*South East Asian Studies*, Vol. 16, No. 4, March 1979

# A Format for Field Soil Records for Computer-Based Data Management System

Hisao FURUKAWA* and Takashi KOSAKI**

## Introduction

We are trying to set up a soil information system which allows rapid retrieval of soil data stored in various forms, e.g., field soil records, analytical data, soil maps, etc. The establishment of this system requires the provision of several modules, one of which, a format standardized for field soil records and easily transposable to a computer-compatible form is described herein. This format has been revised through experience gained mainly in west Japan.

A standardized format has to meet ends which are self-conflicting. It should provide items and terms which can convey the framework which the survey planner has in mind, and thus tends to fix and confine the framework of surveyors' observation. On the other hand, the surveyor's standpoint should be free and flexible when handling a very complicated matter like a soil. Is it then useful to follow a standardized format? The answer is "Yes." From detailed descriptions of soils found in various landscapes, a soil surveyor can gain a picture of the intricate interactions among soil formers. But he has to recollect and integrate all the soil individuals in order to draw a soil distribution pattern; and he has to analyse and simplify all the variations of soils into a few governing factors in order to extract substantial soil units. These processes have hitherto often been hampered by several factors, the most important of which in practice is the surveyor's inability to memorize all the details of the individual soil in relation to the site of the soil. It has been necessary, therefore, to cut off the trivial details at appropriate levels of soil recognition. This confinement also applies in data processing by manual procedures. The use of a computer as a data stocker and processor can release this confinement to a large extent. Large amount of data can be stocked effectively for the recognition of soils, provided that the observed items reflect the substantial soil conditions and the terms are stated with clear limits. The possibility of grasping all the details that fall within the scope of the field soil survey will allow a reappraisal of soil maps, soil units used therein and concurrent theories on soil genesis and distribution pattern.

We are aiming, then, to establish a common data bank in which presently available soil data is collected, to which further data can be deposited, and from which anybody can retrieve whatever data he needs. This is the background to our trial.

* 古川　久雄, The Center for Southeast Asian Studies, Kyoto University
** 小崎　　隆, Faculty of Agriculture, Kyoto University

## I Requisites for Data Recording

The field soil records consist of site and soil profile records. These records should be stored in a computer-based data bank. The requisites for data recording are that these be recorded in a standardized and coded form in the field, that the coded cards be easy to read for later manual sorting, and that they should have enough space for free remarks.

The first requirement is to reduce the laborious task of recoding the uncoded records. To meet this, Hazelden *et al.* (1976) proposed a proforma compatible with 80-column punch cards. They take almost all field soil records in coded form in the field using an aide-memoire. In our experience, however, this method evidently reduces the efficiency of the field survey, because we have to search for a code number for a particular property from among many. In addition it is not very easy to read the survey card unless these many codes are completely memorized. The tick box method proposed by Lee *et al.* (1976) was easier to handle, since all possible terms were given on the card. The disadvantage of their method, however, is that little space is available for free or additional remarks. This format, therefore, cannot accommodate uncoded records, such as are often encountered in soil surveys in different localities from those for which the manual and the format were primarily designed.

After several trials, we concluded that the format should meet the following requirements: 1) the code number for properties should appear on the card to facilitate recording and reading; 2) properties like horizon names, color, texture, cutan nature, and mottle, etc., which are indexing characteristics for soils, should be written in uncoded form; 3) the columns allocated for each horizon should be kept blank in order to give enough space for additional remarks and for non-standardized uses; and 4) site file and profile description file should be cross-referenced through common indices.

## II A Format for Field Soil Records

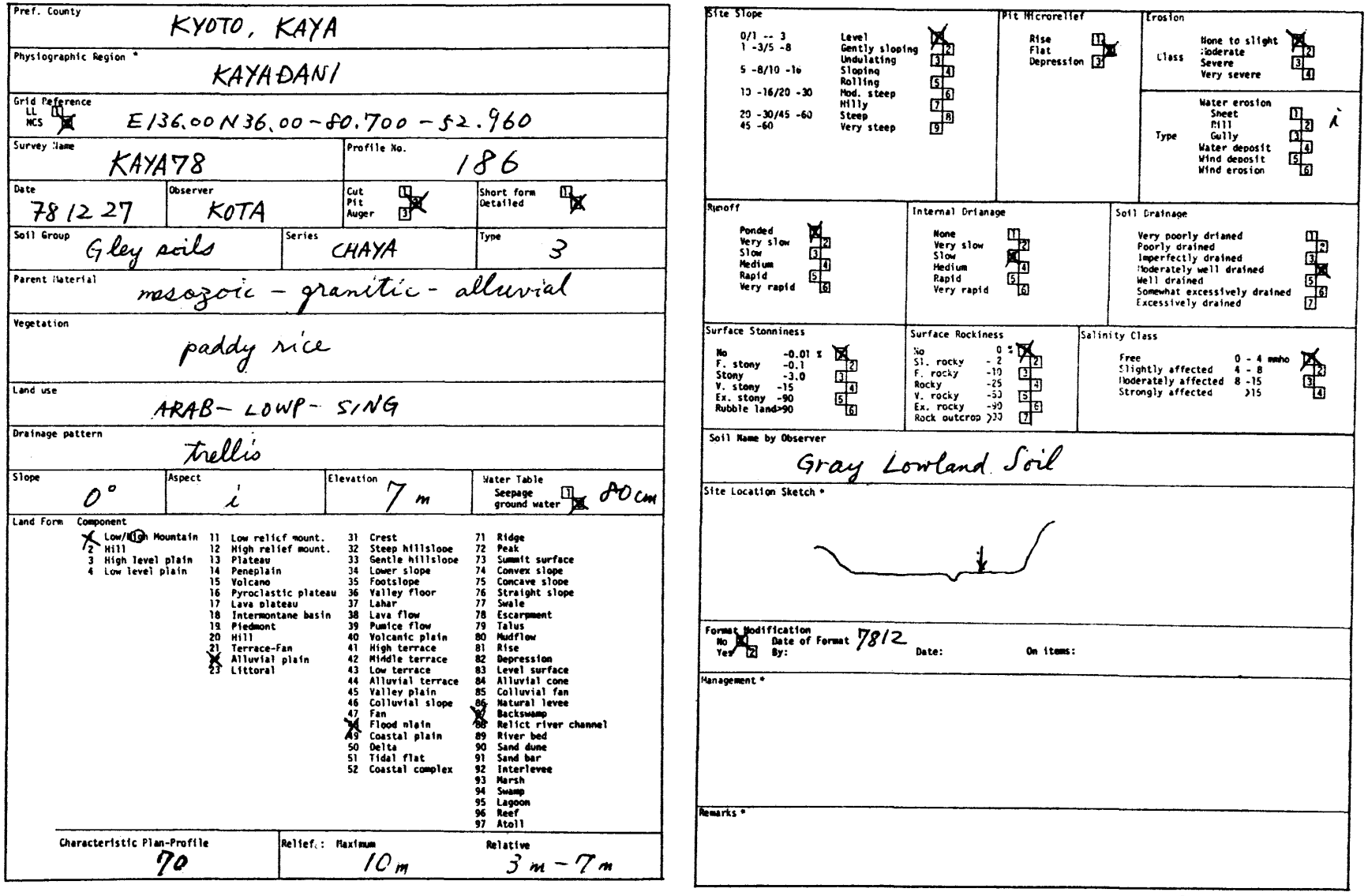
The final version of the format is shown in Fig.1. It is printed on A4 sized card, and uses both sides; one for the site and the other for the profile description.

Code numbers are given on the card; we can easily choose appropriate ones. Some items, however, are recorded in uncoded forms; survey name, parent material, horizon name, soil color, etc. If needed, for example, for data analysis, uncoded records can be easily coded by use of a subroutine program. Some codes are based on actual measurements; slope (degree), aspect, elevation(m), cone penetration (mm, kg $cm^{-2}$), etc.

Codes are needed for missing records and irrelevant items. For coding the missing records, 999 and blank are used for items in digit form and letter form, respectively. Irrelevant items are coded by 0 (zero) and i in a similar sense.

A soil profile is refered to the soil number consisting of survey name and profile number.

The location of observation site is digitized using a grid-type digitizer, and punched out on the site card or written on the site file tape, which can be cross-referenced with profile description file through indexing by the grid reference and the soil number.



Pref. County: KYOTO, KAYA

Physiographic Region *: KAYADANI

Grid Reference: LL [1] MCS [X] E136.00 N36.00 -80.700 -52.960

Survey Name: KAYA78 | Profile No.: 186

Date: 78 12 27 | Observer: KOTA | Cut [1] Pit [X] Auger [3] | Short form [1] Detailed [X]

Soil Group: Gley soils | Series: CHAYA | Type: 3

Parent Material: mesozoic - granitic - alluvial

Vegetation: paddy rice

Land use: ARAB- LOWP- SING

Drainage pattern: trellis

Slope: 0° | Aspect: i | Elevation: 7 m | Water Table: Seepage [1] ground water [X] 40cm

Land Form Component

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| X Low/(1)gh Mountain | 11 Low relief mount. | 31 Crest | 71 Ridge |
| 2 Hill | 12 High relief mount. | 32 Steep hillslope | 72 Peak |
| 3 High level plain | 13 Plateau | 33 Gentle hillslope | 73 Summit surface |
| 4 Low level plain | 14 Peneplain | 34 Lower slope | 74 Convex slope |
| | 15 Volcano | 35 Footslope | 75 Concave slope |
| | 16 Pyroclastic plateau | 36 Valley floor | 76 Straight slope |
| | 17 Lava plateau | 37 Lahar | 77 Swale |
| | 18 Intermontane basin | 38 Lava flow | 78 Escarpment |
| | 19 Piedmont | 39 Pumice flow | 79 Talus |
| | 20 Hill | 40 Volcanic plain | 80 Mudflow |
| | 21 Terrace-Fan | 41 High terrace | 81 Rise |
| | X Alluvial plain | 42 Middle terrace | 82 Depression |
| | 23 Littoral | 43 Low terrace | 83 Level surface |
| | | 44 Alluvial terrace | 84 Alluvial cone |
| | | 45 Valley plain | 85 Colluvial fan |
| | | 46 Colluvial slope | 86 Natural levee |
| | | 47 Fan | X Backswamp |
| | | X Flood plain | 88 Relict river channel |
| | | 49 Coastal plain | 89 River bed |
| | | 50 Delta | 90 Sand dune |
| | | 51 Tidal flat | 91 Sand bar |
| | | 52 Coastal complex | 92 Interlevee |
| | | | 93 Marsh |
| | | | 94 Swamp |
| | | | 95 Lagoon |
| | | | 96 Reef |
| | | | 97 Atoll |

Characteristic Plan-Profile: 70 | Relief: Maximum 10 m | Relative 3 m - 7 m

Site Slope: 0/1 -- 3 Level; 1 -3/5 -8 Gently sloping; 5 -8/10 -16 Undulating; 10 -16/20 -30 Sloping; 20 -30/45 -60 Rolling; 45 -60 Mod. steep; Hilly; Steep; Very steep

Pit Microrelief: Rise [1] Flat [2] Depression [X]

Erosion: Class: None to slight [X] :loderate [2] Severe [3] Very severe [4]

Type: Water erosion: Sheet [1] Rill [2] Gully [3] Water deposit [4] Wind deposit [5] Wind erosion [6]

Runoff: Ponded [X] Very slow [2] Slow [3] Medium [4] Rapid [5] Very rapid [6]

Internal Drainage: None [1] Very slow [2] Slow [X] Medium [4] Rapid [5] Very rapid [6]

Soil Drainage: Very poorly drained [1] Poorly drained [2] Imperfectly drained [3] :loderately well drained [X] Well drained [5] Somewhat excessively drained [6] Excessively drained [7]

Surface Stoniness: No -0.01 % [X] F. stony -0.1 [2] Stony -3.0 [3] V. stony -15 [4] Ex. stony -90 [5] Rubble land>90 [6]

Surface Rockiness: No 0 % [X] Sl. rocky - 2 [2] F. rocky -10 [3] Rocky -25 [4] V. rocky -50 [5] Ex. rocky -90 [6] Rock outcrop >90 [7]

Salinity Class: Free 0 - 4 mmho [X] Slightly affected 4 - 8 [2] :loderately affected 8 -15 [3] Strongly affected >15 [4]

Soil Name by Observer: Gray Lowland Soil

Site Location Sketch *

Format Modification: No [X] Yes [2] Date of Format 7812 By: Date: On items:

Management *

Remarks *

78 HF&TK,Kyoto Univ.

**Fig. 1** An Example of the Completed Format. Site Description.

Pref. County * KYOTO, KAYA | Survey KAYA 78 | Profile No. 186

| | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| HORIZON NO. | | 1 | 2 | 3 | 4 |
| HORIZON NAME | | A1 6Op | A12 9O | BGo | CGo |
| THICKNESS cm | | 15 | 9 | 14 | 28 |
| BLEACHING | 1 2 3 4 5 6 | 1 | 1 | 1 | 1 |
| ACCUMULATION | Material | i | i | Fe | i |
| | Class 1 2 3 4 5 | 1 | 1 | 2 | 1 |
| BOUNDARY / Topogra. | Contrast: 1 abrupt-2cm 2 clear -5 3 gradual-12 4 diffuse>12 | 1/1 | 1/1 | 2/1 | |
| | Topogra.: 1 smooth 2 wavy 3 irregular 4 broken | | | | |
| COLOR | Matrix | 2.5Y 4/1 | 5Y 5/1 | 5Y 5/1 | 10Y 4/1 |
| | Crushed | 〃 | 〃 | 〃 | 〃 |
| MOISTURE | 1 dry 2 moist 3 wet 4 v. wet 5 x. wet | 4 | 3 | 3 | 3 |
| TEXTURE | | CL | CL | LiC | LiC |
| MOTTLE / CUTAN | Abundance: 1 none 2 few -5% 3 com. -10 4 many -30 5 abundant 30 | 2/1 | 4/1 | 4/1 | 3/1 |
| | Abundance: 1 none 2 patchy 3 broken 4 continuous | | | | |
| | Contrast /Surface: 1 faint 2 distinct 3 prominent | 1/0 | 3/0 | 2/0 | 2/0 |
| | Contrast /Surface: 1 grain 2 ped 3 void | | | | |
| | Size/Thickness: 1 fine 2 medium 3 coarse | i/0 | 2/0 | 2/0 | 1/0 |
| | Size/Thickness: 1 thin 2 moderate 3 thick | | | | |
| | M. Color | 10YR 5/6 | 7.5YR 5/8 | 10YR 5/6 | 10YR 5/6 |
| | C. Color | i | i | i | i |
| | M. Shape | SPOT | FILM | TUBE | TUBE |
| | C. Nature | i | i | i | i |
| O.M. | Content: 1 low -2 % 2 medium -5 3 high -10 4 v. high -20 % 5 x. high >20 | 2 | 1 | 1 | 1 |
| | Form/Decomposition | i | i | i | i |
| STONE D/S | Abundance: 1 none 2 few -5 % 3 common -10 4 many -30 % 5 abundant-50 6 dominant>50 | 2 | 2 | 2 | 1 |
| | Size: 1 gravel -6mm 2 s. pebble-25 3 pebble -64 4 cobble -256mm 5 boulder>256 | 1 | 1 | 1 | 0 |
| | Weather-ing: 1 none 2 slightly 3 moderate 4 strongly | 2 | 2 | 2 | 0 |
| | Shape | SA | SA | SA | i |
| | Type | Gr | Gr | Gr | i |

Soil Group * | Land Use * | Grid Reference

| | | | | | |
|---|---|---|---|---|---|
| MINERAL | Abundance 1 2 3 4 | 2 | 2 | 2 | 2 |
| | Type | MFQ | MFQ | MFQ | FMQ |
| FERROUS | Class 1 2 3 4 | 1 | 1 | 1 | 1 |
| COMPACT-NESS | 1 loose 2 penetrable 3 deep f. p. 4 shallow f. p. 5 no f. p. 6 knife | 3 | 4 | 4 | 3 |
| | Penetrometer mm & kg cm$^{-2}$ | 13 | 20 | 18 | 16 |
| PERMEA-BILITY | kg cm$^{-2}$ | missing | | | |
| BULK DENSITY | Moist Soil | missing | | | |
| | Dry Soil | | | | |
| STRUCTURE | 1 Do. 2 Sub. 3 Br. | 1 | 1/3 | 1/3 | 1 |
| | Grade: 1 no 2 weak 3 moderate 4 strong | 2 | 1/2 | 1/2 | 1 |
| | Size: 1 v. fine 2 fine 3 medium 4 coarse 5 v. coarse | 4 | 0/5 | 0/5 | 0 |
| | D/S or B Type: 1 platy 2 prismatic 3 columnar 4 blocky 5 angular 6 granular 7 crumb 8 massive 9 single grain | 4 | 8/4 | 8/4 | 8 |
| CONSIS-TENCE | Moist/Dry: 1 loose 2 v. friable 3 friable 4 firm 5 v. firm 6 x. firm | 3/ | 3/ | 3/ | 3/ |
| | Wet: 1 non-stf./pl. 2 sl.sticky/pl. 3 sticky/plas. 4 v. sticky/pl. | 2/3 | 2/3 | 4/4 | 4/4 |
| POROSITY | Intra-/Interpeda: 1 f. porous-1mm 2 porous -3 3 spongy -5 4 cavern. -10 1 f. fiss. 2 fissured 3 w. fiss. 4 v.w. fiss. 5 x.w. fiss. | 1/2 | 1/1 | 1/1 | 0 |
| ROOT | Biopore Quant.: 1 none 2 few -2/100cm$^2$ 3 freqquent-10 4 abundant >10 | 3 | 2 | 2 | 2 |
| | Biopore Size: 1 small -3 mm 2 medium-12 3 large -30 4 coarse >30 | 1 | 1 | 1 | 1 |
| | Quantity: 1 none 2 few 3 many 4 abundant 5 root mat | 3 | 2 | 2 | 2 |
| | Type/Distri.: 1 evergreen 2 deciduous 3 grass 4 others 1 horizontal 2 vertical 3 oblique 4 ubiquitous | 3/4 | 3/2 | 3/2 | 0 |
| FABRIC | 1 earthy 2 sandy 3 rough 4 smooth | 1 | 1 | 1 | 1 |
| PAN | Cementation: 1 none 2 weakly 3 strongly 4 indurated | 1 | 1 | 1 | 1 |
| | Structure | i | i | i | i |
| SECOND-ARY FORMA-TION | Abundance 1 2 3 4 5 6 | 1 | 1 | 1 | 2 |
| | Type | i | i | i | NCD |
| | Composition | i | i | i | FeCO3 |
| SAMPLE | Bulk/Core 1 yes 2 no | 1/1 | 2/2 | 1/1 | 1/2 |
| PHYSICAL RIPENING | 1 2 3 4 5 | 1 | 1 | 1 | 1 |

Core No. K311 K312

**Fig. 1 (cont'd)** An Example of the Completed Format. Profile Description.

Those items not stored in the soil files are marked on the card by an asterisk. The detailed description of soil and crop management needs another format and file, which require further approximation.

The land form description given in an open-ended list also needs elaborations. Site location sketch is necessary to reevaluate this list.

The format may be modified if needed. The modification is identified by registering it in the relevant column.

A full description of a site needs two 80-column punch cards and that of one horizon needs three cards. This is a significant drawback in view of the punching efficiency as compared to those reported by others. This is due to our choice to hold a large number of uncoded records. But, the format itself is very easy to use and to read. Even a beginner can learn how to use it within a few days.

The data stored in magnetic tapes have been combined with a computer program to write a survey report, and to retrieve the point data plotted on a map. This is an effective aid in drawing a soil map. By plotting the point data on an existing soil map, which can be also retrieved from a cartographic file, the correspondence of the soil boundary with the new point data can be easily checked. These procedures as well as file management method will be reported separately.

## Summary

A format for field records for use with a soil data bank is described. It is aimed to collect field soil data in detail, and to retrieve them as text or as plots showing attribute distributions on a map with or without processing. This is particularly important for reclassifying the soil profiles and for reconstructing the soil map and soil units.

The format is simple and easy to use, since many of the necessary properties are coded on the card.

The manual for soil description integrates several methods, and is published in Discussion Paper Series of the CSEAS of Kyoto University (Furukawa, 1979).

## References

Furukawa, Hisao 1979. "The manual for field soil records," Discussion Paper Series of the Center for Southeast Asian Studies, Kyoto University, No. 103.

Hazelden, J., Beckett, P. H. T. and Jarvis, M. G. 1976. "A computer-compatible proforma for field soil records," *Geoderma*, 15, pp. 21–29.

Lee, R., Mew, G., Newman, M. J. and Gibson, A. R. 1976. "Computer processing of soil profile data from surveys in New Zealand," *Geoderma*, 16, pp. 201–209