3)
2.	a	6	(4)
3.	ae	5	(3)
4.	aegk	1	(1)
5.	aei	1	(1)
6.	aeik	12	(8)
7.	aek	41	(27)
8.	ag	6	(4)
9.	agk	6	(4)
10.	agkn	1	(1)
11.	agknt	2	(1)
12.	agkt	1	(1)
13.	ai	1	(1)
14.	aik	1	(1)
15.	ak	13	(9)
16.	egk	1	(1)
17.	egkn	1	(1)
18.	eik	4	(3)
19.	ek	4	(3)
20.	ekn	2	(1)
21.	g	15	(10)
22.	g k	3	(2)
23.	g kn	2	(1)
24.	g n	1	(1)
25.	gns	1	(1)
26	gt	1	(1)
27.	k	14	(9)

necessary. For example, when saline soils are being evaluated, the sodium saturation should also be used.

At this stage, only one value for each condition modifier is used. However, when sufficient research data are available, these modifiers could be graded into serious, moderate and minor levels depending on how easily these fertility limitations can be corrected and how seriously each limitation will affect the crop concerned. Thus each soil mapping unit could then be placed into different Fertility-Capability Classes according to the number and degree of limitations it has.

12.4. EVALUATION OF SOME COMMON SOILS

An evaluation was done using the system on one hundred and fifty profiles (Table 12.2). These represented a wide range of soils developed on a variety of parent materials found in this country.

Sixteen of the possible 50 'Type-Substrata Type' combinations were found in the soils evaluated (Table 12.3a). The T, C, H and MC classes (silty, clayey and fine loamy textures) accounted for 65% of the soils. Twenty-seven different combinations of the 'condition modifiers' were found. The dominant combination was 'aek' which accounted for 27% of the sample. Three percent of the soils had no condition modifiers (Table 12.3b).

Of the nine different 'condition modifiers' used in the evaluation, potassium deficiency (k) occurred in 70% of the soils, while 65% of the soils had aluminium toxicity (a) and low cation exchange capacity (e) occurring in 47% of the soils. A wetness limitation (g) occurred in 27% of the soils studied. Thus the interpretation used in this paper implies that many of the soils would either have potassium deficiency, aluminium toxicity or a low cation exchange capacity as their major fertility related problem. The fact that 27% of the soils studied had all the three limitations together (a, e, k) also emphasises this problem.

The study indicates that while the taxonomic classification of the soils varied from Oxisols, Alfisols, Ultisols, Inceptisols and Spodosols, the fertility-related problems cannot be directly inferred from their taxonomic classification. Consequently, the natural taxonomy cannot be directly translated into this technical system. The specific fertility-capability parameters have to be thus evaluated independently of the taxonomy in each individual soil.

12.5. CONCLUSIONS

The proposed technical soil classification system groups soils according to criteria of significance to scientists in fertility and soil testing. It provides a mechanism whereby either existing soils data from soil survey reports or on-site examination of an area, can be used to group soils into reasonably homogeneous classes for the purpose of extrapolating fertility data. It must be emphasised that this guide in no way replaces soil testing which is necessary to monitor annual changes in soil-fertility levels due to management practices. It is further emphasised that the proposed system also does not replace the Soil-Crop Suitability Classification of Wong (1974). In fact, the fertility capability classification should be used to supplement this classification so that a more complete approach to soil evaluation can be made. It does however, enable the agronomists and the soil fertility specialists to group soils with somewhat uniform properties. This would allow extrapolation of soil test and agronomic information with greater confidence. This evaluation will also help to reduce the number of mapping units or soil series in a large area to a relatively few management classes.

Other potential uses of the system appear probable. For example, analyses of economic returns from fertiliser use can now be examined by groups of soils, expected to respond similarly to fertilisers. The system can be modified and improved on for specific crops by using different levels of limitations and grouping the soils into fertility-capability classes according to the number and degree of limitations the soil possesses.

The system of fertility-capability classification suggested here provides a system of soil grouping that relates directly to one use of the soil, that of managing soil fertility and thereby should provide a basis for the locational extrapolation of fertility management techniques. If incorporated in soil survey reports, it should offer a mechanism or information collected to be of greater value in soil fertility management.

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