Methodology proposed for land evaluation in the wet zone of Sri Lanka

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INTRODUCTION

1 : 1 *New Concepts of Soil Survey*

SOIL science was initiated by Dokuchaev in the vast plains of Russia, where Quaternary successive glaciations had completely washed away all previous soils. New soils were formed from newly deposited loess and glacial material and their formation started after the last Wurm glaciation (6,000 to 8,000 years ago), only one meteorological cycle was involved, soils were monogenical and a plain theory of zonality could be developed, in which *climate* is almost the only influencing factor on the podogenesis.

After some time a theory of azonality was formulated, in which the *parent material* is the dominant soil-forming factor. A podzol, for instance, cannot mature from a calcareous marl, whatever the climate and vegetation may be.

More recently (1948) the discovery of paleosols and complex soils due to polygenic evolution (Geze 1948) has shown that soil genesis was neither as simple nor as quick as in the Russian plains. Paleosols in the Mediterranean regions and in Africa are supposed to have been formed in the Tertiary period, more than 2 million years ago ; for such extremely weathered soils, *time* has been the main factor.

Still more recently Geomorphology has put forward the importance of the *land form,* which combines the effect of several factors and whose study is really the very basis of any good soil survey.

As soil science is mostly used for the development of new lands for agriculture, other factors than the mere "soil" have to be considered. This has become so obvious that, when speaking of soil today, one has to think of *ecological factors,* including all environmental factors, whose description is called *physiography.*

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So gradually " soil survey " has been replaced by " land evaluation survey " and the *land form* has proved to be the best approach to it. C. S. Stewart and G. A. Christian, of the CSIRO in Australia, began using a land-system approach, which was very successful, especially in reconnaissance surveys (Christian 1958). This method was used successfully in Lebanon, Senegal, Greece (Desaunettes 1964) and Iran (Vakilian and Mahler 1969).

In 1968 UNESCO organized a conference in Toulouse, at which this method was largely discussed and its methodology explained (Christian and Stuart 1968). The methodology of land evaluation surveys, on the other hand, was discussed and principles laid down at a recent conference in Wageningen (Smyth and AC. 1972) organized by FAO. It was recognized that only general principles and definitions could be given and that each specific case had to be treated according to local conditions and needs. From this meeting two interesting definitions can be quoted which clearly show the new concept of the ecological approach :

> *Land.* ' A tract of Land is defined geographically as a specific area of the earth's surface : its characteristics embrace all reasonably stable or predictably cyclic attributes of the biosphere vertically above and below this area, including those of the atmosphere, the soil and underlying geology, the hydrology, the plant and the animal populations and the results of past and present human activity, to the extent that these attributes exert a significant influence on present and future uses of the land by man. '
>
> *Land Evaluation.* ' The process of collecting and interpreting basic inventories of soil, vegetation, climate and other aspects of land in order to identify and make a first comparison of promising land-use alternatives in simple socio-economic terms. '

1 : 2 *Case of Sri Lanka*

The replacement of tea and rubber by more profitable crops, whenever and wherever it is economically suitable in the parts of the wet zone of Sri Lanka where these two major crops are grown, poses many problems. Some are of an economic nature and are outside the scope of this paper. Others are of a physical nature and the most important one is to know what are the best crops to be recommended on a specific tract of land. This is complicated by the very complex nature of the wet zone, where a very uneven and

highly-dissected relief, ranging from sea level up to more than 6,000 feet (2,000m), creates many varied land conditions, such as micro-ecological zones with their specific pattern of features (land form, soils, micro-climate, vegetation and *land use*). Last, but not least, man's influence has contributed for centuries to the modification of the already complicated pattern, especially through accelerated erosion caused since the last century by the planting of coffee and, later, tea.

Fortunately for us the geological formation is homogeneous throughout the Wet Zone and is composed of genesis with some minor mineralogical variations and occasional veins of quartz, etc. Consequently the soils are fundamentally similar and are mostly represented by the red-yellow podzolie group (Panabokke 1962) or Hapludult. Variations occur mostly in soil phases, such as a truncated profile due to erosion (especially in tea plantations), soil depth, soil gravels, stoniness, rockiness, slope, drainage and the like.

But, as relief is mostly responsible for the complexity of the wet zone, land form will logically be the best approach for any kind of land evaluation survey, and the *physiographic method,* which is universally recommended, has been adopted.

The practical realization of such a survey, on the other hand, is not so simple to tackle because results are requested as soon as possible and funds for the study are limited. In other words time and money are short, whereas conditions are such that it would require a very long time and a lot of money to complete a detailed study with the scale of 1/10,000 necessary for the land development. A reconnaissance study (scale 1/50,000 or even 1/25,000) is useless for this purpose. Available documents consist mainly of toposheets (1 inch = 1 mile, or 1/63,360 scale), sixteen chain maps (1/12,672 scale) and a new 1/25,000 air survey.

When all these factors had been taken into consideration a solution was formulated—the *sample area method,* in which each typical landscape or ecological region is sampled by means of a semi-detailed study of a representative part (sample area). The size of each sample area may vary according to physiographic features, but is usually about 9,000 acres (3,600 ha), which corresponds to the surface of an entire sixteen-chain map (scale 1/12,672).

For Land Development Planning, results obtained in a sample area are generalized to cover the corresponding ecological region. At the level of land development in the fields the generalization is done

through extension. Once the different land units are defined, described and classified, agricultural or forest extension officers are in a position to identify them and treat them according to the recommended techniques. This method is usually better than a detailed study because, in dense rubber plantations for instance, it is very difficult for an extension officer to locate himself exactly according to a detailed map.

METHOD

2 : 1 *Choice of sample area*

A general map of the natural regions of the wet zone (scale 1/253,440) was plotted from other documents :—

Ceylon Agroclimatic Regions—Dr. C. R. Panabokke (1969),
General Map of Sri Lanka (scale 1/253,440)—Survey Dept.,
Ceylon Mean Annual Rainfall (1997-1956)—Meteorological Dept.,
Generalized Geological Map of Wet Zone—Geological Survey Dept.,
Landform maps of the Hunting Survey groups,
Generalized Land Use Map of Ceylon—Survey Dept. (scale 1/253,440).
Topographic maps of Ceylon (scale 1/63,360)—Survey Dept.,

which delineate the different morpho-climatic or broad natural regions of the wet zone. In principle one sample area at least is taken in each of these natural regions. Sometimes significant physiographic differences of the landscape make it necessary to split certain regions into smaller sub-units according to the macro-landform. The field observations of the landscape and the delineations of the corresponding macro-landform on the toposheets where those features appear to be already represented were the basis used in drafting the map.

47 sample areas have been proposed for the main representative natural regions of the wet zone. Each sample area, as already seen, covers approximately one sixteen-chain map. As there are 410 such maps for the entire wet zone, the area to be surveyed is roughly 8 per cent. of the total surface. But, as forest reserves and rough broken mountainous lands are not suitable for diversification, they are discounted and the actual figure is thus higher. In fact it may be that some more sample areas will become necessary and their size may be conveniently and accordingly reduced.

2.2 *Photographic interpretation*

The interpretation of a new air-photo survey (1972/73, scale 1/25,000) is done according to a physiographic legend based on land form and geomorphology. Sri Lanka has been divided into three major geomorphological ensembles. 'The lowest peneplain of Sri Lanka surrounds the central hill country on all sides and is a flat sometimes gently undulating plain stretching down to the coast. It has an average height of less than 100 feet but rises inland to 300 or 400 feet above sea level. Rising from the inner edge is a steep step of about 1,000 feet in the middle peneplain with a maximum elevation of 2,500 feet above sea level, best seen on the south and east of the island. Within it and rising from it is another steep step of 3,000 to 4,000 feet which is the highest peneplain at a general level of 5,000 to 6,000 feet, but rising in places to 7,000 or 8,000 feet. Though deeply dissected by river valleys, these peneplains are recognized as such by the fact that the summits of the hills and ridges show a general accordance of level; remnants of higher erosion levels sometimes rise above them.' (Cooray 1972). In fact it is still more complicated than this schematic division suggests, owing to the many faults associated with the tectonic uplift of the mountainous massif. Sri Lanka is composed of many step-like surfaces at different elevations, each step representing a more or less dissected old surface (1) separated from the next one by a complicated pattern of hills and valleys (structural valleys as well as tectonic).

These facts being taken into account, a pragmatic classification of land units into five major land systems may be made which permits the delineation of tracts of land according to their major characteristics and in a way which is significant for land suitability :—

B .. Marine system with typically marine units, such as beaches, lagunas, lidos (2) dunes and associated units.

C .. Plain system basically composed of an undulating land and small hillocks (amplitude maximum 50 m) with occasional isolated hills which are mainly erosion remnants (Inselberg and Monadnocke).

D .. Hilly system composed basically of hills and ridges associated with more or less important surfaces of dissected old plateau-like units and erosion remnants.

(1) Sometimes called "Arena" (Vithanage 1972).

(2) Sand stretches between the set and the lagunas (Derruau Traite de Geomorphologie).

E .. Hilly and mountainous system, inter-grade between D and F.

F .. Mountainous system (elevation above 1,200 m or 4,000 feet).

An alluvial A system groups all alluvial deposits and formations which are not characteristic units of the previous systems. In fact a river valley starts in the mountain and ends in the sea. It is difficult systematically to attribute a portion of the valley to a given system.

The alluvial system is divided into :

A1 .. Alluvio-marine sub-system composed of marshes and swamps, sometimes cultivated as paddy fields, with bog soils. Such units are mostly found close to the sea, in the B and lower part of C systems.

A2 .. Alluvial sub-system represented basically by river valleys (river beds, river banks, terraces and levees). Soils are either alluvial or gley soils. Such units are frequent on the C and D systems, but also present in E and F.

A3 .. Alluvio-colluvial sub-system typically composed of all the many interhills, mini-plains or basins, almost universally used as paddy fields. As a consequence the soil is a gley soil. Different kinds of interhill mini-plains are mostly frequent in the D and E systems.

A4 .. Closed alluvial sub-system, grouping all endoreic (1) low areas such as swamps (without marine influence), closed basins and low-lying plains. Units tof this sub-system are scattered all along the main systems.

A miscellaneous system, M, is provided for miscellaneous units such as bluffs, rock outcrops, river beds, lakes, settlements, badlands, scree-fans, etc., summits and deep V-shaped gorges and gullies.

This method of classification of the somewhat complex landforms was based on repeated systematic interpretation of aerial photographs of different sample areas, coupled with regular field checking and correlation of field data to supplement the interpretations. Improvements to the legend were made as the work progressed and as more

(1) Internal drainage without outlets.

and more information became available from the study of new sample areas, until finally a comprehensive physiographic legend was obtained. (see annex).

Definitions of all units have to be precise enough not to permit any overlapping, and all natural units must be represented so that no gap is permitted. The legend stays open to admit eventual new units. Furthermore, great care must be taken to make each unit significant to land suitability for agriculture.

2.3 *Field work*

Each unit is carefully described on an observation sheet—general features concerning the physiography and environmental characteristies, as well as a short but careful description of the soil profile, are recorded. Soil phases, such as rockiness, erosion and slops, depth of the soil and drainage rating are noted according to a Land Classification based on Dr. Smith's recommendations (Smith 1971) (see page 6 table of Land Classes).

Each physiographic unit may contain one, two or more land classes, which may be mapped*. In some cases, however, the percentage of a land class may be more simply noted if the soil phase is easily recognizable on the spot by the land developer, and its surface area is deduced from the percentage attached to each mapped land unit for the land palnner.

A small physiographic unit, such as a turtleback-shaped hillock, may contain 15 per cent. of A1 land (slope 20 per cent), 55 per cent. of A2.1 land (slope 20 per cent. to 50 per cent.) and 30 per cent. of A3.1 land (slope 50 per cent. to 75 per cent.). Each of these three categories is significant to land development since the initial input for plantation will vary for each of them. Present land use, natural vegetation and possible development of the land are also indicated on the observation sheet.

Each unit may contain one or several *inclusions*. Such an inclusion may be either a different soil phase (e.g., slope, rockiness, etc.) or a smaller unit covering less than 15 per cent. of the total surface of the main unit and too small to be delineated easily. Complexes of two different soils may also be described, such as alternations of small rocky *thalwegs* and *intervaves* where the soil is deep.

* A separate "Land Capability Survey" is being undertaken, with the co-operation of the Survey Department, for the mapping of Land classes, according to Dr. Smith's legend, at the scale of a sixteen-chain map.

Photographs may also be corrected on the spot. In principle at least one observation sheet is filled in for each unit: in fact several may be necessary to record different categories of soils, such as the slopes of hill units in very dissected areas.

Samples of soil are taken from each representative profile and sent to the laboratory. A systematic and thorough sampling of all units of the same kind is not required if a careful selection of physiographic units has been done and the pattern of land forms and associated soils is readily known ; all units of the same kind are very similar in their characteristics and the sampling of one of them is usually sufficient. Discovering the 'key to the soil pattern enigma' is one of the fascinating aspects of soil survey : this is facilitated by using the physiographic approach, since each similar land unit, if it has the same pattern of substratum, age, geomorphological history, supports also the same soil—at least when man has not interfered in the process.

TABLE OF LAND CLASSES

LEGEND

A class : Sloping Lands (hills and mountains)

Note.—Bench terraces for plantation crops have to be included in the general slope sasessment.

A1 *Gentle slopes and flats*—All crops possible

	Slope		*Soil Depth (including C)*		*Rocks and Stones*	
	< 20%	>	1.00 m.	<	25%	

A2 *Gentle to moderate slope*

	Slope		*Soil Depth*		*Rocks*	
A2–1	20%–50%	>	1.00 m.	<	25%	
A2–2	< 20%	>	1.00 m.		25%–50%	

Plantation crops. Fodder pasture and forestry.

A3 *Moderate to steep slopes*

	Slope		*Soil Depth*		*Rocks*	
A3–1	50%–75%	<	1.00 m.	<	25%	Good drainage, water table deeper than 1.20 m.
A3–2	20%–50%	<	1.00 m.		25%–50%	
A3–3	50%–75%	<	1.00 m.		25%–50%	

Pasture, forestry (rubber, cloves, nutmeg may be included).
Marginal for exacting plantation crops.

A4

	Slope		*Soil Depth*		*Rocks*
A4–1	> 75%	>	1.00 m.	<	50%
A4–2	< 75%	<	1.00 m.	<	50%
A4–3	< 75%	>	1.00 m.	>	50%

Conservation forestry, eventually pasture.
(Tea and rubber may, in fact, grow well on such lands but whether they are economic or not is another question.)

2 : 4 *Laboratory Work*

Each sample is dried and strained through a 2 m/m sieve to discard the coarse elements (gravel). The sample is weighed before and after straining and the percentage of the coarse elements is calculated.

Different analysis or determinations are than made on the fine fraction of the soil :—

(*a*) Mechanical analysis with the pipette method or the hydrometer, for the determination of percentages of clay, silt and sand.

(*b*) Measures of pH with water and potassium chloride.

(*c*) Determination of pF at 1/3 bar and 15 bars, for the calculation of the water-holidng capacity, which is one of the most basic characteristics of soils.

(*d*) Analysis of the exchangeable cations (Ca-Mg-Na. Mg and H).

(*e*) Determination of phosphorus (Truog's).

(*f*) Lastly, use of borophosphate dithionyde method for the determination of iron, aluminium and humic acids.

2 : 5 *Office work*

After the necessary corrections have been made on the aerial photographs a sixteen-chain map is drafted delineating the different units, the photographs being transcribed on to the corrected map.

Each typical standard unit is then carefully described and eventually sketched. Soils are sorted and classified according to a practical system of tentative soil series which takes into account the relevant features significant to agriculture, especially the total water-holding capicity and the pH.

3. *Interpretation*

Tables of land suitability are computed for each sample area. 'The land suitability is the fitness of a given tract of land for a definite use. Differences in the degree of suitability are determined by the relationship, actual or anticipated, between benefits and required inputs associated with the use on the tract in question.' (Glossary of the FAO meeting.)

Two kinds of land suitability are recognized:

(1) Land suitability in its present condition (without major improvements).

(2) Potential land suitability after major improvements (such as terracing, basic fertilization, stone picking, etc.) have been made.

After a thorough inspection of the sample area by the Survey Team and the Agronomy Team, during which the land suitability of each unit for different types of crops is discussed and scrutinized with the help of past experience and possible experimentation, land evlauation tables are made.

All crops suitable for cultivation in the climatic conditions of the area are listed in a table setting out their suitability, the relative amount of input necessary for the land development, and the nature of works to be carried out for such development.

For instance, the unit E31T2 of the Nilambe/Atabage sample area is:—

E .. Hilly and Mountainous system
31 .. Straight hill slope
T .. Tea cultivation
2 .. Soil series No. 2.

Such a unit covers a surface of 100 acres consisting of 45 per cent. of A1 land and 55 per cent. of A2.1 land, and represents a surface of 396 acres and 485 acres respectively on the corresponding land zone (or natural region).

Major possible crops include:—

P1 .. Coffee (arabica only)
P2 .. Pepper, Mulberry
P3 .. Coconut (up to 700 m)
P4 .. Tea (VP Tea).
G .. Improved mixed gardens (introduction of valuable species according to micro-climates and/or replacement of non-economic ones. Better management).

Fod .. Fodder crops (for cattle breeding)
S .. Sugar Cane
For .. Forest (*Pinus Hondurensis*)
R .. Grazing (Guinea grass)
N .. Natural vegetation (protection)
P .. Paddy (or vegetables and paddy according to the water availability).

The possibility of each crop for the two phases of E31T2 unit is examined in terms of :—

(*a*) Capability.

A unit which is naturally suited to a particular cultivation without any major improvement is quoted as Ni (no input) in the appropriate column.

(*b*) Potentiality.

When the prospect of a reasonably good yield is sure, and in that case only, the work necessary to achieve the plantation is indicated, as well as the initial corresponding input.

Works

C = Contour cropping (slope 20 per cent.)
B = Benches (slope 20-50 per cent.)
T = Terraces (slope 50-75 per cent.)
f = Fertilization
F = High fertilization and soil correction
S = Stone picking
P = Protection works for the control of erosion
U = Uprooting of existing forest or plantation trees.

Input

Li = Low input (including C, f)
Mi = Moderate input (including B, U or S)
Hi = High input (including T, P or a combination of several other works).

The land suitability table reads in the following way :—

Unit	*Land*	*Surface*	P1	P2	P3	P4	G	S/Fod	For	R N
E31T 2	A1–45%	396	Li/Cf	Li/Cf	Li/Cf	Ni	Li/Cf	Li/Cf	Li/C	– –
	A2–1–55%	485	Mi/Bf	Mi/Bf	Mi/Bf	Ni	Mi/Bf	Mi/Bf	Li/B	– –

Note.—In the case of this unit, R (Grazing) and N (Keep under natural vegetation) are not recommended because much better uses can be made of it.

SUMMARY AND CONCLUSIONS

Modern soil science applied to agriculture uses physiographic methods for land evaluation. This method, combined with a sample-area system, makes possible the assessment of the lands of the Sri Lanka (Wet Zone) for their best agricultural suitability.

Lands are mapped with a scale of 1/12,672 and land evaluation tables give their suitability for all possible crops, as well as the necessary input and land improvements for each specific crop.

With such a Land Evaluation Survey, any kind of land planning is simple and economic prospects may be computed on a realistic basis. As far as land development itself is concerned, the training of skilled extension officers is necessary to make full use of the survey.

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APPENDIX I

PHYSIOGRAPHIC LEGEND FOR LAND EVALUATION (WET ZONE OF SRI LANKA)

A—*Alluvial System*

A1 Alluvio-marine sub-system

A11	Marshes (Tree vegetation—ex-mangrove)	bog soils
A12	Swamps (low vegetation)	
A13	Low-lying lands (cultivated swamps)	associated
A14	Slightly undulating low-lying lands)	

A2 Alluvial sub-system

A21	Narrow river valley (50m–2m/m on airphoto 1/25,000)—Gley soils	
A22	Wide river valley, flat to gentle slope (<8%)	
A23	Undulating to rolling river valley (slope 8% to 16%)	Alluvial soil
A24	Levees	

A3 Alluvio-colluvial sub-system

A31	Narrow, isolated interhill miniplain	gentle slope <8%
A32	Wide, isolated interhill miniplain	
A33	Ramifield interhill miniplain	
A34	Undulating (slope 8% to 16%) to rolling	

A4 Closed Alluvial sub-system

A41	Narrow depressed area
A42	Closed basin
A43	Marsh (without marine influence)

B—*Marine System* (0–10m elevation range)

B1 Beaches

B2	Dune system
B21	Dunes
B22	Flat, sandy deposits (usually coconut plantations)

B3 Lidos

APPENDIX I—PHYSIOGRAPHIC LEGEND FOR LAND EVALUATION (WET ZONE OF LANKA)—(*contd.*)

C—*Undulating plain system* (elevation 5–60m)

C1 Undulating to gently rolling land

- C11 Undulating land (slope <8%) Red-yellow
- C12 Rolling land (slope 8%–15%) Podzolic + lateritic gravels

C2 Hillocks (relief < 60m. amplitude)

- C21 Isolated hillock
- C22 Undulating land (slope <8%) with hillocks (relief amplitude <60m)
- C23 Rollong land (slope 8%–15%) with hillocks

C3 Occasional isolated hill

- C31 Straight hill slope (inclined, flat and even surface).
- C32 Complex slope (convex, concave, sigmoidal or more complicated slope).
- C33 Corrugated slope (longitudinally straight, the slope is laterally an alternation of thalwegs or gullies and interfluves, or convex surface between two thalwegs.)

C4 Erosion remnants (rockiness >50%)

- C41 Monadnocks (slope <100%)
- C42 Inselbergs (slope >100%)
- C43 Rocky heaps

D—*Hilly System* (elevation range 50–350 m.)

D1 Undulating to gently rollingl and

- D11 Undulating land
- D12 Undifferentiated ridges (slopes cannot be delineated in a pattern of parallel ridges of small relief amplitude).

D2 Hillocks

- D21 Isolated hillocks
- D22 Undulating land + hillocks
- D23 Rolling land + hillocks
- D24 Rolling hillocks and minihills (dissected plateau).
- D25 Foothill hillock and Lanferes.

D3 Hill slopes (relief amplitude 50 to 300m.).

- D31 Straight slopes (no variation of slope).
- D32 Complex slope (concave or convex, sigmoidal, etc.).
- D33 Corrugated slope (straight longitudinally, rolling laterally alternation altenation of thalwegs and interfluves).
- D34 Dissected slope, straight longitudinally, but dissected by erosion.
- D35 Corrugated and complex.
- D36 Dissected and complex
- D37 Artificially terraced for paddy fields.
- D38 Complex,corrugated and dissected.

D4 Erosion remnants

- D41 Inselberg
- D42 Monadnocks
- D43 Rockheaps

E—*Hilly and Mountainous System* (elevation range 300 to approximately 1,200m.).

E1 Plateau/peneplain

- E11 Undulating plateau/peneplain
- E12 Undifferentiated ridges (slope cannot be delineated).
- E13 Rolling area

E2 Hillocks

- E21 Isolated hillocks(maximum amplitude 60m.).
- E22 Undulating to rollingland +hillocks plain mainly).
- E23 Hillocks in rolling pattern (plateau/peneplain).
- E24 Foothill hillocks and lanieres (long-inclined and possible meandering ridge tonguing out from a versant).
- E25 Ridges with a relief amplitude of 60m. maximum.
- E26 Interhill rolling area. (small unit neither peneplain nor plateau).

E3 Hill and Ridge slopes (amplitude 60–300 m.).

- E31 Straight hill slope.
- E32 Complex hill slope.
- E33 Corrugated hill slope.
- E34 Dissected hill slope.
- E35 Complex and corrugated slope.
- E36 Complex and dissected slope.
- E37 Terraced for paddy fields.
- E38 Complex, corrugated and dissected.

E4 Mountain slopes (amplitude 300 m.).

- E41 Straight mountain slope.
- E42 Complex mountain slope.
- E43 Corrugated mountain slope.
- E44 Dissected mountain slope.
- E45 Complex and corrugated.
- E46 Complex and dissected.
- E47 Terraced for paddy
- E48 Complex, corrugated and dissected.
- E49 Rough broken and rocky slope complex slope including many cat step gullies, small cirque or amphitheatre, etc.

E5 Talus slope (piedmont slope with a complicated convex shape and an accumulation of boulders, usually situated under a rocky bluff). Rockyness <50%.

- E51 Gentle talus slope
- E52 Steep talus slope (slope > 50%).

E6 Erosion remnants

- E61 Inselberg
- E62 Monadnocks

E7 Bench on slope (natural terrace) or cirque bottom (amphitheatre).

- E71 Flat to undulating
- E72 Undulating to Rolling
- E73 Cat step (locally limited step on a slope)
- E74 Corrugated break on a slope

} Small units uneasily delineated on slopes such as rough broken slope.

F—*Mountain and Plateau system* (Only *part* of the highest peneplain. Elevation usually above 1,200m. or 4,000 feet).

F1 Plateau/peneplain

- F11 Flat Plateau
- F12 Undulating plateau/peneplain
- F13 Rolling area (peneplain/plateau)

F2 Hillocks

- F21 Isolated hillocks
- F22 Undulating to rolling land + hillocks (mainly plain).
- F23 Rolling hillocks area (mainly plateau).
- F24 Foothill hillocks and lanieres.
- F25 Ridges (amplitude < 60m.)
- F26 Limited interhill rolling area (small unit neither peneplain nor plateau).

F3 Hill slopes (relief amplitude 50–300 m.)

- F31 Straight slope
- F32 Complex slope
- F33 Corrugated slope
- F34 Dissected slope
- F35 Complex and corrugated slope
- F36 Complex and dissected slope
- F37 Terraced for paddy
- F38 Complex, corrugated and dissected slope.

F4 Mountain slope (amplitude > 300m.)

- F42 Complex
- F43 Corrugated
- F44 Dissected
- F45 Complex and corrugated
- F46 Complex and dissected
- F47 Terraced for paddy
- F48 Complex, corrugated and dissected
- F49 Rough broken land slope (slope without any definite pattern, but with a bumpy, tormented and complicated shape).

F5 Talus slope

- F51 Gentle talus slope (slope < 50%)
- F52 Steep talus slope (slope > 50%)

F6 Erosion remnant

F7 Bench on slope or cirque bottom.

- F71 Undulating
- F72 Rolling
- F73 Cat step
- F74 Corrugated break on a slope.

M—*Miscellaneous System* (Common to all other systems)

M1 Bluff (slope > 100%, rockiness > 60%)

M2 Rock outcrop (sheer rock, slab rock)

M3 Settlements (more than 20% of the surface occupied by buildings)

M4 River beds

M5 Lakes

- M51 Lagunas (brackish water)
- M52 Lakes and tanks (sweet water)

M6 Miscellaneous land types.

- M61 Bad lands (alternation of gullies on a very dissected surface).
- M62 Rough, broken and rocky land. (Steep F49 with more than 50% rocks).
- M63 Mountain scree (more than 50% boulders and steep slope).
- M64 Earth-slide scars.

M7 Thalwegs, V shaped gorges and gullies

M8 Convex and sharp summits or crest lines.

- M81 Sharp summit and crest line (soils are usually shallow and rocky)
- M82 Rounded summit (may have deep soil).

M9 Flat and plateau-like summits (small units)

- M91 Flat to undulating summit
- M92 Mountain pass

} Soils may be deep

Colombo, July, 1973