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Overview of soil phosphorus data from a large international soil database

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ISRIC World Soil Information

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PREFACE

ISRIC – World Soil Information has the mandate to create and increase the awareness and understanding of the role of soils in major global issues. As an international institution, we inform a wide audience about the multiple roles of soils in our daily lives; this requires scientific analysis of sound soil information.

Phosphorus is an essential element for life. Unlike carbon, oxygen, nitrogen, and hydrogen, it does not cycle between plants/soils and the atmosphere. It is mined, processed and applied to the soil as fertilizer; it cycles between plants and soils and some of it is ultimately lost as runoff into lakes, streams and, ultimately, the ocean. Phosphate mines may be exhausted in the near future. In this context, ISRIC has initiated research to understand better the availability and dynamics of soil phosphorus.

The present study is aimed at identifying whether it is feasible to present representative values for soil-P, determined according to defined extraction methods, for major soil types for possible use in model-based assessments of resource scarcity in relation to food security.

This project has been carried out in the framework of a quantitative modelling analysis, initiated by Plant Research International, to study input requirements for enhancing agricultural productivity on the African continent, funded by the Netherlands Ministry of Economic Affairs, Agriculture and Innovation (BO-10-011-007).

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SUMMARY

This exploratory study presents an inventory of extractable soil phosphorus (P-Bray, P-Olsen, P-Mehlich and P-water) and P-retention (P New Zealand) data held in a publicly available version of the National Cooperative Soil Characterization Database (USDA-SSL). The primary aim is to assess whether representative P-values by broad soil group (FAO system) can be determined for each of these analytical methods. In the affirmative, such derived data may be linked to global soil geographic databases, that consider the FAO Legend for demarcating major soil groups, in order to be used for model-based assessments of food security. For many soil properties, FAO soil groups have been shown to be useful carriers of soil information.

The primary data set, containing over 35 000 soil profiles, was screened to identify profiles suitable for this assessment. These profiles should be geo-referenced, classified at Great Group level, according to USDA Soil Taxonomy, to permit correlation with major soil groups of the FAO system. Further, they should include P-data, analysed according to defined analytical methods. Following soil correlation and screening of the primary data for possible inconsistencies, depth-weighted soil properties (0-20, 20-40, 40-60, 60-80 and 80-100 cm) were stored in a secondary data set.

Some 4920 of the original profiles, from 48 different countries representing 25 FAO major soil groups, have P-data for some horizons. In accordance with pedological practice, different analytical procedures were used by USDA-SSL largely depending on soil acidity and mineralogy. For 0-20 cm depth, 2733 profiles have data for P-retention, 2680 for P-Bray1, 289 for P-Mehlich3, 189 for P-Olsen and 85 for P measured in water. Generally, there a fewer observations for the deeper layers.

Median and mean P-values are presented for each FAO soil group and depth layer, further stratified according to soil textural class. Coefficients of variation (CV) in excess of 100% are observed for extractable-P, irrespective of the extraction method, for most FAO soil groups. For P-Bray1, the average CV is 134% for 0-20 cm, with extremes of 71% and 224%.

CVs for P-retention range from 20% to 72% (for 0-20 cm) for the major soil groups under consideration. When considering the upper 60 cm (i.e., 0-20, 20-40 and 40-60 cm) for mineral soil units, average P-retention (wt%) decreases in the following sequence: Andosols (74 (Avg.) ± 28 (SD)), Ferralsols (57 ± 19), Acrisols (48 ± 22) and Podzols (46 ± 27). Overall, this pattern is in accordance with soil P-fixing properties reported in earlier studies.

The present set of median P-values, by major soil grouping and depth layer, is not considered representative for any specific geographic area or country; as such, it should not be used for spatial extrapolation using the ISRIC-WISE derived soil property geodatabase and similar. Similarly, best subset regressions that consider extractable-P (determined according to a given analytical method) as a multilinear function of several independent

predictor soil variables had low predictive capability with most adjusted R^2 values being < 0.3.

In view of these findings, and the fact that actual amounts of plant available-P will be affected by crop type, farmers' nutrient management and soil conservation practices, a practical solution may be needed for defining available P-levels, for specific soil units, as required for exploratory assessments of resource scarcity and food security at a broad scale. One approach could be to propose P levels (for defined analytical methods) below which a marked fertilizer response is likely to occur according to published sources. Using such simple assumptions as a first approximation, "windows-of-opportunity" for fertilizer application in inherently unfertile and nutrient depleted regions could be estimated, in combination with auxiliary GIS layers on regional P-fertilizer use, subject to the availability of a regionally validated model. The ultimate purpose of such an exploratory analysis would be to improve nutrient input strategies for raising food production in nutrient-limited cropping systems.

Keywords: data set, soil phosphorus, P-Bray, P-Olsen, P-Mehlich, P-Water, P-retention, uncertainty, extrapolation

1 INTRODUCTION

There is "wide agreement that the productivity and eco-efficiency of agricultural systems should increase to meet future global demands. However, quantitative information is lacking on where and what should be done (crop management, watershed management, socio-economic infrastructure) to realize such systems"[1], see also Keating et al. (2010). One of the soil properties for which little information is available globally is soil phosphorus (P), an essential and often limiting plant nutrient.

As reviewed in a preceding study (Batjes 2010), the amounts, forms (organic and inorganic), and distribution of P in the soil vary with different processes: natural processes that determine soil mineralogy and P-sorbtion characteristics, as well as human-controlled processes such as the application and timing of P-containing fertilizers, lime and organic material. Under natural conditions, the weathering and dissolution of rocks and relatively insoluble P-containing minerals is a slow process. This weathering is only capable of supporting slow-growing vegetation and crops adapted to low P-availability. In acid soils, various forms of iron (Fe), aluminum (Al) and manganese (Mn) oxides strongly bind P, while in calcareous soils P is mainly found in the form of Ca-compounds of varying solubility (Dabin 1980; Fairhurst *et al.* 1999; Ryan and Rashid 2006); volcanic soils rich in allophane strongly fix phosphorus. Ultimately, the form of P in the soil will influence P-availability to the plant; actual uptake will be determined by soil water conditions, crop type and growth rate, root morphology and plant-specific characteristics to extract soil-P through excretion of exudates (Hoffland *et al.* 1992); fungi may also be important in this respect (Hoffland *et al.* 2004).

The so-called "plant-available" fraction of soil phosphorus (i.e., the fraction extractable with a given laboratory method, such as P-Bray or P-Olsen) is most important for studying soil-nutrient crop-response relationships. Experimental fields carefully located in main agro-ecological regions to derive such relationships provide the basis for regional fertilizer recommendations. However, as indicated by Cope et al. (1973), chemical values obtained by extraction have no absolute meaning with respect to nutrient supply available to the root system of plants. Different crop types will respond in different ways to identical rates of P-fertilizer, for given conditions of climate and soil. Soil testing procedures, such as P-Olsen and P-Bray, can provide an accurate "relative" index of the amount of P that a given crop may utilize from a soil, but rarely, if ever, can they provide and absolute measure of it (Landon 1991; Thomas and Peaslee 1973).

Soil fertility degradation has been coined as the single most important threat to food security in Sub-Saharan Africa (Gichuru *et al.* 2003; Stoorvogel *et al.* 1993). A large portion of the soils has a low inherent fertility (FAO 1993) but the major cause of soil fertility degradation in the region is the negative nutrient balances (e.g., nutrient output not replaced by inputs) (Bindraban *et al.* 2008; Smaling 1998). In regions over-supplied with phosphorus, P-loadings

[1] BO-10-011-007 Resource scarcity and distribution in a changing world

may exceed the natural capacity of soils to retain P leading to runoff and water quality problems such as eutrophication (Bouwman *et al.* 2009; Harrison *et al.* 2010).

Generally, data for plant-extractable soil-P are under-represented in most soil profile data sets because P is seldom measured during the underpinning soil surveys (Batjes 2010). The aim of this study is to assess the feasibility of presenting derived values for "plant-available" soil P that may be linked to soil geographical databases that consider the Legend of the Soil Map of the World (FAO-Unesco 1974), for example the 0.5 x 0.5 degree and more recent 5 x 5 minute version for the ISRIC-WISE database[1]. Conceptually, under the assumption that adequate primary soil-P data are available for the assessment, this information may then be linked to a framework of spatially explicit databases thereby permitting integrated model-based studies of environmental sustainability and agricultural production. Different types of predictive models will be needed to evaluate the effects P-application under different soil, management and climatic conditions, for use at various scales (e.g., Daroub *et al.* 2003; Dzotsi *et al.* 2010; Greenwood *et al.* 2001; Janssen *et al.* 1990; Kozar *et al.* 2002; Lesschen *et al.* 2007; Wang *et al.* 2009); their review is beyond the scope of this study.

Large soil databases are needed to underpin environmental and agricultural studies of soil-P levels at global and continental level. Ideally, these should present data on soil P levels, assessed according to defined extraction methods, as well as information on land use management/history, for all major soils of the world. Data for this study were extracted from a publicly available, merged version of the USDA-SSL Characterization Database[2] (NCSS 2010). Profiles were taken using *purposive* sampling (see Schoenberger *et al.* 2002; Soil Survey Staff 1983); they characterize a wide range of soils from a wide range of agroclimatic zones. The set includes data for over 35 000 profiles, corresponding with over 230 000 horizons/layers. It can accommodate over 30 soil properties for each soil horizon/layer, including soil P data analysed according to various methods. As indicated on the USDA-SSL website, analytical data presented for most of the pedons is fairly complete, according to the prevailing view of the research and characterization needs when the pedon was sampled. Overall, however, the range of analyses has increased over time. Most of the profile data were collated over the last 40 years; for details see http://soils.usda.gov/survey/nscd/description.html.

[1] http://www.isric.org/NR/exeres/545B0669-6743-402B-B79A-DBF57E9FA67F.htm
[2] http://ssldata.nrcs.usda.gov/rptgen.htm

2 DATA AND METHODS

2.1 Data

Specific laboratory methods for extracting P, for the determination of nutrient-plant yield response curves, are needed for different soil types. To a large extent, selection of the appropriate extraction method is determined by soil pH and soil mineralogy (Elrashidi 2010).

Soil P can be assessed using many procedures. Comparative studies have shown that incomplete or excessive extraction of P is the most significant contributor to inter-laboratory variation (Burt 2004). Soil P data provided by USDA-SSL are mainly determined with colorimetric methods, with the exception of the multi-element extractant Mehlich No. 3. The type of P analyses considered in the data set include: water soluble (4D2a1a1); Bray P-1 (4D3a1); Olsen sodium-bicarbonate (4D5a1); Mehlich No. 3 (4D6a1); citric acid soluble (4D7a1); and New Zealand P Retention (4D8a1). Codes between brackets refer to procedures described in the Soil Survey Laboratory Methods Manual (Burt 2004).

The P-Bray1 procedure is widely used as an index of available P in the soil, but it has limited ability to extract P in calcareous soils due to the neutralization of the dilute acid by carbonates. Alternatively, the Olsen method is preferred for slightly acid and calcareous soils. The Olsen method has been modified by Dabin (1967; 1980) for application on acid, weathered tropical soils. In practice, however, some P-methods may have been applied to soils types for which they are not considered appropriate (e.g., P-Bray in calcareous soils).

Landon (1991) provides general guidelines for the interpretation of available phosphorus for selected crop types. Specific soil fertility – crop yield response curves will have to be developed depending on the soil types, soil analytical methods, crops and climates under consideration to underpin fertilizer advice to farmers. Using field test data, recommendations can then be made about the amounts of phosphate and other fertilizers that will most likely give optimum, respectively economically viable yields.

P retention of soil material, measured according to the *Blakemore* or *New Zealand* method, is a criterion for andic soil properties in USDA Soil Taxonomy (Soil Survey Staff 2010) and the World Reference Base for Soil Resources (WRB 2006). Factors that affect soil P-retention are not well understood; phosphate retention is also called P adsorption, sorption, or fixation.

In USDA Soil Taxonomy and WRB, "1 percent citric acid soluble P_2O_5" is used as a criterion for distinguishing between mollic and anthropic epipedons. As such, data for citric acid soluble P_2O_5 are not considered in this study.

2.2 Methods

Prior to starting with the actual analyses, logical relationships were established between the various attribute tables to filter-out profiles relevant for this study. Profiles without geo-references, USDA soil classification or the necessary set of horizon (attribute) data were excluded from further analysis. This first filtering led to the rejection of some 30% of the original number of profiles.

To permit stratification, according to FAO major soil group, the remaining profiles were correlated to the Legend of the Soil Map of the World (FAO-Unesco 1974). Simple taxotransfer rules were developed using the most recent USDA subgroup classification —2162 unique combinations for the present data set—, and descriptive criteria presented in FAO-Unesco (1974, p. 13-20); see Appendix 2. Inherently, this type of conversion will encompass some loss of detail (Spaargaren and Batjes 1995; WRB 2006).

Horizon data for each profile were allocated to a fixed depth layer (e.g., 0-20, 20-40, 40-60, 60-80 and 80-100 cm), using procedures described in Batjes et al. (1997; 2007) Thereafter, depth-weighted soil property values were calculated for each layer. Subsequently, all profiles having some P-data were flagged, specifying the chemical extraction method (e.g., P-Olsen or P-Bray resp. P-retention). Inherently, this process lead to a greatly reduced data set. This new, harmonized set, containing some 4900 profiles, was used for the statistical analyses.

With a view to possible refinements, the layer data were also clustered into broad textural classes. Class limits are based on criteria used in SOTER (van Engelen and Dijkshoorn 2010) and the Georeferenced Soil Database for Europe (ESB 2001). Seen the broad scale, only three classes are considered in this study: C= Coarse; M= Medium and Medium Fine; V= Fine and very fine (see Figure 1).

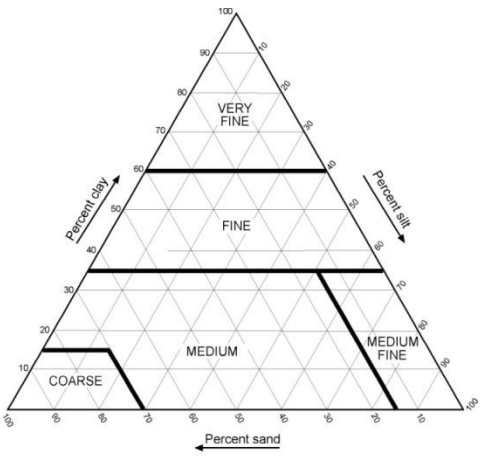

Figure 1. Default soil textural classes

3. RESULTS AND DISCUSSION

3.1 Secondary data set

The structure of the secondary soil data set, containing data for some 4920 profiles, is presented in Appendix 1; analytical methods are described in Appendix 5. Besides soil phosphorus data, several other soil properties have been considered in the depth-harmonized data set notably pH_{water}, organic carbon content, total nitrogen and exchangeable K. These data may be used to develop or fine tune "soil P- crop response" models, such as QUEFTS (Janssen *et al.* 1990). Further, the secondary data set contains: content of sand, silt and clay; cation exchange capacity measured in ammonium acetate buffered at pH7 (CEC-NH4), resp. defined as sum of bases (CEC-SUM, buffered at pH8.2). Some of these properties were later considered as independent variables during exploratory, best subset regression analyses discussed in Section 3.6.

3.2 Soil groups represented

In view of the diversity of soil types worldwide, it is generally useful to stratify soils according to broad soil classes, such as FAO soil units, as carriers of derived soil information(Batjes *et al.* 1997; Batjes 2002; Bouma *et al.* 1998). Such stratification, however, will be most useful for soil properties that are considered diagnostic.

Rules developed for this study to correlate the USDA classification to the FAO-Unesco (1974) system are listed in Appendix 2. Results of this inherently coarse conversion are listed in Table 1, showing that (some) P data are available for 25 major soil groups.

Table 1. Type and number of major soil groups (FAO) represented in the screened profile dataset (n= 4920)

FAO major soil group*	Name	*n*
A	Acrisols	379
B	Cambisols	735
C	Chernozems	177
D	Podzoluvisols	50
E	Rendzinas (Ex)	6
F	Ferralsols	67
G	Gleysols	397
H	Phaeozems	223
I	Lithosols (Ix)	1

FAO major soil group*	Name	*n*
J	Fluvisols	58
K	Kastanozems	597
L	Luvisols	857
N	Nitosols	4
O	Histosols	35
P	Podzols	299
Q	Arenosols	145
R	Regosols	99
S	Solonetz	36
T	Andosols	435
U	Ranker	7
V	Vertisols	106
W	Planosols	14
X	Xerosols	159
Y	Yermosols	29
Z	Solonchaks	5

* Geo-referenced profiles only

3.3 Regional distribution of soil profiles

Profiles considered in the merged data set originate from 48 countries, with the majority (>90%) coming from the USA (Table 2).

Table 2. Number of soil profiles with phosphorus data by country

ISO	Country name	n
US	United States	4497
ZI	Zimbabwe	24
PS	Palau	21
CA	Canada	19
TW	Taiwan	18
MX	Mexico	17
RP	Philippines	17
CR	Costa Rica	16
JA	Japan	16
UY	Uruguay	16
CG	Congo (Democratic Republic of the)	15
RS	Russia	14
WS	Samoa	13
PK	Pakistan	13
EC	Ecuador	13

ISO	Country name	n
GT	Guatemala	12
CI	Chile	12
AR	Argentina	11
ID	Indonesia	11
GH	Ghana	10
CO	Colombia	9
AL	Albania	8
AF	Afghanistan	8
HO	Honduras	7
TH	Thailand	7
IN	India	7
LG	Latvia	6
LH	Lithuania	6
MI	Malawi	6
FM	Fed. States of Micronesia	6

ISO	Country name	n
SY	Syria	6
EN	Estonia	6
RW	Rwanda	6
DA	Denmark	5
SO	Somalia	5
KE	Kenya	5
VE	Venezuela	4
CH	China	4
NU	Nicaragua	4
ES	El Salvador	4

ISO	Country name	n
NI	Nigeria	4
AY	Antarctica	3
NP	Nepal	3
PM	Panama	2
EG	Egypt	1
FI	Finland	1
BU	Bulgaria	1
MY	Malaysia	1

3.4 Number of P data

3.4.1 By analytical method

The recommended method for a certain soil region will vary with the purpose of the study and soil type under consideration. The number of layers for which P-data are available, for the analytical methods described earlier, is listed in Table 3. It may be noted that relatively few data are available here for the P-Olsen, P-Mehlich and P-water method, which may preclude any relevant statistical analyses for numerous soil groups. In addition, fewer P-data are available for the deeper layers.

Table 3. Number of soil layers with soil P-data grouped by analytical method

Depth layer	P_Bray1	P_Olsen	P_Mehlich	P_Water	P_Retention[a]
D1 (0-20 cm)	2680	189	289	85	2733
D2 (20-40 cm)	2353	173	289	56	2737
D3 (40-60 cm)	2061	160	278	54	2548
D4 (60-80 cm)	1807	152	236	49	2304
D5 (80-100 cm)	1579	145	227	48	2007

[a] According to New Zealand method (expressed in % wt). All other P-data are given as mg P kg^{-1}, see Appendix 5.

3.4.2 By analytical method, FAO major soil group and depth layer

Profiles were grouped and analysed according to FAO major soil group. The summary of P-Bray1 data available for Acrisols, by depth layer, is shown as an example in Table 4. Results for the other FAO major soil groups, clustered by analytical method and depth layer, are provided in Appendix 3. For many clusters, the number of available observations is less than 30 the minimum recommended for statistical analyses (Snedecor and Cochran 1980). A

complicating factor here is that there is no detailed information on land use history in the data set. Land use effects on soil N, P, C and pH can persist for many years (e.g., Falkengren-Grerup *et al.* 2006; Fraterrigo *et al.* 2005; Schulp and Verburg 2009). The current selection of available P-data may relate to profiles taken in either fertilized or unfertilized fields respectively under undisturbed natural vegetation. Possibly, for any given cluster, the smaller values may relate to unfertilized fields and the larger ones to fertilized fields, but this cannot be ascertained objectively here. Therefore, the various subsets for P could not be evaluated for possible (statistical) outliers.

Table 4 Number of Acrisol profiles having P-data grouped by analytical method and depth-layer

FAO major soil group	Layer	P_Bray1	P_Olsen	P_Mehlich3	P_Water	P_Retention
Acrisols	D1	286	2	14	12	143
Acrisols	D2	237	2	14	10	144
Acrisols	D3	226	2	14	10	143
Acrisols	D4	212	2	14	10	141
Acrisols	D5	186	2	14	10	129

See Table 3 for definition of depth layers (D_i)

3.5 Descriptive statistics

Median or mean soil property values, for defined soil classes and depth ranges, can be useful when spatial extrapolation based on conventional mapping approaches is the objective in broad scale, exploratory assessments. Typically, for non-normal distributions, the median is more robust than the mean as well as more resistant to erratic extreme observations (Snedecor and Cochran 1980, p. 136-137).

Descriptive statistics for P-data, clustered according to analytical method, major soil group and depth layer are presented in Appendix 4. In view of the length of the corresponding tables, an excerpt for Acrisols is shown in Table 5 as an example. Overall, the coefficients of variation (CV) in excess of 100% are observed for extractable-P, irrespective of the analytical method. The smallest CVs are reported for P-retention, some 45%, for the example given in Table 5. When considering P-retention for the upper 60 cm (i.e., 0-20cm, 20-40cm and 40-60 cm) for mineral soil units, values for average P-retention (wt%) decrease in the following sequence: Andosols (74 (Avg.) ± 28 (SD)), Ferralsols (57 ± 19), Acrisols (48 ± 22) and Podzols (46 ± 27). Overall, this pattern is in accordance with other studies (FAO 1993; WRB 2006), with a lower P-retention reported for other mineral soil groups. Alternatively, no clear pattern is observed for the extractable-P methods (see Appendix 4). Unlike P-retention, the P-Bray1, P-H_2O and P-Mehlich3 method are not diagnostic in WRB or USDA

Soil Taxonomy (see Section 2.1); they provide a measure for "extractable P", according to a certain analytical method, that should be appraised in conjunction with field-based crop-response curves.

Table 5. Summary of P-data for Acrisol profiles for 0-20 cm and 20-40 cm depth

Method	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	A/D1	286	30.70	68.71	224	7.00	5.50	2.50	23.17	0.00	586.17
P_BRAY1	A/D2	237	14.74	41.00	278	2.00	1.70	0.65	8.02	0.00	294.76
P_H2O	A/D1	12	0.06	0.08	132	0.04	0.04	0.00	0.09	0.00	0.30
P_H2O	A/D2	10	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
P_Mehlich3	A/D1	14	31.50	43.11	137	12.02	10.70	1.72	40.22	0.50	125.93
P_Mehlich3	A/D2	14	6.29	13.49	215	1.82	1.48	0.50	5.16	0.27	51.96
P_Retention	A/D1	143	47.15	22.85	48	43.00	17.50	28.00	65.60	1.00	96.20
P_Retention	A/D2	144	48.87	21.15	43	47.15	16.15	32.25	66.04	9.70	97.80

Note: String FAO74_LAY consists of the FAO code for the major soil group (e.g., A for Acrisols, followed by "/" and a code for the depth layer (D1= 0 to20 cm, D2= 20 to 40 cm, etc.). Under Min, '0.00' stands for traces (NCSS 2010). See Appendix 5 for units of measurement. N in the sample size, AVG the average, SD the standard deviation, CV the coefficient of variation, MIN the minimum, MAX the maximum, MED the median and MAD the median absolute deviation from the median.

For the considered Acrisol profiles (Table 6), both the average and median P-retention increase as the texture gets finer, that is in the sequence Coarse, Medium and Fine, reflecting the importance of clay content and clay mineralogy for P-retention/release (Dixon *et al.* 1977).

Table 6. Summary of P-data for Acrisols for 0-20 cm and 20-40 cm depth, clustered according to soil textural class

Method	FAO74_text[a]	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	A/D1-C	38	66.67	119.94	179.89	14.82	13.29	3.19	86.65	0.60	586.17
P_BRAY1	A/D1-M	208	25.88	54.28	209.72	7.40	5.40	3.00	22.31	0.00	449.70
P_BRAY1	A/D1-V	37	21.49	63.73	296.55	2.95	2.65	0.99	7.91	0.00	313.00
P_BRAY1	A/D2-C	25	26.43	40.83	154.49	9.00	7.90	2.22	32.80	0.32	169.60
P_BRAY1	A/D2-M	148	11.56	34.35	297.15	2.00	1.41	1.00	7.20	0.00	294.76
P_BRAY1	A/D2-V	60	16.89	54.54	322.88	0.64	0.64	0.11	6.06	0.00	282.02
P_H2O	A/D1-M	11	0.07	0.09	123.15	0.05	0.04	0.00	0.09	0.00	0.30
P_H2O	A/D2-M	9	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
P_Mehlich3	A/D1-M	8	51.19	49.00	95.71	27.14	19.72	15.51	108.55	1.33	125.93
P_Mehlich3	A/D2-M	8	9.48	17.51	184.75	2.07	1.11	1.66	9.70	0.27	51.96
P_Mehlich3	A/D2-V	6	2.04	2.45	120.24	0.77	0.43	0.36	4.35	0.30	6.30
P_Retention	A/D1-C	9	21.48	20.63	96.05	13.00	6.00	7.40	30.95	6.00	68.75
P_Retention	A/D1-M	94	45.25	22.12	48.89	38.75	13.25	27.00	63.38	1.00	96.20
P_Retention	A/D1-V	39	57.21	19.68	34.41	60.00	14.00	41.40	73.50	8.30	95.00

P_Retention	A/D2-C	8	32.72	28.83	88.10	21.55	11.70	10.05	55.75	9.70	87.80
P_Retention	A/D2-M	71	44.07	19.77	44.86	42.00	12.40	29.15	54.40	10.00	97.80
P_Retention	A/D2-V	62	56.63	18.69	33.00	54.00	17.17	42.83	74.68	20.50	94.35

[a] String FAO74_text consists of the FAO code for the major soil group (e.g., A for Acrisols, followed by "/" and a code for the depth layer (D1= 0 to20 cm, D2= 20 to 40 cm, etc.), then "-" and the code for the soil textural class (C= Coarse, M=Medium and Medium Fine, V= Fine and Very fine; see Figure 1). Units of measurement are listed in Appendix 5 .

A summary of the coefficients of variation, observed for all FAO soil groupings and depth zones, is presented in Table 7. Similar data are presented in Table 8, which further clusters the available data according to soil textural class. Again, CVs are largest for the various available P-methods, generally well in excess of 100% up to 461% (for P-Bray1, case "D3-V"), and lowest for P-retention (some 50-70%). For the available P-methods, part of the variation may be due to land use history, in particular P-fertilizer application, but this aspect cannot be assessed in view of the lack of detailed land use data. This was also the case for an earlier study that focused on P-Olsen data held in the ISRIC-WISE soil profile database (Batjes 2010).

Table 7. Summary of coefficients of variation for available-P and P-retention, for five depth layers, as observed for the various major soil groups

Variable	Layer	N[a]	Avg. of CV	Min. of CV	Max. of CV
P_BRAY1	D1	20	134	71	224
P_BRAY1	D2	20	183	99	331
P_BRAY1	D3	20	190	90	311
P_BRAY1	D4	20	178	118	325
P_BRAY1	D5	20	175	105	323
P_H2O	D1	6	126	70	194
P_H2O	D2	3	105	84	119
P_H2O	D3	4	122	62	219
P_H2O	D4	4	131	67	211
P_H2O	D5	4	152	91	273
P_Mehlich3	D1	10	128	65	236
P_Mehlich3	D2	10	146	105	233
P_Mehlich3	D3	10	140	107	199
P_Mehlich3	D4	9	144	91	201
P_Mehlich3	D5	9	136	92	194
P_Olsen	D1	8	95	51	130
P_Olsen	D2	7	127	60	223
P_Olsen	D3	7	134	76	185
P_Olsen	D4	7	129	113	180
P_Olsen	D5	7	121	84	187

Variable	Layer	N[a]	Avg. of CV	Min. of CV	Max. of CV
P_retention	D1	21	54	32	69
P_retention	D2	19	52	30	71
P_retention	D3	19	58	35	85
P_retention	D4	18	63	37	108
P_retention	D5	18	67	36	97

[a] N refers to the total number of FAO soil groups for which coefficients of variation (CV in per cent) are available. For these, the average, minimum and maximum CV are presented here. Inherently, the number of profiles having P-data, for the analytical method under consideration, will vary with each FAO soil group (see Appendix 3 for details). Only major soil groups represented by at least five profiles are considered in this overview.

Table 8. Summary of coefficients of variation for available-P and P-retention, for five depth layers and three textural classes, as observed for the various major soil groups

Variable	Layer/Texture	N[a]	AvgOfCV	MinOfCV	MaxOfCV
P_BRAY1	D1-C	14	120	66	216
P_BRAY1	D1-M	19	129	61	251
P_BRAY1	D1-V	10	148	74	297
P_BRAY1	D2-C	14	136	63	257
P_BRAY1	D2-M	15	181	67	333
P_BRAY1	D2-V	10	194	108	323
P_BRAY1	D3-C	14	148	100	212
P_BRAY1	D3-M	15	197	125	299
P_BRAY1	D3-V	11	199	90	461
P_BRAY1	D4-C	14	155	89	257
P_BRAY1	D4-M	15	162	108	326
P_BRAY1	D4-V	11	181	117	228
P_BRAY1	D5-C	14	130	68	193
P_BRAY1	D5-M	13	163	82	345
P_BRAY1	D5-V	10	175	79	263
P_H2O	D1-M	6	128	60	208
P_H2O	D2-M	3	111	77	129
P_H2O	D3-M	4	120	57	206
P_H2O	D4-M	3	121	31	198
P_H2O	D5-C	1	155	155	155
P_H2O	D5-M	3	127	77	227
P_Mehlich3	D1-C	2	94	65	124
P_Mehlich3	D1-M	8	125	88	219
P_Mehlich3	D1-V	2	106	88	124
P_Mehlich3	D2-C	5	109	86	171
P_Mehlich3	D2-M	7	136	97	190
P_Mehlich3	D2-V	5	154	120	254
P_Mehlich3	D3-C	3	128	66	199
P_Mehlich3	D3-M	6	130	84	204

Variable	Layer/Texture	N[a]	AvgOfCV	MinOfCV	MaxOfCV
P_Mehlich3	D3-V	5	129	109	165
P_Mehlich3	D4-C	2	63	38	88
P_Mehlich3	D4-M	7	134	83	174
P_Mehlich3	D4-V	6	117	52	178
P_Mehlich3	D5-C	3	74	68	84
P_Mehlich3	D5-M	6	146	81	194
P_Mehlich3	D5-V	6	108	51	179
P_Olsen	D1-C	2	58	50	67
P_Olsen	D1-M	7	95	51	125
P_Olsen	D1-V	2	58	53	63
P_Olsen	D2-C	2	76	60	91
P_Olsen	D2-M	5	123	112	134
P_Olsen	D2-V	2	131	68	195
P_Olsen	D3-C	1	103	103	103
P_Olsen	D3-M	5	147	123	169
P_Olsen	D3-V	3	114	95	142
P_Olsen	D4-C	2	57	28	86
P_Olsen	D4-M	5	121	87	151
P_Olsen	D4-V	3	95	81	110
P_Olsen	D5-C	1	123	123	123
P_Olsen	D5-M	5	119	80	140
P_Olsen	D5-V	2	74	53	94
P_retention	D1-C	12	69	47	106
P_retention	D1-M	16	49	25	66
P_retention	D1-V	8	37	29	44
P_retention	D2-C	13	65	41	93
P_retention	D2-M	16	50	26	71
P_retention	D2-V	10	39	28	58
P_retention	D3-C	11	65	42	91
P_retention	D3-M	16	55	38	74
P_retention	D3-V	10	41	30	50
P_retention	D4-C	14	74	26	145
P_retention	D4-M	14	59	43	82
P_retention	D4-V	9	43	30	57
P_retention	D5-C	14	77	47	95
P_retention	D5-M	15	65	44	108
P_retention	D5-V	11	45	28	59

[a] N refers to the total number of FAO soil groups for which coefficients of variation (CV in per cent) are available for each combination of depth layer and soil textural class. For these, the average, minimum and maximum CV are presented here. Inherently, the number of profiles with P-data, for the analytical method and cluster under consideration, will vary with each FAO soil group (see Appendix 3 for details).

3.6 Best subset multiple linear regression

The above summary and discussion of the available data illustrate that there is little scope for coupling the present median soil-P data, for a given analytical

method and depth layer, to spatial (GIS) soil layers that characterize soils according to the FAO74 Legend. A complicating factor in this respect is that specific methods for determining available P are recommended for given soil types, largely as a function of soil pH and overall soil mineralogy (Elrashidi 2010). This aspect has been discussed in greater detail in a preceding study that focused on P-Olsen data held in the ISRIC-WISE database (Batjes 2010). Further, as indicated earlier, except for the "1 percent citric extractable soil P" method, extractable P is not used a diagnostic criterion for demarcating FAO soil units (FAO 1988).

As a possible alternative, the scope for establishing predictive (*though not necessarily causal*) relationships between soil-P values, determined according to a given analytical method, and a number of independent soil variables was investigated. For this study, possible predictor variables should also occur in the spatial soil database selected as input for future nutrient-crop response modelling. This precludes consideration of any mineralogical analyses, although such variables occur in the USDA-SLL dataset. Mineralogy, for example, through weathering is known to be an important determinant of extractable P (Dixon *et al.* 1977) as are former applications of P-containing fertilizers.

Best subset regression, which identifies the best regression models given a full model that contains all the potential predictor variables of interest, was used for this purpose (Analytical Software 2000). The procedure lists a number of subset models with the highest R^2 for each model size. All candidate variables were defined as "non-forced independent variables." All models were fitted with a constant term (i.e., not forced through the origin).

Best subset regressions for P-Bray1 and P-retention were carried out using the following possible predictor variables: content of clay, organic carbon (as a proxy for soil organic matter, a possible source of organic-P forms), pH_{water} and CEC_{clay} (defined here as CEC_{NH4} per 100 g clay, not corrected for the contribution of organic matter to be used as a coarse proxy for clay mineralogy). However, since both the content and type of clay minerals resp. organic matter largely determine the cation exchange capacity (CEC), generally the latter could not be considered in view of observed co-variation. Similarly, the possible effects of combinations of, for example, (sand + silt), (clay * clay), (orgc * orgc) or (pH_{water} * pH_{water}) were tested during preliminary analyses. These indicated that, generally, such "combined variables" are highly correlated with other predictor variables. Variation inflation factors (VIF) greater than 7.0 were often reported and these provide a statistical measure for co-linearity (Analytical Software 2000). Further, it should be noted that complex relationships occur between soil-P and soil pH (e.g., Landon 1991 p. 116-117). At low pH, P is liable to be fixed by Fe, Al and Mn while insoluble P-forms occur at high pH values. Hence, the use of specific extractants for given soil-pH ranges, as described by Elrashidi (2010) and others.

For samples from all mineral soils, the highest adjusted R^2 values emanating from best subset regression for P-Bray1 is < 0.1. R^2 values close to zero

indicate that there is no linear fit between the explaining variables (X_i) under consideration and the variable to be explained (Ys); the best-fit line is a horizontal line going through the mean of all Y values (Analytical Software 2000). Similarly, various stepwise regressions for this data set lead to an adjusted R^2 < 0.15, again pointing at the non-existing predictive capability of such functions. Since the P-Bray1 method is recommended for acid soils, similar analyses were also carried out excluding all depth-weighted samples with a pH_{water} greater than 7. Again, adjusted R^2 values hovered around zero (<0.1, n= 5577, see Table 9).

Best stepwise regressions for P-Bray1, by major soil group, are presented in Table 9; for each case, the main predictor variables are listed. R^2 values ranges from 0.00 for Histosols to 0.55 for Yermosols, with an average of 0.16. This points at a poor predictive capability of the various regression model(s). This was confirmed by plots of standardized residuals against fitted values (Analytical Software 2000, p. 173).

It should be noted that Yermosols, for which the highest R^2 value was found in this study, occur in arid regions and are moderately alkaline to alkaline (Batjes 1995). As such, extraction with a dilute acid as used for P-Bray1 is not recommended for Yermosols, but rather the P-Olsen method (Elrashidi 2010).

Table 9. Best subset regressions for P-Bray1 by major soil group

FAO major soil group		P-Bray1			
Code	Name	N	R^2	SE	Vars
A	Acrisols	919	0.125	42.5	K,P,C,O,Os
B	Cambisols	1154	0.072	47.8	K,C,O,Cs
C	Chernozems	273	0.139	19.4	K,O,Cs,Os
D	Podzoluvisols	73	0.296	17.1	K,P,O
E	Rendzinas	ND[b]	-	-	-
F	Ferralsols	112	0.351	6.77	K,Os
G	Gleysols	500	0.008	34.0	K,C
H	Phaeozems	383	0.080	28.4	K,O,Os
I	Lithosols	ND	-	-	-
J	Fluvisols	75	0.179	17.3	K,P
K	Kastanozems	ND	-	-	-
L	Luvisols	1441	0.046	39.1	K,C,O,Os
M	Greyzems	ND	-	-	-
N	Nitosols	ND	-	-	-
O	Histosols	62	0.000	14.9	K
P	Podzols	118	0.080	22.3	K,E
Q	Arenosols	169	0.000	66.6	K
R	Regosols	207	0.129	60.4	K,C,O
S	Solonetz	56	0.217	16.9	K,C,E
T	Andosols	392	0.025	32.7	K,C,E
U	Rankers	ND	-	-	-

FAO major soil group				P-Bray1	
Code	Name	N	R^2	SE	Vars
V	Vertisols	242	0.267	19.5	K,C,Os
W	Planosols	41	0.218	13.9	K,O
X	Xerosols	227	0.275	8.6	K,P,C
Y	Yermosols	70	0.554	6.1	K,P
Z	Solonchaks	ND	-	-	-
ALL[c]	Mineral units	7339	0.027	37.8	K,P,C,O
	Mineral, pH<7	5577	0.039	41.3	K,C,O,Ps

[a] Vars stands for significant independent variables (P<0.05): P= pH_{water}, C= clay content, O= Organic carbon, E= CEC_{NH4} $mmol_c$ per 100 gram clay (not corr. for OC); subscript 's' indicates squared values. All models were fitted with a constant term (K). P to enter resp. exit the regression is set at 0.05. All independent variables with VIF's > 7 were removed from the analyses. SE is the standard error of estimate (Analytical Software 2000)

[b] ND stand for no data (defined here as n < 30, see text for details).

[c] Stands for samples from mineral soils, undifferentiated (i.e., excluding Histosols)

Stepwise regressions for P-retention (*New Zealand)* are listed in Table 10. For the whole population of mineral soils, the adjusted R^2 is 0.15. Alternatively, when data are clustered according to major soil group, adjusted R^2 values range from zero for Vertisols to 0.44 for Acrisols. With such low levels of influence, most regressions would not be useful in estimating, much less predicting, soil P-retention (Snedecor and Cochran 1980). Typically, P retention is meant to assess andic properties of soils (WRB 2006).

Table 10. Best subset regressions for P-retention by major soil group

FAO major soil group				P-retention	
Code	Name	N	R^2	SE	Vars
A	Acrisols	686	0.440	16.1	K,P,C,O,E,Os
B	Cambisols	2303	0.336	20.8	K,P,O,E
C	Chernozems	430	0.091	14.3	K,C,O,E
D	Podzoluvisols	114	0.305	12.5	K,O,E
E	Rendzinas	ND	-	-	-
F	Ferralsols	297	0.095	19.0	K,E
G	Gleysols	668	0.286	16.2	K,P,C,O
H	Phaeozems	133	0.045	20.4	K,E
I	Lithosols	ND	-	-	-
J	Fluvisols	74	0.421	13.0	K,C
K	Kastanozems	1449	0.177	15.6	K,C,O,E
L	Luvisols	1244	0.223	15.3	K,P,C,O,E
M	Greyzems	ND	-	-	-
N	Nitosols	ND	-	-	-
O	Histosols	64	0.291	20.5	K,P,O
P	Podzols	1147	0.245	23.1	K,C,O,Os
Q	Arenosols	291	0.035	14.2	K,O,E

FAO major soil group		P-retention			
Code	Name	N	R^2	SE	Vars
R	Regosols	205	0.146	13.2	K,P,C
S	Solonetz	58	0.399	15.9	-
T	Andosols	1690	0.218	24.5	K,P,O,E
U	Rankers	ND	-	-	-
V	Vertisols	130	0.000	15.2	K
W	Planosols	ND	-	-	-
X	Xerosols	316	0.194	19.7	K,C,Ps
Y	Yermosols	ND	-	-	-
Z	Solonchaks	ND	-	-	-
ALL[c]	Mineral units	11266	0.148	24.1	K,P,C,O,E

[a] Vars stands for significant independent variables (P<0.05): P= pH_{water}, C= clay content, O= Organic carbon, E= CEC_{NH4} $mmol_c$ per 100 gram clay (not corr. for OC); subscript 's' indicates squared values. All models were fitted with a constant term (K). P to enter resp. exit the regression is set at 0.05. All independent variables with VIF's > 7 were removed from the analyses. SE is the standard error of estimate (Analytical Software 2000)

[b] ND stand for no data (defined here as n < 30, see text).

[c] ALL stands for samples from mineral soils, undifferentiated (i.e., excluding Histosols)

3.7 Use of proxy values

According to the above analyses, and earlier work concerning P-Olsen data in the ISRIC-WISE database (Batjes 2010), the following may be concluded. Based on the present selection of legacy data, derived from *purposive* sampling, representative P-measures (e.g., medians or regression equations) by FAO soil group could not be established to support food security studies at global and continental level. This is not unexpected in view of the complex nature of soil-P interactions (Dabin 1980; De Geus 1973; Fairhurst *et al.* 1999; Ryan and Rashid 2006). Further, for a given extractant, soil/extractant ratio and extraction time, the soil P test calibration (i.e., relationship between yield, expressed as a percentage of the maximum yield, and soil P test), will generally differ for different plant species and for different fertilizer types, subject to the prevailing agro-ecological conditions (e.g., Bolland *et al.* 1994; De Geus 1973; Landon 1991; Thomas and Peaslee 1973).

Proxy-based approaches that also take into account soil fertilizer use for broadly defined land use/crop types —for defined grid cells, using GIS overlays— may need to be developed as a first approximation by the relevant modelling groups. For example, for naturally P-deficient, weathered soils from Africa that are assumed to be unfertilized, a default value of 0-15 mg P-Bray kg^{-1} (Landon 1991; Thomas and Peaslee 1973) could be assumed as a proxy for soil conditions where crop response to fertilizer application is most likely. The relative distribution of soil units having such properties, within a grid cell, may be identified using quantitative land evaluation (FAO 1976; Sys *et al.* 1993). A similar approach may be used for soil regions where P-Olsen is the recommended method for analysing available P, but other class intervals should then be used (e.g., 0-5 mg P-Olsen kg^{-1}) (Landon 1991; Thomas and Peaslee 1973). This would imply the availability of validated P-extraction method-

specific, "soil nutrient crop-response" models that also consider interactions between N-P-K. Without the crop-uptake dimension, soil P-test values are generally of limited value (e.g., Bolland *et al.* 1994; Landon 1991; Tabi *et al.* 2008). For example, QUEFTS (Janssen *et al.* 1990) a system for quantitative evaluation of the fertility of tropical soils, specifically considers soil N-P_{Olsen}-K relationships with maize as the reference crop, for defined boundary conditions. As has been indicated in the introduction, different types of predicative models will be needed to evaluate the effects P-fertilizer application under different soil, management, and climatic conditions, for use at various scales.

Seen the large uncertainties regarding any soil P measurement and the fact that soil P (for any given extraction method) is affected by farmers' nutrient management practices, attainable yields may need to be calculated assuming fixed ranges for plant-extractable P for broadly defined, *unfertilized*, soil classes (i.e., low, medium or high response to P-fertilizers likely). The location of inherently unfertile as well as more fertile soil units can be identified/mapped using quantitative land evaluation (FAO 1976, 1983) and soil parameter estimates held in spatial databases (e.g., Batjes 2006; FAO/IIASA/ISRIC/ISSCAS/JRC 2009). This information may then be combined with GIS layers of P-fertilizer application rates, as mentioned earlier. In principle, such a pragmatic approach should permit the assessment of so-called "windows-of-opportunity" for crop yields on nutrient-deficient soils of say Africa, as a first approximation (e.g., Bouma *et al.* 1998).

Development and testing of appropriate "soil-nutrient crop-response" models for specific climate zones, soil types and land use/crop types will require detailed analyses of field experimental data (e.g, Janssen *et al.* 1990; Kumar *et al.* 1994; Tabi *et al.* 2008). Such work is on going at the Plant Production Systems Group (PPS) of Wageningen University and Research Centre (*pers. comm.* Sheida Sattari). The present derived data[1] set may be used to support such investigations.

4. CONCLUSIONS

- Soil P-levels measured according to P-Bray1 vary greatly within and between major soil groups, possibly due to differences in soil mineral composition and weathering intensity. Part of the observed variation may also be due to land use history at the sites under consideration, but this hypothesis cannot be assessed with the available information.

- Median values for P for defined soil laboratory methods and soil classes presented here are not considered representative for any specific geographic area. The present findings are based on analyses of a relatively

[1] http://www.isric.org/isric/CheckRegistration.aspx?dataset=69

small number of soil profiles, most of which originate from the USA, grouped according to major FAO soil group. Present findings preclude any meaningful linkage of derived values for P-Bray1, as calculated here for selected FAO soil groups and depth layers, to global soil databases that consider the FAO Legend as input for model-based studies of food security at a broad scale.

- There is little scope for developing multiple-regressions to predict P-Bray1 and P-retention from soil variables that are commonly represented in global GIS data sets, derived from the Soil Map of the World, using the current selection of soil profiles.

- Proxy-based approaches that take into account regional differences in soil types and fertilizer use for broadly defined land utilization types may need to be developed as a first approximation. In principle, such a pragmatic approach should allow to propose "windows-of-opportunity" for feasible crop yields on nutrient-limited soils of say Africa, subject to the availability of a regionally validated model.

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REFERENCES

Analytical Software 2000. *Statistix for Windows (ver. 7.0)*. Analytical Software, Talahasee, 333 p

Batjes NH 1995. *A global data set of soil pH properties*. Tech. Pap. 27, ISRIC, Wageningen (available at: http://www.isric.org/Isric/webdocs/Docs/ISRIC_TechPap27.pdf), pp 28

Batjes NH, Fischer G, Nachtergaele FO, Stolbovoy VS and van Velthuizen HT 1997. *Soil data derived from WISE for use in global and regional AEZ studies (ver. 1.0)*. Interim Report IR-97-025, FAO/ IIASA/ ISRIC, Laxenburg (http://www.iiasa.ac.at/Admin/PUB/Documents/IR-97-025.pdf), pp 27

Batjes NH 2002. Revised soil parameter estimates for the soil types of the world. *Soil Use and Management* 18, 232-235

Batjes NH 2006. *ISRIC-WISE derived soil properties on a 5 by 5 arc-minutes global grid (ver. 1.0)*. Report 2006/02, ISRIC - World Soil Information, Wageningen [Available at: http://www.isric.org/isric/webdocs/Docs/ISRIC_Report_2006_02.pdf; last accessed March 2009], pp 50

Batjes NH, Al-Adamat R, Bhattacharyya T, Bernoux M, Cerri CEP, Gicheru P, Kamoni P, Milne E, Pal DK and Rawajfih Z 2007. Preparation of consistent soil data sets for SOC modelling purposes: secondary SOTER data sets for four case study areas. *Agriculture, Ecosystems and Environment* 122, 26-34

Batjes NH 2010. *Inventory of P-Olsen data in the ISRIC-WISE soil database for use with QUEFTS*. Report 2010/06, ISRIC Report 2010/06, ISRIC - World Soil Information, Wageningen (http://www.isric.org/isric/Webdocs/Docs/ISRIC_Report_2010_06.pdf), pp 25 with data set

Bindraban PS, Löffler H and Rabbinge R 2008. How to close the ever widening gap of Africa's agriculture. *International Journal Technology and Globalisation* 4, 276–295

Bolland MDA, Kumar V and Gilkes RJ 1994. A comparison of five soil phosphorus tests for five crop species for soil previously fertilized with superphosphate and rock phosphate. *Nutrient Cycling in Agroecosystems* 37, 125-132

Bouma J, Batjes NH and Groot JJR 1998. Exploring land quality effects on world food supply. *Geoderma* 86, 43-59

Bouwman AF, Beusen AHW and Billen G 2009. Human alteration of the global nitrogen and phosphorus soil balances for the period 1970 -2050. *Global Biogeochem. Cycles* 23, GB0A04, doi:10.1029/2009GB003576

Burt R (editor) 2004. Soil survey laboratory methods manual, Soil Survey Investigations Report No. 42, Version 4.0. United States Department of Agriculture, Natural Resources Conservation Service, 700 (available at: ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab_Methods_Manual/SSIR42_2004_print.pdf) p

Cope JT, Rouse JR and Rouse RD 1973. Interpretation of soil test results. In: Walsh L. M. and J. D. Beaton (editors), *Soil testing and plant analysis*. Soil Science Society of America, Madison, WI pp 35-55

Dabin B 1967. *Sur une méthode d'analyse du phosphore dans les sols tropicaux. Colloque sur la fertilité des sols tropicaux. Tananarive (Madagascar, Nov. 1967)*, IRAT, Montpellier

Dabin P 1980. Phosphorus deficiency in tropical soils as a constraint on agricultural output, *Priorities for alleviating soil-related constraints to food production in the tropics*. IRRI, Los Banos (Philippines), pp 217-233

Daroub SH, Gerakis A, Ritchie JT, Friesen DK and Ryan J 2003. Development of a soil-plant phosphorus simulation model for calcareous and weathered tropical soils. *Agricultural Systems* 76, 1157-1181

De Geus JG 1973. *Fertilizer guide for the tropics and subtropics (sec. ed.)*. Centre d' étude de l' Azote, Zurich

Dixon JB, Weed SB, Kittrick JA, Milford MH and White JL 1977. *Minerals in soil environments*. Soil Science Society of America, Madison (WI), 948 p

Dzotsi KA, Jones JW, Adiku SGK, Naab JB, Singh U, Porter CH and Gijsman AJ 2010. Modeling soil and plant phosphorus within DSSAT. *Ecological Modelling* 221, 2839-2849

Elrashidi MA 2010. *Selection of an appropriate phosphorus test for soils*, Soil Survey Laboratory, USDA, Lincoln (NE) (available at ftp://ftp-fc.sc.egov.usda.gov/NSSC/Analytical_Soils/phosphor.pdf; last accessed 04 May 2010)

ESB 2001. *Georefenced soil database for Europe, Manual of Procedures (version 1.0)*, Report EUR 18092 EN, European Soil Bureau (on behalf of the Contributing Organisations), Office for Official Publications of the European Communities, Luxembourg (available at: http://eusoils.jrc.ec.europa.eu/esdb_archive/eusoils_docs/esb_rr/n05_ManualVer11EN4.pdf), pp 178

Fairhurst T, Lefroy R, Mutert E and Batjes NH 1999. The importance, distribution and causes of P deficiency as a constraint to crop production in the tropics. *Agroforestry Forum* 9, 2-8

Falkengren-Grerup U, Brink D-Jt and Brunet J 2006. Land use effects on soil N, P, C and pH persist over 40-80 years of forest growth on agricultural soils. *Forest Ecology and Management* 225, 74-81

FAO-Unesco 1974. *Soil Map of the World, 1:5,000,000. Vol. 1 - Legend*, United Nations Educational, Scientific, and Cultural Organization, Paris

FAO 1976. *A framework for land evaluation*. Soils Bulletin No. 32, Food and Agriculture Organization of the United Nations, Rome

FAO 1983. *Guidelines: land evaluation for rainfed agriculture*. FAO Soils Bulletin 52, Food and Agriculture Organization of the United Nations, Rome, pp 237

FAO 1988. *FAO-Unesco Soil Map of the World, Revised Legend, with corrections and updates*. World Soil Resources Report 60, FAO, Rome; reprinted with updates as Technical Paper 20 by ISRIC, Wageningen,1997, pp 140

FAO 1993. *World Soil Resources: An explanatory note on the FAO World Soil Resources map at 1:25,000,000 scale*. World Soil Resources Report 66 (rev. 1), Food and Agriculture Organization of the United Nations, Rome, pp 61

FAO/IIASA/ISRIC/ISSCAS/JRC 2009. *Harmonized World Soil Database (version 1.1)*, Food and Agriculture Organization of the United Nations, International Institute for Applied Systems Analysis, ISRIC - World Soil Information, Institute of Soil Science - Chinese Academy of Sciences, Joint Research Centre of the European Commission, Laxenburg. Available at http://www.iiasa.ac.at/Research/LUC/luc07/External-World-soil-database/HTML/index.html?sb=1; last accessed 10/2009

Fraterrigo JM, Turner MG, Pearson SM and Dixon P 2005. Effects of past Land Use on Spatial Heterogeneity of Soil Nutrients in Southern Appalachian Forests. *Ecological Monographs* 75, 215-230

Gichuru MP, Bationo A, Bekunda MA, Goma HC, Mafongonya PL, Mugenid DN, Murwira HM, Nandwa SM, Nyathi P and Swift MJ (editors) 2003. Soil fertility

management in Africa: A regional perspective. Academy Science Publishers, Nairobi, 306 p

Greenwood DJ, Karpinets TV and Stone DA 2001. Dynamic Model for the Effects of Soil P and Fertilizer P on Crop Growth, P Uptake and Soil P in Arable Cropping: Model Description. *Annals of Botany* 88, 279-291

Harrison JA, Bouwman AF, Mayorga E and Seitzinger S 2010. Magnitudes and sources of dissolved inorganic phosphorus inputs to surface fresh waters and the coastal zone: A new global model. *Global Biogeochem. Cycles* 24

Hoffland E, Boogaard R, Nelemans J and Findenegg G 1992. Biosynthesis and root exudation of citric and malic acids in phosphate-starved rape plants. *New Phytologist* 122, 675-680

Hoffland E, Kuyper TW, Wallander Hk, Plassard C, Gorbushina AA, Haselwandter K, HolmstrÃ¶m S, Landeweert R, LundstrÃ¶m US, Rosling A, Sen R, Smits MM, van Hees PA and van Breemen N 2004. The role of fungi in weathering. *Frontiers in Ecology and the Environment* 2, 258-264

Janssen BH, Guiking FCT, van der Eijk D, Smaling EMA, Wolf J and van Reuler H 1990. A system for quantitative evaluation of the fertility of tropical soils (QUEFTS). *Geoderma* 46, 299-318

Keating BA, Carberry PS, Bindraban PS, Asseng S, Meinke H and Dixon J 2010. Eco-efficient Agriculture: Concepts, Challenges, and Opportunities. *Crop Science* 50, S109 – S119

Kozar B, Lawrence R and Long DS 2002. Soil Phosphorus and Potassium Mapping Using a Spatial Correlation Model Incorporating Terrain Slope Gradient. *Precision Agriculture* 3, 407-417

Kumar V, Bolland MDA and Gilkes RJ 1994. Comparison of the P_i, Colwell, Bray 1, calcium acetate lactate (CAL) and Truog soil phosphorus test for predicting growth of oats, barley, triticale and clover in the field in lateritic soils fertilised with superphosphate and rock phosphate. *Nutrient Cycling in Agroecosystems* 37, 115-124

Landon JR 1991. *Booker Tropical Soil Manual*. Longman Scientific & Technical, New York, 474 p

Lesschen J, Stoorvogel J, Smaling E, Heuvelink G and Veldkamp A 2007. A spatially explicit methodology to quantify soil nutrient balances and their uncertainties at the national level. *Nutrient Cycling in Agroecosystems* 78, 111-131

NCSS 2010. *National Cooperative Soil Survey. National Cooperative Soil Characterization Database (available at: http://ssldata.nrcs.usda.gov/)*

Ryan J and Rashid A 2006. Phosphorus. In: Lal R. (editor), *Encyclopedia of Soil Science, Vol. 2*. Taylor & Francis, New York, pp 1275-1279

Schoenberger PJ, Wysicki DA, Benham EC and Broderson WD 2002. *Field book for describing and sampling soils (ver. 2.0)*. National Soil Survey Center, Natural Resources Conservation Service, USDA, Lincoln NE (Available through: ftp://ftp-fc.sc.egov.usda.gov/NSSC/Field_Book/FieldBookVer2.pdf; Accessed: June 2008)

Schulp CJE and Verburg PH 2009. Effect of land use history and site factors on spatial variation of soil organic carbon across a physiographic region. *Agriculture, Ecosystems & Environment* 133, 86-97

Smaling EMA 1998. Nutrient balances as indicators of productivity and sustainability in Sub-Saharan Africa. *Agriculture, Ecosystems and Environment* 71, 1-346

Snedecor GW and Cochran WG 1980. *Statistical Methods (7th. ed.)*. The Iowa State University Press, Iowa, 507 p

Soil Survey Staff 1983. *Soil Survey Manual (rev. ed.)*. United States Agriculture Handbook 18, USDA, Washington (Available through: http://soils.usda.gov/technical/manual/; Accessed: June 2008)

Soil Survey Staff 2010. *Keys to Soil Taxonomy, 11th ed.* USDA-Natural Resources Conservation Service, Washington, DC. (ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Taxonomy/keys/2010_Keys_to_Soil_Taxonomy.pdf)

Spaargaren OC and Batjes NH 1995. *Report on the classification into FAO-Unesco soil units of profiles selected from the NRCS pedon database for IGBP-DIS*. Work. Pap. 95/01, ISRIC, Wageningen, pp 15

Stoorvogel J, Smaling EMA and Janssen BH 1993. Calculating soil nutrient balances in Africa at different scales. *Fertilizer Research* 35, 227-235

Sys IC, van Ranst E, Debaveye IJ and Beenaert F 1993. *Land evaluation (Part I - III)*, Agricultural Publications, General Administration for Development Cooperation, Brussels, pp 199

Tabi F, Diels J, Ogunkunle A, Iwuafor E, Vanlauwe B and Sanginga N 2008. Potential nutrient supply, nutrient utilization efficiencies, fertilizer recovery rates and maize yield in northern Nigeria. *Nutrient Cycling in Agroecosystems* 80, 161-172

Thomas GW and Peaslee DE 1973. Testing soils for phosphorus. In: Walsh L. M. and J. D. Beaton (editors), *Soil testing and plant analysis (rev. ed.)*. Soil Science Sociery of America, Madison (WI), pp 115-132

van Engelen VWP and Dijkshoorn JA 2010. *Global and National Soils and Terrain Digital Databases (SOTER; Version 2.0, in prep.)*. (Published also as FAO World Soil Resources Report No. 74), IUSS, ISRIC and FAO, Wageningen, pp 125

Wang YP, Law RM and Pak B 2009. A global model of carbon, nitrogen and phosphorus cycles for the terrestrial biosphere. *Biogeosciences Discuss.* 6, 9891-9944

WRB 2006. *World Reference Base for soil resources - A framework for international classification, correlation and communication*. World Soil Resources Reports 103, International Union of Soil Sciences, ISRIC - World Soil Information and Food and Agriculture Organization of the United Nations, Rome, pp 128

APPENDICES

Appendix 1. Structure of harmonized data set

Field Name	Data Type	Description
pedon_key	Number	Unique identifier for profile
lat_point	Number	Lattitude (dd)
long_point	Number	Longitude (dd)
FAO74maj_CODE	Text	Code for FAO 1974 major soil group (FAO-Unseco 1974)
FAO74_NAME	Text	Name for above
Trunc_FINAL	Text	USDA soil classification (truncated)
TOPorBOT	Text	Code for depth layer (D1=) to 20 cm; D2= 20-40 cm; D3=40-60 cm; D4=60-80 cm; D5=80-100 cm)
NofLayers	Number	Number of data(subests) considered to compute the depth-weigted values
p_nz	Number	p_Retention (depth-weighted value)
p_brayI	Number	p_Bray1
p_brayZ	Number	p_Bray2
p_olsn	Number	p_Olson
p_mehlich3	Number	p_Mehlich3
p_h2o	Number	P measured in water
pHwater	Number	pH measured in water
CEC_nh4	Number	CEC, measured in H44
CEC_sum	Number	CEC, sum of bases (at pH8.2)
sand	Number	sand content
silt	Number	silt content
clay	Number	clay content
Texture	Text	textural class (see report for details)
ORGcon	Number	Organic carbon content (from OC (organic carbon), resp. as total C (c_tot) corrected for CaCO3 contributions
TOTN	Number	Total N
EXk	Number	Exchageable potassium

Note: Analytical methods are described in Appendix 5

Appendix 2. Correlation of USDA soil types to FAO major soil groups

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
A	Acrisols	Paleaquult
A	Acrisols	Kandiudult
A	Acrisols	Haploxerult
A	Acrisols	Haplohumult
A	Acrisols	Kandiustult
A	Acrisols	Sombrihumult
A	Acrisols	Ochraquult
A	Acrisols	Kanhaplaquult
A	Acrisols	kanhapludult
A	Acrisols	Palexerult
A	Acrisols	Kanhaplustult
A	Acrisols	Fragiudult
A	Acrisols	Hapludult
A	Acrisols	Plinthustult
A	Acrisols	Kanhaplohumult
A	Acrisols	Tropudult
A	Acrisols	Tropohumult
A	Acrisols	Fragiaquult
A	Acrisols	fragiudult
A	Acrisols	Palehumult
A	Acrisols	Arenic Hapludult
A	Acrisols	paleudult
A	Acrisols	Tropaquult
A	Acrisols	arenic paleudult
A	Acrisols	Paleudults, fine-loamy, siliceous, semiactive, thermic
A	Acrisols	Paleustult
A	Acrisols	Haplustult
A	Acrisols	endoaquult
A	Acrisols	Plinthustult
A	Acrisols	Plinthaquic Paleudult
A	Acrisols	Plinthic Kanhapludult
A	Acrisols	Plinthic Paleudult
A	Acrisols	Paleudult
A	Acrisols	Umbraquult
A	Acrisols	Paleustult
A	Acrisols	Epiaquult
A	Acrisols	Plinthohumult
A	Acrisols	Cuirustult
A	Acrisols	Kanhapludult
A	Acrisols	Palehumult
A	Acrisols	Kandiustult
A	Acrisols	plinthic kandiudult
A	Acrisols	Kandiaquult
A	Acrisols	Hapludult (Hapludalf)
A	Acrisols	hapludult

[1] This list should be seen as a first approximation. It was made specifically for this study using simple assumptions (see text for details). As indicated by Spaargaren and Batjes (1995), full scale correlation should take into account all soil attributes. Such an exercise is beyond the scope of this exploratory study.

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
A	Acrisols	Plinthudult
A	Acrisols	Kandhaplustult
A	Acrisols	Kanihumult
A	Acrisols	Kandhapludult
B	Cambisols	Molliturbel
B	Cambisols	Haplustept
B	Cambisols	Haploxerept
B	Cambisols	Haploturbel
B	Cambisols	Haplocryept
B	Cambisols	mixed, superactive Typic Haplocryept
B	Cambisols	Xeric Haplocambid
B	Cambisols	Ustochrept
B	Cambisols	mesic Dystric Fluventic Eutrochrept
B	Cambisols	Xerochrept
B	Cambisols	mesic Dystric Eutrochrept
B	Cambisols	Haplocambid
B	Cambisols	Hapludept
B	Cambisols	Fragiochrept
B	Cambisols	mixed, superactive Aquic Haplorocryept
B	Cambisols	Cryochrept
B	Cambisols	euthrochrept
B	Cambisols	Ustic Haplocambid
B	Cambisols	over loamy, mixed Cryumbrept
B	Cambisols	over loamy Cryumbrept
B	Cambisols	Humicryept
B	Cambisols	Pachic Humitropept
B	Cambisols	Eutrochrept
B	Cambisols	Ustochrept
B	Cambisols	Lithic Xerochrept
B	Cambisols	Fluventic Eutrochrept
B	Cambisols	calcixerept
B	Cambisols	Humitropept
B	Cambisols	Eutrogelept
B	Cambisols	Ustropept
B	Cambisols	Eutropept
B	Cambisols	Calciustept
B	Cambisols	Cryumbrept
B	Cambisols	Eutrudept
B	Cambisols	Haplumbrept
B	Cambisols	Eutrocryept
B	Cambisols	fluventic eutrudept
B	Cambisols	Calcicryept
B	Cambisols	Pachic Dystropept
B	Cambisols	Humic Dystropept
B	Cambisols	Humic Dystrudent
B	Cambisols	Cryumbrept
B	Cambisols	Dystrochrept
B	Cambisols	Dystrudept
B	Cambisols	Xerumbrept
B	Cambisols	isotic Typic Dystrocryept
B	Cambisols	Argid
B	Cambisols	Sulfudept
B	Cambisols	Dystrogelept
B	Cambisols	Dystrocryept
B	Cambisols	Ruptic-Xerorthentic Xerochrept

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
B	Cambisols	Ruptic-Alfic Eutrochrept
B	Cambisols	Eutrudept
B	Cambisols	Lithic Dystrocryept
B	Cambisols	Aquicambid
B	Cambisols	Haplocambid
B	Cambisols	Haplocryept
B	Cambisols	Aquic Dystrocryept
B	Cambisols	Anhyorthel
B	Cambisols	Dystric Xerochrept
B	Cambisols	Dystric Dystrochrept
B	Cambisols	haploxerept
B	Cambisols	Haplustept
B	Cambisols	Dystric Eutrudept
B	Cambisols	Durustept
B	Cambisols	Dystrochrept
B	Cambisols	Lithic Haplustept
B	Cambisols	Durixerept
B	Cambisols	Anhyorthel
B	Cambisols	Dystrustept
B	Cambisols	Durochrept
B	Cambisols	Dystrudept
B	Cambisols	Oxyaquic Dystrudept
B	Cambisols	Dystroxerept
B	Cambisols	Xerochrept
B	Cambisols	Xerumbrept
B	Cambisols	Fragiudept
B	Cambisols	Lithic Ustochrept
B	Cambisols	Haplorthel
B	Cambisols	Calciustept
B	Cambisols	Fragixerept
B	Cambisols	Dystropept
B	Cambisols	Psammentic Dystrudept
B	Cambisols	Fragiumbrept
B	Cambisols	Lithic Dystrudept
B	Cambisols	Dystric Eutrochrept
B	Cambisols	Durorthid
B	Cambisols	Cryochrept
B	Cambisols	Hapocryept
B	Cambisols	Humic Dystrudept
B	Cambisols	Terric Glacistel
B	Cambisols	Lithic Dystroxerept
B	Cambisols	Petrocambid
C	Chernozems	Pachic Cryoboroll
C	Chernozems	smectitic Aquic Cryoboroll
C	Chernozems	Udic Haploboroll
C	Chernozems	smectitic, mesic Lithic Argixeroll
C	Chernozems	Udic Argiboroll
C	Chernozems	Pachic Paleboroll
C	Chernozems	Paleboroll
C	Chernozems	Haploboroll
C	Chernozems	Palecryoll
C	Chernozems	Duricryoll
C	Chernozems	thermic Fluvaquentic Haploxeroll
C	Chernozems	Paleudoll
C	Chernozems	Vertic Cryoboroll

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
C	Chernozems	Cumulic Haplocryoll
C	Chernozems	Argiboroll
C	Chernozems	Haploxeroll
C	Chernozems	Haplocryoll
C	Chernozems	Haplogeloll
C	Chernozems	Cryoboroll
C	Chernozems	Haplocryoll
C	Chernozems	Argicryoll
C	Chernozems	Argialboll
C	Chernozems	Argiboroll
C	Chernozems	Argicryoll
C	Chernozems	mesic Typic Argiustoll
C	Chernozems	Calciboroll
C	Chernozems	Calcicryoll
C	Chernozems	thermic Udertic Argiustoll
C	Chernozems	Calciudoll
C	Chernozems	over loamy, smectitic Typic Argiboroll
C	Chernozems	over loamy Calcic Udic Cryoboroll
C	Chernozems	over loamy Cryoboroll
C	Chernozems	Vermiboroll
C	Chernozems	Cryic Paleboroll
C	Chernozems	Cryoboroll
D	Podzoluvisols	Glossic Fragiudult
D	Podzoluvisols	Glossaqualf
D	Podzoluvisols	Glossoboralf
D	Podzoluvisols	Fraglossudalf
D	Podzoluvisols	Oxyaquic Glossudalf
D	Podzoluvisols	Glossocryalf
D	Podzoluvisols	Glossudalf
D	Podzoluvisols	Fragic Glossaqualf
D	Podzoluvisols	Vertic Glossudalf
E	Rendzinas (Ex)	Lithic Argiustoll
E	Rendzinas (Ex)	Rendoll
E	Rendzinas (Ex)	Lithic Cryoboroll
E	Rendzinas (Ex)	Haprendoll
E	Rendzinas (Ex)	Lithic Rendoll
F	Ferralsols	Acrorthox
F	Ferralsols	Haplorthox
F	Ferralsols	Haploperox
F	Ferralsols	Kandiustox
F	Ferralsols	Kandiudox
F	Ferralsols	Hapludox
F	Ferralsols	Kandiperox
F	Ferralsols	Acrustox
F	Ferralsols	Haplaquox
F	Ferralsols	Acrudox
F	Ferralsols	Eutrudox
F	Ferralsols	Eutroperox
F	Ferralsols	Haplohumox
F	Ferralsols	Sombriorthox
F	Ferralsols	Rhodic Kandiustox
F	Ferralsols	Rhodic Kandiudox
F	Ferralsols	Rhodic Haplustox
F	Ferralsols	Rhodic Eutrustox
F	Ferralsols	Rhodic Eutrudox

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
F	Ferralsols	Acroperox
F	Ferralsols	Rhodic Acrudox
F	Ferralsols	Acrohumox
F	Ferralsols	Acraquox
F	Ferralsols	Gibbsihumox
F	Ferralsols	Lithic Hapludox
F	Ferralsols	Umbraquox
F	Ferralsols	Umbriorthox
F	Ferralsols	Eustrustox
F	Ferralsols	Haplustox
F	Ferralsols	Eutrotorrox
F	Ferralsols	Acrustox
F	Ferralsols	Hapludox
F	Ferralsols	Xanthic Eutrudox
F	Ferralsols	Eutrustox
G	Gleysols	Pergelic Cryaquept
G	Gleysols	mesic Vertic Haplaquoll
G	Gleysols	endoaquept
G	Gleysols	isohyperthermic Typic Argiaquoll
G	Gleysols	mixed, superactive Fluvaquentic Haplocryept
G	Gleysols	Endoaquent
G	Gleysols	Fragiaquept
G	Gleysols	Halaquept
G	Gleysols	Placaquept
G	Gleysols	Endoaquoll
G	Gleysols	Hydraquent
G	Gleysols	Epiaquept
G	Gleysols	Epiaquoll
G	Gleysols	Gelaquept
G	Gleysols	Haplaquept
G	Gleysols	Haplaquent
G	Gleysols	Fluvaquent
G	Gleysols	Petraquept
G	Gleysols	Epiaquent
G	Gleysols	Lithic Cryaquept
G	Gleysols	over loamy Fluvaquent
G	Gleysols	Tropic Fluvaquent
G	Gleysols	Epiaquoll
G	Gleysols	Cryaquept
G	Gleysols	Fluvaquent
G	Gleysols	Humaquept
G	Gleysols	Tropaquent
G	Gleysols	Cryaquoll
G	Gleysols	Udic Endoaquoll
G	Gleysols	Tropaquept
G	Gleysols	Epiaquept
G	Gleysols	Haplaquept
G	Gleysols	Argiaquoll
G	Gleysols	Vertic Endoaquoll
G	Gleysols	Aquept
G	Gleysols	Andaquept
G	Gleysols	Typic Argiaquoll
G	Gleysols	Calciaquoll
G	Gleysols	Aquiturbel
G	Gleysols	Sulfaquept

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
G	Gleysols	Cryaquept
G	Gleysols	Tropaquept
G	Gleysols	Haplaquoll
G	Gleysols	Cryaquoll
G	Gleysols	Cryaquent
G	Gleysols	Vertic Epiaquoll
G	Gleysols	Cryaquent
G	Gleysols	Sulfaquent
G	Gleysols	Epiaquent
G	Gleysols	Humaquept
G	Gleysols	Histic Cryaquept
G	Gleysols	Aquorthel
G	Gleysols	Psammaquent
G	Gleysols	thermic Typic Haplaquoll
G	Gleysols	Endoaquept
G	Gleysols	smectitic, mesic, sloping Typic Argiaquoll
H	Phaeozems	Vertic Argiudoll
H	Phaeozems	Vermudoll
H	Phaeozems	Hapludoll
H	Phaeozems	Argiudoll
H	Phaeozems	Pachic Hapludoll
H	Phaeozems	Oxyaquic Hapludoll
H	Phaeozems	Argiudoll
H	Phaeozems	Typic Argiudoll
H	Phaeozems	Hapludoll
H	Phaeozems	Cumulic Hapludoll
I	Lithosols (Ix)	Lithic Ustorthent
J	Fluvisols	Tropofluvent
J	Fluvisols	Torrifluvent
J	Fluvisols	mesic Typic Udifluvent
J	Fluvisols	cryofluvent
J	Fluvisols	Gelifluvent
J	Fluvisols	Xeric Torrifluvent
J	Fluvisols	Ustifluvent
J	Fluvisols	Xerofluvent
J	Fluvisols	Udifluvent
K	Kastanozems	thermic Lithic Argixeroll
K	Kastanozems	Xeric Argialboll
K	Kastanozems	Durustoll
K	Kastanozems	Paleustoll
K	Kastanozems	Argiduridic Durixeroll
K	Kastanozems	Petrocalcic Palexeroll
K	Kastanozems	Calciustoll
K	Kastanozems	Calciustoll
K	Kastanozems	Calcixeroll
K	Kastanozems	Calcic Argixeroll
K	Xerosols	Durixeroll
K	Kastanozems	Rhodic Durixeroll
K	Kastanozems	thermic Typic Argixeroll
K	Kastanozems	Argixeroll
K	Kastanozems	Ultic Haploxeroll
K	Kastanozems	Argixeroll
K	Kastanozems	Udic Haplustoll
K	Kastanozems	Aridic Durixeroll
K	Xerosols	Duric Haploxeroll

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
K	Kastanozems	Ultic Argixeroll
K	Kastanozems	Argiustoll
K	Kastanozems	Haplustoll
K	Kastanozems	Paleustoll
K	Kastanozems	Udertic Haplustoll
K	Kastanozems	Palexeroll
K	Kastanozems	Udic Calciustoll
K	Kastanozems	Haploxeroll
K	Kastanozems	Lithic Haplustoll
K	Kastanozems	Argiustoll
L	Luvisols	Fragiudalf
L	Luvisols	Arenic Hapludalf
L	Luvisols	Arenic Ochraqualf
L	Luvisols	Haploxeralf
L	Luvisols	Rhodoxeralf
L	Luvisols	Plinthustalf
L	Luvisols	Paleustalf
L	Luvisols	Paleudalf
L	Luvisols	Aeric Ochraqualf
L	Luvisols	Agrudalf
L	Luvisols	Haplustalf
L	Luvisols	Kandiudalf
L	Luvisols	Kanhapludalf
L	Luvisols	Kandiustalf
L	Luvisols	Cryoboralf
L	Luvisols	Haplocryalf
L	Luvisols	Aquic Ochraqualf
L	Luvisols	Kanhaplustalf
L	Luvisols	frigid Typic Eutroboralf
L	Luvisols	frigid Mollic Hapludalf
L	Luvisols	Eutroboralf
L	Luvisols	Fragixeralf
L	Luvisols	Arenic Eutroboralf
L	Luvisols	Hapludalf
L	Luvisols	Haplic Durixeralf
L	Luvisols	Vertic Epiaqualf
L	Luvisols	Umbric Endoaqualf
L	Luvisols	Umbraqualf
L	Luvisols	Ultic Haploxeralf
L	Luvisols	Haplocryalf
L	Luvisols	Epiaqualf
L	Luvisols	Oxyaquic Hapludalf
L	Luvisols	Pachic Cryoboralf
L	Luvisols	Typic Ochraqualf
L	Luvisols	Cryoboralf
L	Luvisols	Paleboralf
L	Luvisols	over loamy, mixed Cryoboralf
L	Luvisols	Paleudalf
L	Luvisols	Paleustalf
L	Luvisols	Palexeralf
L	Luvisols	Tropaqualf
L	Luvisols	Durixeralf
L	Luvisols	endoaqualf
L	Luvisols	isohyperthermic Plinthustalf
L	Luvisols	Ruptic-Xerochreptic Haploxeralf

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
L	Luvisols	mixed, mesic Typic Paleudalf
L	Luvisols	Rhodoxeralf
L	Luvisols	Haplustalf
L	Luvisols	Fragiaqualf
L	Luvisols	mesic Mollic Haploxeralf
L	Luvisols	Fragic Epiaqualf
L	Luvisols	Fragic Endoaqualf
L	Luvisols	Xeric Haplocryalf
L	Luvisols	Aridic Haplustalf
L	Luvisols	Fragiboralf
L	Luvisols	Mollic Cryoboralf
L	Luvisols	Mollic Haploxeralf
L	Luvisols	Aridic Paleustalf
L	Luvisols	Hapludalf
L	Luvisols	Haploxeralf
L	Luvisols	Arenic Paleustalf
L	Luvisols	Vertic Paleustalf
L	Luvisols	Vertic Hapludalf
L	Luvisols	thermic Udic Haplustalf
L	Luvisols	Vertic Endoaqualf
L	Luvisols	Vermaqualf
L	Luvisols	Ochraqualf
L	Luvisols	Chromic Hapludalf
L	Luvisols	Chromic Vertic Epiaqualf
L	Luvisols	Eutroboralf
L	Luvisols	over loamy Cryoboralf
L	Luvisols	over loamy Typic Paleboralf
L	Luvisols	Nadurargid
N	Nitosols	Rhodustalf
N	Nitosols	rhodudult
N	Nitosols	Rhodudalf
N	Nitosols	Tropudalf
N	Nitosols	Rhodustult
O	Histosols	Tropofibrist
O	Histosols	Tropofolist
O	Histosols	Lithic Borosaprist
O	Histosols	Troposaprist
O	Histosols	Cryosaprist
O	Histosols	Haplohemist
O	Histosols	Udifolist
O	Histosols	Cryosaprist
O	Histosols	Cryohemist
O	Histosols	Ustifolist
O	Histosols	Cryofibrist
O	Histosols	Cryofibrist
O	Histosols	Cryohemist
O	Histosols	Tropohemist
O	Histosols	Borosaprist
O	Histosols	Borohemist
O	Histosols	Borofolist
O	Histosols	Borofibrist
O	Histosols	Haplofibrist
O	Histosols	Haplosaprist
O	Histosols	Cryofolist
O	Histosols	Historthel (thawed)

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
O	Histosols	Sphagnofibrist
O	Histosols	Sulfihemist
O	Histosols	Folist
O	Histosols	Medisaprist
O	Histosols	Histoturbel
O	Histosols	Medihemist
O	Histosols	Historthel
O	Histosols	Sulfisaprist
O	Histosols	Hemistel
O	Histosols	Terric Borosaprist
O	Histosols	Terric Haplosaprist
O	Histosols	Torrifolist
O	Histosols	Sapristel
P	Podzols	Fragiaquod
P	Podzols	Fragiorthod
P	Podzols	Grossarenic Alorthod
P	Podzols	Haplohumod
P	Podzols	Arenic Haplaquod
P	Podzols	Alaquod
P	Podzols	Alorthod
P	Podzols	Epiaquod
P	Podzols	Entic Haplohumod
P	Podzols	Haplocryod
P	Podzols	Endoaquod
P	Podzols	Duraquod
P	Podzols	Cryaquod
P	Podzols	Durihumod
P	Podzols	Durorthod
P	Podzols	Cryohumod
P	Podzols	Cryorthidic Haplorthod
P	Podzols	Cryorthod
P	Podzols	haplaquod
P	Podzols	isotic, frigid Typic Haplohumod
P	Podzols	Oxyaquic Haplorthod
P	Podzols	Haplorthod
P	Podzols	over sandy or sandy-skeletal Typic Cryorthod
P	Podzols	Haplorthod
P	Podzols	Troporthod
P	Podzols	over loamy, mixed Typic Cryorthod
P	Podzols	Sideraquod
P	Podzols	Humicryod
P	Podzols	isotic, frigid Lithic Haplorthod
P	Podzols	Oxyaquic Fragiorthod
P	Podzols	Tropohumod
P	Podzols	Haplocryod
P	Podzols	mixed Lithic Cryorthod
P	Podzols	Tropaquod
P	Podzols	Lithic Cryohumod
P	Podzols	Lithic Cryorthod
P	Podzols	Cryorthod
P	Podzols	isotic, frigid Aquic Haplorthod
P	Podzols	Humic Lithic Cryorthod
P	Podzols	Haplorthod (Humod)
P	Podzols	Humic Cryorthod
P	Podzols	Ultic Alaquod

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
P	Podzols	Ultic Haplaquod
P	Podzols	Placaquod
P	Podzols	Placorthod
P	Podzols	Ultic Haplorthod
P	Podzols	Tropohumod
P	Podzols	over loamy-skeletal, mixed Humic Cryorthod
Q	Arenosols	Durorthidic Xeropsamment
Q	Arenosols	Torripsamment
Q	Arenosols	Ustic Torripsamment
Q	Arenosols	Ustipsamment
Q	Arenosols	Tropopsamment
Q	Arenosols	Cryopsamment
Q	Arenosols	Udipsamment
Q	Arenosols	quartzipsamment
Q	Arenosols	Xeropsamment
R	Regosols	Vitrandic Xerorthent
R	Regosols	Xeric Torriorthent
R	Regosols	Orthogel
R	Regosols	Cryorthent
R	Regosols	Ustic Torriorthent
R	Regosols	Xerarent
R	Regosols	Xerorthent
R	Regosols	Ustorthent
R	Regosols	Dystrudent
R	Regosols	Ustorthent
R	Regosols	Udorthent
R	Regosols	Andeptic Cryorthent
R	Regosols	Udarent
R	Regosols	Troporthent
R	Regosols	Cryorthent
R	Regosols	Ustarent
R	Regosols	Udarent
R	Regosols	Ustarent
S	Solonetz	Natraqualf
S	Solonetz	Xeric Natrargid
S	Solonetz	Natrudalf
S	Solonetz	Vertic Natrustoll
S	Solonetz	glossic natraqualf
S	Solonetz	Natrustoll
S	Solonetz	Natrustalf
S	Solonetz	Natrudoll
S	Solonetz	Udic Natriboroll
S	Solonetz	Natraquoll
S	Solonetz	Leptic Natrustalf
S	Solonetz	Natralboll
S	Solonetz	Natraqualf
S	Solonetz	Natraquert
S	Solonetz	Natrixeroll
S	Solonetz	Natrargid
S	Solonetz	Natrargid or Camborthid
S	Solonetz	Natridurid
S	Solonetz	Natrixeralf
S	Solonetz	Natrigypsid
S	Solonetz	Natriboroll
S	Solonetz	Natriboralf

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
T	Andosols	Udivitrand
T	Andosols	Vitraquand
T	Andosols	Placaquand
T	Andosols	Thaptic Hydrudand
T	Andosols	Cryaquand
T	Andosols	Duritorrand
T	Andosols	Cryandept
T	Andosols	Duricryand
T	Andosols	Ultic Hapludand
T	Andosols	over loamy, mixed Dystric Cryandept
T	Andosols	Duraquand
T	Andosols	mixed, frigid Alfic Vitrixerand
T	Andosols	Vitrandept
T	Andosols	Durudand
T	Andosols	Durandept
T	Andosols	Ustivitrand
T	Andosols	Dystrandept
T	Andosols	Placudand
T	Andosols	Hydric Hapludand
T	Andosols	Fulvicryand
T	Andosols	Fulvudand
T	Andosols	Vitricryand
T	Andosols	isomesic Hydric Dystrandept
T	Andosols	isohyperthermic Hydric Dystrandept
T	Andosols	Hydrudand
T	Andosols	Hydric Melanudand
T	Andosols	Hydric Hydrudand
T	Andosols	Fulvudand
T	Andosols	Alfic Udivitrand
T	Andosols	isothermic Hydric Dystrandept
T	Andosols	Haplaquand
T	Andosols	Humic Vitrixerand
T	Andosols	Humic Haploxerand
T	Andosols	Haplustand
T	Andosols	Hapludand
T	Andosols	Haplocryand
T	Andosols	Haploxerand
T	Andosols	Haplotorrand
T	Andosols	Vitritorrand
T	Andosols	Haplotorrand
T	Andosols	over loamy, mixed Typic Cryandept
T	Andosols	Vitritorrand
T	Andosols	Vitrixerand
T	Andosols	Endoaquand
T	Andosols	Xeric Vitricryand
T	Andosols	Pachic Placudand
T	Andosols	Pachic Melanudand
T	Andosols	Andisol
T	Andosols	Lithic Fulvudand
T	Andosols	Eutrandept
T	Andosols	or cindery, amorphic over isotic, frigid Humic Haploxerand
T	Andosols	Lithic Vitrixerand
T	Andosols	Melanudand
T	Andosols	Melanaquand
T	Andosols	Melanoxerand

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
T	Andosols	Melanocryand
T	Andosols	Pachic Fulvudand
V	Vertisols	Haplustert
V	Vertisols	Calciaquert
V	Vertisols	(Calcic) Haplustert
V	Vertisols	Chromustert
V	Vertisols	Calciustert
V	Vertisols	Chromoxerert
V	Vertisols	Calcitorrert
V	Vertisols	Haploxerert
V	Vertisols	calcixerert
V	Vertisols	Chromoxerert
V	Vertisols	Torrert
V	Vertisols	Chromudert
V	Vertisols	Torrert
V	Vertisols	Pelludert
V	Vertisols	dystrudert
V	Vertisols	Pellustert
V	Vertisols	Leptic Haplustert
V	Vertisols	Salitorrert
V	Vertisols	Gypsitorrert
V	Vertisols	Gypsiustert
V	Vertisols	Durixerert
V	Vertisols	Dystraquert
V	Vertisols	Haplustert
V	Vertisols	Duraquert
V	Vertisols	Endoaquert
V	Vertisols	Haplotorrert
V	Vertisols	Haploxerert
V	Vertisols	Udic Haplustert
V	Vertisols	Pelloxerert
V	Vertisols	Hapludert
V	Vertisols	epiaquert
W	Planosols	Albaqualf
W	Planosols	Albaquult
W	Planosols	Vertic Albaqualf
X	Xerosols	Lithic Haplargid
X	Xerosols	over loamy, acid Typic Calciorthid
X	Xerosols	mixed, superactive, mesic Lithic Xeric Haplargid
X	Xerosols	Argigypsid
X	Xerosols	Paleargid
X	Xerosols	Calcigypsid
X	Xerosols	Calciorthid
X	Xerosols	Lithic Calciorthid
X	Xerosols	Gypsiorthid
X	Xerosols	Haplargid
X	Xerosols	Xerollic Haplargid
X	Xerosols	Gypsiorthid
X	Xerosols	Argigypsid
X	Xerosols	Haplargid
X	Xerosols	Haplocalcid
X	Xerosols	Paleargid
X	Xerosols	Petrocalcid

Major soil group (FAO74)[1]		USDA soil type
Code	Description	
X	Xerosols	Petrogypsid
X	Xerosols	Haplodurid
X	Xerosols	Haplogypsid
X	Xerosols	Gypsiargid
X	Xerosols	Petrogypsid
X	Xerosols	Ustalfic Haplargid
X	Xerosols	Durargid
X	Xerosols	Ustollic Calciorthid
X	Xerosols	Camborthid
X	Xerosols	Ustollic Haplargid
X	Xerosols	Duric Calciorthid
X	Xerosols	Ustollic Paleargid
X	Xerosols	Vertic Camborthid
X	Xerosols	sondy-skeletal, gypsic, thermic Leptic Haplogypsid
X	Xerosols	Calciorthid
X	Xerosols	Argidurid
X	Xerosols	Ustic Calciorthid
X	Xerosols	Ustic Calciargid
X	Xerosols	Calcicryid
X	Xerosols	Xeric Haplocalcid
X	Xerosols	Xerollic Camborthid
X	Xerosols	Ustic Haplocalcid
X	Xerosols	Ustic Haplargid
X	Xerosols	Paleorthid
X	Xerosols	Xerollic Durargid
X	Xerosols	Xeric Petrocryid
X	Xerosols	Calcigypsid
X	Xerosols	Xeric Haplargid
X	Xerosols	Xeric Argidurid
X	Xerosols	Petroargid
X	Xerosols	Petrocalcid
X	Xerosols	Petrocryid
X	Xerosols	Calciargid
Y	Yermosols	Torriorthent
Y	Yermosols	Torriarent
Y	Yermosols	Torriorthent
Z	Solonchaks	Haplosalid
Z	Solonchaks	Salorthid
Z	Solonchaks	Aquisalid
Z	Solonchaks	Aquisalid
Z	Solonchaks	Haplosalid

Appendix 3. Number of soil P data by FAO major soil group and depth layer

FAO74	Layer	P_bray1	P_Olsen	P_Mehlich3	P_Water	P_Retention
Acrisols	D1	286	2	14	12	143
Acrisols	D2	237	2	14	10	144
Acrisols	D3	226	2	14	10	143
Acrisols	D4	212	2	14	10	141
Acrisols	D5	186	2	14	10	129
Andosols	D1	121	0	3	0	432
Andosols	D2	116	0	3	0	432
Andosols	D3	96	0	3	0	408
Andosols	D4	80	0	3	0	367
Andosols	D5	67	0	3	0	312
Arenosols	D1	56	1	34	0	72
Arenosols	D2	55	1	34	0	72
Arenosols	D3	44	1	34	0	64
Arenosols	D4	39	1	2	0	60
Arenosols	D5	36	1	2	0	52
Cambisols	D1	345	26	29	15	531
Cambisols	D2	309	25	29	15	527
Cambisols	D3	255	25	25	15	487
Cambisols	D4	200	25	22	14	431
Cambisols	D5	150	22	18	14	370
Chernozems	D1	95	13	7	1	95
Chernozems	D2	72	13	7	0	91
Chernozems	D3	49	13	7	0	90
Chernozems	D4	41	12	7	0	86
Chernozems	D5	32	12	7	0	75
Ferralsols	D1	28	0	2	5	65
Ferralsols	D2	28	0	2	5	65
Ferralsols	D3	27	0	2	4	64
Ferralsols	D4	17	0	2	1	55
Ferralsols	D5	15	0	2	0	51
Fluvisols	D1	47	0	1	0	16
Fluvisols	D2	45	0	1	0	16
Fluvisols	D3	44	0	1	0	15
Fluvisols	D4	42	0	1	0	14
Fluvisols	D5	38	0	1	0	14
Gleysols	D1	264	7	27	12	167
Gleysols	D2	252	7	28	10	180
Gleysols	D3	238	7	28	10	170
Gleysols	D4	213	6	28	9	153
Gleysols	D5	193	6	28	9	137
Histosols	D1	18	0	0	0	23
Histosols	D2	23	0	0	0	27
Histosols	D3	21	0	0	0	24
Histosols	D4	13	0	0	0	20
Histosols	D5	10	0	0	0	19
Kastanozems	D1	244	46	62	7	376
Kastanozems	D2	216	46	62	4	373
Kastanozems	D3	175	42	62	4	332
Kastanozems	D4	140	39	59	4	283
Kastanozems	D5	116	38	56	4	234

FAO74	Layer	P_bray1	P_Olsen	P_Mehlich3	P_Water	P_Retention
Lithosols (Ix)	D1	0	0	0	0	1
Lithosols (Ix)	D2	0	0	0	0	1
Lithosols (Ix)	D3	0	0	0	0	0
Luvisols	D1	653	18	44	22	276
Luvisols	D2	581	18	44	1	269
Luvisols	D3	544	18	44	1	256
Luvisols	D4	505	17	42	1	244
Luvisols	D5	471	16	40	1	228
Nitosols	D1	1	0	1	0	3
Nitosols	D2	1	0	1	0	3
Nitosols	D3	1	0	1	0	3
Nitosols	D4	1	0	1	0	3
Nitosols	D5	1	0	1	0	2
Phaeozems	D1	175	9	25	1	30
Phaeozems	D2	147	9	25	1	31
Phaeozems	D3	131	9	24	0	27
Phaeozems	D4	124	9	24	0	26
Phaeozems	D5	116	7	24	0	23
Planosols	D1	11	0	0	0	4
Planosols	D2	7	0	0	0	4
Planosols	D3	8	0	0	0	4
Planosols	D4	8	0	0	0	4
Planosols	D5	7	0	0	0	4
Podzols	D1	53	0	0	0	283
Podzols	D2	46	0	0	0	296
Podzols	D3	37	0	0	0	281
Podzols	D4	29	0	0	0	250
Podzols	D5	24	0	0	0	204
Podzoluvisols	D1	27	0	2	0	26
Podzoluvisols	D2	22	0	2	0	26
Podzoluvisols	D3	14	0	2	0	22
Podzoluvisols	D4	11	0	2	0	22
Podzoluvisols	D5	8	0	2	0	21
Ranker	D1	3	0	0	0	6
Ranker	D2	2	0	0	0	3
Regosols	D1	67	2	2	2	51
Regosols	D2	49	2	2	2	48
Regosols	D3	37	1	2	2	47
Regosols	D4	32	1	2	2	41
Regosols	D5	31	1	2	2	34
Rendzinas (Ex)	D1	3	1	3	0	6
Rendzinas (Ex)	D2	2	1	3	0	5
Rendzinas (Ex)	D3	0	0	1	0	3
Rendzinas (Ex)	D4	0	0	1	0	3
Rendzinas (Ex)	D5	0	0	1	0	2
Solonchaks	D1	3	1	1	0	1
Solonchaks	D2	3	1	1	0	1
Solonchaks	D3	3	1	1	0	1
Solonchaks	D4	2	1	1	0	1
Solonchaks	D5	1	1	1	0	1
Solonetz	D1	20	3	3	0	12
Solonetz	D2	10	3	3	0	12
Solonetz	D3	11	3	3	0	12
Solonetz	D4	8	3	3	0	11
Solonetz	D5	7	3	3	0	11
Vertisols	D1	72	19	8	0	27

FAO74	Layer	P_bray1	P_Olsen	P_Mehlich3	P_Water	P_Retention
Vertisols	D2	54	5	8	0	26
Vertisols	D3	45	5	8	0	26
Vertisols	D4	42	5	8	0	26
Vertisols	D5	30	5	8	0	25
Xerosols	D1	69	36	17	8	79
Xerosols	D2	61	36	17	8	79
Xerosols	D3	41	30	13	8	63
Xerosols	D4	36	29	12	8	59
Xerosols	D5	30	29	12	8	55
Yermosols	D1	19	5	4	0	8
Yermosols	D2	15	4	3	0	6
Yermosols	D3	14	3	3	0	6
Yermosols	D4	12	2	2	0	4
Yermosols	D5	10	2	2	0	4

[a] Codes for major soil groups are according to FAO (1990): AC - Acrisols; AL - Alisols; AN - Andosols; AR - Arenosols; AT - Anthrosols; CH - Chernozems; CL - Calcisols; CM - Cambisols; FL - Fluvisols; FR - Ferralsols; GL - Gleysols; GR - Greyzems; GY - Gypsisols; HS - Histosols; KS - Kastanozems; LP - Leptosols; LV - Luvisols; LX - Lixisols; NT - Nitisols; PD - Podzoluvisols; PH - Phaeozems; PL - Planosols; PT - Plinthosols; PZ - Podzols; RG - Regosols; SC - Solonchaks; SN - Solonetz; VR – Vertisols.

Appendix 3. Descriptive statistics for soil P, clustered according to FAO soil group, for five fixed-depth layers[1]

Variable	FAO74_NAME	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	Acrisols	A/D1	286	30.70	68.71	224	7.00	5.50	2.50	23.17	0.00[a]	586.17
P_BRAY1	Acrisols	A/D2	237	14.74	41.00	278	2.00	1.70	0.65	8.02	0.00	294.76
P_BRAY1	Acrisols	A/D3	226	5.59	17.40	311	1.00	1.00	0.28	4.13	0.00	164.00
P_BRAY1	Acrisols	A/D4	212	4.33	14.10	325	1.00	1.00	0.20	3.07	0.00	164.00
P_BRAY1	Acrisols	A/D5	186	4.30	13.88	323	0.77	0.77	0.10	3.00	0.00	164.00
P_BRAY1	Andosols	T/D1	121	18.99	40.24	212	5.00	5.00	1.05	16.50	0.00	322.56
P_BRAY1	Andosols	T/D2	116	15.24	39.80	261	2.30	2.30	0.00	10.05	0.00	336.90
P_BRAY1	Andosols	T/D3	96	9.49	19.09	201	2.45	2.45	0.16	8.40	0.00	115.00
P_BRAY1	Andosols	T/D4	80	5.99	8.83	147	2.10	2.10	0.22	7.00	0.00	43.00
P_BRAY1	Andosols	T/D5	67	4.21	6.89	164	2.00	2.00	0.00	6.00	0.00	43.00
P_BRAY1	Arenosols	Q/D1	56	68.47	85.65	125	42.40	32.78	10.38	85.23	0.95	316.00
P_BRAY1	Arenosols	Q/D2	55	57.16	80.24	140	21.70	20.70	6.00	60.96	0.00	393.00
P_BRAY1	Arenosols	Q/D3	44	48.21	81.47	169	13.43	12.38	3.89	64.25	0.00	393.00
P_BRAY1	Arenosols	Q/D4	39	38.60	69.68	181	9.00	8.00	3.00	41.35	0.00	306.06
P_BRAY1	Arenosols	Q/D5	36	31.57	49.80	158	8.90	7.93	2.00	38.45	0.00	199.80
P_BRAY1	Cambisols	B/D1	345	38.03	69.30	182	13.00	11.40	2.76	40.78	0.00	478.00
P_BRAY1	Cambisols	B/D2	309	22.80	54.10	237	4.40	4.15	1.35	21.38	0.00	478.00
P_BRAY1	Cambisols	B/D3	255	11.51	25.05	218	3.20	3.00	1.00	11.70	0.00	219.30
P_BRAY1	Cambisols	B/D4	200	9.28	16.75	180	3.59	3.20	0.96	10.81	0.00	117.20
P_BRAY1	Cambisols	B/D5	150	10.24	17.78	174	3.83	3.48	0.86	12.00	0.00	105.37
P_BRAY1	Chernozems	C/D1	95	24.43	23.14	95	18.00	12.00	7.86	32.00	0.00	131.00
P_BRAY1	Chernozems	C/D2	72	16.93	22.62	134	8.13	6.85	2.82	23.75	0.00	131.00
P_BRAY1	Chernozems	C/D3	49	9.55	13.81	145	6.00	4.90	1.00	10.00	0.00	61.80
P_BRAY1	Chernozems	C/D4	41	7.77	11.05	142	3.60	3.40	0.45	7.10	0.00	44.85
P_BRAY1	Chernozems	C/D5	32	9.66	14.04	145	3.50	3.45	0.98	12.13	0.00	64.36
P_BRAY1	Ferralsols	F/D1	28	7.25	15.56	215	1.00	0.85	0.38	6.75	0.00	63.90
P_BRAY1	Ferralsols	F/D2	28	2.18	7.20	331	0.26	0.26	0.01	1.01	0.00	38.20
P_BRAY1	Ferralsols	F/D3	27	1.13	2.96	262	0.20	0.20	0.00	1.00	0.00	15.47
P_BRAY1	Ferralsols	F/D4	17	0.40	0.50	126	0.10	0.10	0.00	1.00	0.00	1.50
P_BRAY1	Ferralsols	F/D5	15	0.45	0.52	115	0.20	0.20	0.00	1.00	0.00	1.50
P_BRAY1	Fluvisols	J/D1	47	30.23	33.58	111	20.20	14.20	8.00	42.78	0.00	155.75
P_BRAY1	Fluvisols	J/D2	45	16.25	20.73	128	8.00	6.00	3.20	20.25	0.00	90.20
P_BRAY1	Fluvisols	J/D3	44	11.61	16.84	145	6.60	4.55	2.20	11.77	0.00	77.00
P_BRAY1	Fluvisols	J/D4	42	11.34	15.29	135	6.95	4.22	2.74	11.44	0.00	77.00
P_BRAY1	Fluvisols	J/D5	38	13.84	16.71	121	8.80	5.93	3.05	17.77	0.00	77.00
P_BRAY1	Gleysols	G/D1	264	46.35	53.92	116	29.45	26.50	6.10	67.75	0.00	376.00
P_BRAY1	Gleysols	G/D2	252	22.69	37.99	167	11.54	9.70	3.58	27.83	0.00	375.00
P_BRAY1	Gleysols	G/D3	238	11.61	20.73	178	5.30	4.10	2.00	11.70	0.00	192.00
P_BRAY1	Gleysols	G/D4	213	12.39	31.65	255	5.00	4.00	2.00	11.00	0.00	342.60
P_BRAY1	Gleysols	G/D5	193	11.96	30.72	257	4.05	3.05	1.50	11.35	0.00	309.60
P_BRAY1	Histosols	O/D1	18	9.64	17.74	184	0.35	0.35	0.00	9.92	0.00	60.50
P_BRAY1	Histosols	O/D2	23	3.03	9.02	298	0.00	0.00	0.00	1.95	0.00	42.25
P_BRAY1	Histosols	O/D3	21	3.06	8.14	266	0.40	0.40	0.00	1.70	0.00	37.00
P_BRAY1	Histosols	O/D4	13	5.65	13.23	234	1.00	1.00	0.93	4.78	0.00	49.18
P_BRAY1	Histosols	O/D5	10	9.14	22.52	247	1.40	1.40	0.11	6.00	0.00	72.90
P_BRAY1	Kastanozems	K/D1	244	31.68	42.65	135	19.00	15.00	6.09	43.61	0.00	327.40
P_BRAY1	Kastanozems	K/D2	216	16.32	25.92	159	6.11	5.93	1.40	24.31	0.00	223.00
P_BRAY1	Kastanozems	K/D3	175	8.82	15.86	180	2.31	2.11	1.00	10.21	0.00	132.00
P_BRAY1	Kastanozems	K/D4	140	6.43	10.96	170	2.00	1.75	0.76	7.47	0.00	67.80

[1] Codes for FAO74_lay consist of abbreviations for FAO74 major soil grouping (e.g., B= Cambisols), and depth layer (e.g., D1=0-20cm). For details, see text.

Variable	FAO74_NAME	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	Kastanozems	K/D5	116	5.56	9.03	162	2.00	1.90	0.74	6.32	0.00	49.90
P_BRAY1	Luvisols	L/D1	653	42.20	55.74	132	20.65	16.35	7.70	53.05	0.00	364.00
P_BRAY1	Luvisols	L/D2	581	18.33	34.75	190	6.80	5.75	2.22	19.77	0.00	509.40
P_BRAY1	Luvisols	L/D3	544	12.24	30.72	251	3.55	2.65	1.06	10.00	0.00	504.40
P_BRAY1	Luvisols	L/D4	505	11.25	30.75	273	3.00	2.50	1.00	10.43	0.00	409.50
P_BRAY1	Luvisols	L/D5	471	10.58	29.26	277	3.00	2.46	1.00	9.20	0.00	407.00
P_BRAY1	Phaeozems	H/D1	175	57.60	78.62	137	34.00	23.00	18.68	64.00	1.00	616.00
P_BRAY1	Phaeozems	H/D2	147	34.36	65.73	191	17.30	12.56	6.04	37.60	0.00	594.00
P_BRAY1	Phaeozems	H/D3	131	16.44	38.58	235	5.80	4.53	2.00	15.30	0.00	316.00
P_BRAY1	Phaeozems	H/D4	124	16.21	32.00	197	4.97	3.97	1.80	17.00	0.00	217.80
P_BRAY1	Phaeozems	H/D5	116	14.23	26.19	184	5.80	4.82	1.39	16.40	0.00	157.25
P_BRAY1	Planosols	W/D1	11	23.76	17.02	72	21.00	5.00	12.00	26.00	3.30	64.35
P_BRAY1	Planosols	W/D2	7	13.48	16.60	123	8.00	4.90	3.10	20.42	0.80	48.32
P_BRAY1	Planosols	W/D3	8	4.80	4.30	90	5.13	3.50	0.25	7.79	0.00	11.95
P_BRAY1	Planosols	W/D4	8	10.45	15.28	146	5.35	4.85	0.25	17.45	0.00	44.30
P_BRAY1	Planosols	W/D5	7	12.41	16.04	129	3.50	3.50	1.00	33.00	0.00	38.00
P_BRAY1	Podzols	P/D1	53	18.01	22.74	126	8.70	6.70	4.15	22.04	0.00	92.67
P_BRAY1	Podzols	P/D2	46	9.30	13.92	150	4.03	2.69	1.99	7.85	0.00	58.25
P_BRAY1	Podzols	P/D3	37	14.35	19.63	137	6.00	4.00	2.15	14.75	0.30	67.00
P_BRAY1	Podzols	P/D4	29	22.65	26.77	118	10.90	6.90	5.80	31.61	1.00	108.15
P_BRAY1	Podzols	P/D5	24	23.31	24.45	105	19.10	8.60	10.25	29.00	1.00	124.02
P_BRAY1	Podzoluvisols	D/D1	27	23.42	27.04	115	11.00	9.00	5.60	34.00	0.00	96.10
P_BRAY1	Podzoluvisols	D/D2	22	15.31	17.90	117	7.86	6.28	1.90	25.50	0.62	67.00
P_BRAY1	Podzoluvisols	D/D3	14	10.16	13.19	130	4.30	3.98	0.98	16.30	0.30	46.40
P_BRAY1	Podzoluvisols	D/D4	11	4.57	5.89	129	3.44	2.66	0.50	4.00	0.38	19.80
P_BRAY1	Podzoluvisols	D/D5	8	3.74	5.71	153	1.49	1.13	0.43	5.32	0.13	17.00
P_BRAY1	Regosols	R/D1	67	31.62	36.42	115	18.00	13.80	8.00	49.60	0.00	220.00
P_BRAY1	Regosols	R/D2	49	15.59	27.38	176	5.32	5.13	1.70	21.25	0.00	171.70
P_BRAY1	Regosols	R/D3	37	13.03	26.49	203	4.90	3.72	1.19	13.15	0.00	151.00
P_BRAY1	Regosols	R/D4	32	7.67	10.90	142	2.90	2.40	1.10	12.26	0.00	47.50
P_BRAY1	Regosols	R/D5	31	7.10	9.88	139	2.00	2.00	0.60	10.20	0.00	39.00
P_BRAY1	Solonetz	S/D1	20	26.12	23.37	89	18.33	11.39	8.30	37.88	2.15	92.00
P_BRAY1	Solonetz	S/D2	10	7.69	7.63	99	5.21	4.56	0.98	16.81	0.00	19.70
P_BRAY1	Solonetz	S/D3	11	10.65	10.69	100	6.20	5.08	2.00	21.00	0.60	29.90
P_BRAY1	Solonetz	S/D4	8	12.73	16.18	127	3.10	2.90	0.80	25.81	0.00	42.80
P_BRAY1	Solonetz	S/D5	7	12.63	20.06	159	3.00	1.00	2.00	23.00	0.00	54.50
P_BRAY1	Vertisols	V/D1	72	22.25	25.48	115	12.50	10.31	2.82	40.50	0.00	122.95
P_BRAY1	Vertisols	V/D2	54	11.95	19.05	160	3.05	3.05	1.00	15.23	0.00	88.00
P_BRAY1	Vertisols	V/D3	45	9.09	17.18	189	1.00	1.00	0.03	9.68	0.00	79.25
P_BRAY1	Vertisols	V/D4	42	10.83	19.14	177	1.00	1.00	0.52	16.47	0.00	79.60
P_BRAY1	Vertisols	V/D5	30	15.37	24.99	163	2.91	2.91	0.90	23.08	0.00	108.10
P_BRAY1	Xerosols	X/D1	69	15.23	10.74	71	15.10	9.09	4.95	23.80	0.00	40.50
P_BRAY1	Xerosols	X/D2	61	3.76	8.03	214	1.00	1.00	0.00	3.42	0.00	50.00
P_BRAY1	Xerosols	X/D3	41	3.01	8.06	268	1.00	1.00	0.00	2.25	0.00	50.00
P_BRAY1	Xerosols	X/D4	36	3.72	8.71	234	1.00	1.00	0.00	2.53	0.00	50.00
P_BRAY1	Xerosols	X/D5	30	3.10	6.01	194	1.00	1.00	0.00	2.11	0.00	26.80
P_BRAY1	Yermosols	Y/D1	19	12.38	14.27	115	8.50	4.17	4.25	12.67	0.00	51.00
P_BRAY1	Yermosols	Y/D2	15	4.70	5.05	107	3.00	3.00	0.00	8.70	0.00	17.00
P_BRAY1	Yermosols	Y/D3	14	4.34	5.11	118	3.30	3.30	0.00	7.71	0.00	17.00
P_BRAY1	Yermosols	Y/D4	12	3.18	3.97	125	1.65	1.65	0.00	6.89	0.00	10.00
P_BRAY1	Yermosols	Y/D5	10	2.78	3.60	129	1.40	1.40	0.00	5.00	0.00	10.00
P_H2O	Acrisols	A/D1	12	0.06	0.08	132	0.04	0.04	0.00	0.09	0.00	0.30
P_H2O	Acrisols	A/D2	10	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
P_H2O	Acrisols	A/D3	10	0.02	0.04	219	0.00	0.00	0.00	0.01	0.00	0.10
P_H2O	Acrisols	A/D4	10	0.02	0.04	211	0.00	0.00	0.00	0.03	0.00	0.10
P_H2O	Acrisols	A/D5	10	0.01	0.03	273	0.00	0.00	0.00	0.00	0.00	0.10

Variable	FAO74_NAME	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_H2O	Cambisols	B/D1	15	0.16	0.31	194	0.09	0.09	0.00	0.20	0.00	1.24
P_H2O	Cambisols	B/D2	15	0.07	0.08	119	0.02	0.02	0.00	0.10	0.00	0.20
P_H2O	Cambisols	B/D3	15	0.06	0.08	121	0.00	0.00	0.00	0.10	0.00	0.20
P_H2O	Cambisols	B/D4	14	0.09	0.14	159	0.02	0.02	0.00	0.12	0.00	0.50
P_H2O	Cambisols	B/D5	14	0.07	0.09	127	0.05	0.05	0.00	0.10	0.00	0.30
P_H2O	Gleysols	G/D1	12	0.15	0.28	186	0.08	0.08	0.00	0.17	0.00	1.00
P_H2O	Gleysols	G/D2	10	0.06	0.07	112	0.05	0.05	0.00	0.11	0.00	0.20
P_H2O	Gleysols	G/D3	10	0.09	0.07	86	0.10	0.08	0.01	0.14	0.00	0.20
P_H2O	Gleysols	G/D4	9	0.09	0.08	87	0.10	0.10	0.00	0.17	0.00	0.20
P_H2O	Gleysols	G/D5	9	0.09	0.10	115	0.10	0.10	0.00	0.17	0.00	0.27
P_H2O	Kastanozems	K/D1	7	0.33	0.27	83	0.26	0.16	0.10	0.60	0.07	0.80
P_H2O	Luvisols	L/D1	22	0.32	0.29	91	0.25	0.15	0.10	0.47	0.00	0.90
P_H2O	Xerosols	X/D1	8	0.54	0.37	70	0.50	0.38	0.16	0.91	0.05	1.02
P_H2O	Xerosols	X/D2	8	0.35	0.29	84	0.34	0.21	0.10	0.50	0.00	0.90
P_H2O	Xerosols	X/D3	8	0.23	0.14	62	0.20	0.10	0.11	0.30	0.05	0.50
P_H2O	Xerosols	X/D4	8	0.14	0.09	67	0.15	0.06	0.04	0.21	0.00	0.26
P_H2O	Xerosols	X/D5	8	0.09	0.08	91	0.10	0.09	0.00	0.17	0.00	0.20
P_Mehlich3	Acrisols	A/D1	14	31.50	43.11	137	12.02	10.70	1.72	40.22	0.50	125.93
P_Mehlich3	Acrisols	A/D2	14	6.29	13.49	215	1.82	1.48	0.50	5.16	0.27	51.96
P_Mehlich3	Acrisols	A/D3	14	1.41	1.63	116	0.77	0.49	0.30	1.83	0.10	5.46
P_Mehlich3	Acrisols	A/D4	14	1.55	2.34	151	0.65	0.50	0.30	1.55	0.10	8.92
P_Mehlich3	Acrisols	A/D5	14	1.29	1.35	105	0.90	0.64	0.25	1.95	0.01	4.40
P_Mehlich3	Arenosols	Q/D1	34	23.48	15.24	65	21.54	8.14	13.13	28.18	8.52	85.27
P_Mehlich3	Arenosols	Q/D2	34	7.43	12.70	171	3.20	1.77	1.79	7.49	0.80	72.24
P_Mehlich3	Arenosols	Q/D3	34	3.43	6.81	199	1.48	0.45	1.09	2.29	0.55	38.53
P_Mehlich3	Cambisols	B/D1	29	16.18	24.66	152	8.20	4.46	4.19	16.05	0.03	123.65
P_Mehlich3	Cambisols	B/D2	29	6.43	6.72	105	3.46	3.16	1.39	12.53	0.00	21.00
P_Mehlich3	Cambisols	B/D3	25	7.76	10.79	139	4.31	3.84	0.70	12.81	0.00	47.92
P_Mehlich3	Cambisols	B/D4	22	9.46	13.89	147	3.95	3.71	0.55	13.31	0.00	57.00
P_Mehlich3	Cambisols	B/D5	18	10.12	12.91	127	5.00	4.70	0.40	14.51	0.10	47.80
P_Mehlich3	Chernozems	C/D1	7	15.01	16.04	107	5.07	3.19	1.97	35.18	1.88	38.97
P_Mehlich3	Chernozems	C/D2	7	3.35	3.55	106	1.71	0.74	1.24	6.19	0.22	10.15
P_Mehlich3	Chernozems	C/D3	7	1.69	1.88	111	1.35	0.75	0.49	2.10	0.00	5.63
P_Mehlich3	Chernozems	C/D4	7	3.11	6.25	201	0.50	0.50	0.30	1.67	0.00	17.21
P_Mehlich3	Chernozems	C/D5	7	5.22	10.10	194	0.46	0.46	0.36	5.68	0.00	27.69
P_Mehlich3	Gleysols	G/D1	27	41.09	36.59	89	31.10	26.84	10.93	77.10	1.84	114.00
P_Mehlich3	Gleysols	G/D2	28	14.44	15.79	109	9.35	6.23	3.49	19.12	0.44	72.20
P_Mehlich3	Gleysols	G/D3	28	7.79	9.48	122	4.45	3.09	2.63	9.73	0.01	41.21
P_Mehlich3	Gleysols	G/D4	28	7.31	8.36	114	4.20	2.95	2.40	11.52	0.09	37.69
P_Mehlich3	Gleysols	G/D5	28	9.00	11.44	127	5.59	4.85	1.88	11.73	0.00	56.60
P_Mehlich3	Kastanozems	K/D1	62	26.48	23.93	90	21.53	14.81	6.78	39.19	1.60	104.65
P_Mehlich3	Kastanozems	K/D2	62	12.95	15.17	117	6.77	4.87	3.02	16.58	0.50	62.20
P_Mehlich3	Kastanozems	K/D3	62	10.72	14.63	136	4.01	3.61	1.30	12.60	0.00	66.20
P_Mehlich3	Kastanozems	K/D4	59	11.45	15.76	138	3.60	3.48	1.36	14.80	0.00	66.20
P_Mehlich3	Kastanozems	K/D5	56	12.35	17.21	139	3.55	3.23	1.15	17.86	0.10	59.87
P_Mehlich3	Luvisols	L/D1	44	47.80	86.32	181	14.56	11.12	5.22	54.99	0.20	470.48
P_Mehlich3	Luvisols	L/D2	44	13.93	21.81	157	4.48	3.53	1.40	17.74	0.00	96.95
P_Mehlich3	Luvisols	L/D3	44	5.02	10.01	199	2.25	1.90	0.79	5.25	0.00	63.00
P_Mehlich3	Luvisols	L/D4	42	4.23	6.38	151	2.11	1.63	0.78	4.75	0.00	33.60
P_Mehlich3	Luvisols	L/D5	40	3.68	5.74	156	1.71	1.16	0.73	3.80	0.10	29.64
P_Mehlich3	Phaeozems	H/D1	25	27.78	65.54	236	4.84	3.77	1.63	20.81	0.55	319.30
P_Mehlich3	Phaeozems	H/D2	25	11.41	26.59	233	2.18	1.55	0.90	5.84	0.00	118.22
P_Mehlich3	Phaeozems	H/D3	24	4.10	6.31	154	2.16	1.77	0.56	5.85	0.00	30.40
P_Mehlich3	Phaeozems	H/D4	24	6.22	11.97	192	1.49	1.34	0.47	7.00	0.00	51.20
P_Mehlich3	Phaeozems	H/D5	24	6.94	11.90	172	1.08	0.96	0.33	8.27	0.00	44.00
P_Mehlich3	Vertisols	V/D1	8	40.73	50.60	124	19.28	12.22	6.58	85.76	4.45	135.65

Variable	FAO74_NAME	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_Mehlich3	Vertisols	V/D2	8	22.20	27.56	124	7.05	6.23	1.57	48.24	0.77	72.23
P_Mehlich3	Vertisols	V/D3	8	10.80	12.75	118	4.95	4.22	1.07	22.27	0.70	34.70
P_Mehlich3	Vertisols	V/D4	8	10.81	12.07	112	5.69	5.18	0.90	20.96	0.29	32.90
P_Mehlich3	Vertisols	V/D5	8	9.74	11.02	113	6.85	5.87	0.89	15.49	0.60	32.90
P_Mehlich3	Xerosols	X/D1	17	65.20	66.54	102	26.00	16.02	19.43	158.59	1.91	175.00
P_Mehlich3	Xerosols	X/D2	17	24.84	31.07	125	11.20	7.54	7.03	39.09	0.30	124.86
P_Mehlich3	Xerosols	X/D3	13	17.13	18.36	107	7.70	7.22	4.14	29.00	0.14	61.50
P_Mehlich3	Xerosols	X/D4	12	16.04	14.65	91	9.95	9.90	2.68	30.38	0.00	39.04
P_Mehlich3	Xerosols	X/D5	12	15.23	14.07	92	11.48	10.62	1.93	27.27	0.17	44.10
P_Olsen	Cambisols	B/D1	26	7.72	10.07	130	3.83	1.76	2.37	10.09	0.69	43.40
P_Olsen	Cambisols	B/D2	25	4.39	9.81	223	1.30	1.00	0.40	3.73	0.00	43.40
P_Olsen	Cambisols	B/D3	25	3.32	6.15	185	1.10	1.00	0.44	3.09	0.00	28.10
P_Olsen	Cambisols	B/D4	25	2.05	2.33	113	1.08	0.82	0.49	2.57	0.00	9.15
P_Olsen	Cambisols	B/D5	22	2.16	2.18	101	1.50	0.90	0.57	2.78	0.00	8.10
P_Olsen	Chernozems	C/D1	13	10.83	9.31	86	7.20	4.89	2.50	18.77	2.20	31.32
P_Olsen	Chernozems	C/D2	13	3.50	3.88	111	1.61	0.75	1.07	5.49	0.09	13.40
P_Olsen	Chernozems	C/D3	13	2.50	4.48	179	0.81	0.21	0.75	1.40	0.00	16.38
P_Olsen	Chernozems	C/D4	12	2.61	4.70	180	0.72	0.42	0.30	2.44	0.00	16.24
P_Olsen	Chernozems	C/D5	12	4.25	7.96	187	0.80	0.46	0.44	3.37	0.10	25.90
P_Olsen	Gleysols	G/D1	7	10.84	10.18	94	6.09	6.09	3.20	22.30	0.00	26.02
P_Olsen	Gleysols	G/D2	7	4.90	3.02	62	5.88	1.77	0.90	7.65	0.76	8.36
P_Olsen	Gleysols	G/D3	7	3.80	3.03	80	2.87	2.11	0.76	6.09	0.50	8.99
P_Olsen	Gleysols	G/D4	6	5.04	6.00	119	3.30	2.40	0.76	8.33	0.70	16.58
P_Olsen	Gleysols	G/D5	6	6.23	5.24	84	5.70	2.55	1.98	9.48	0.70	15.40
P_Olsen	Kastanozems	K/D1	46	8.63	8.33	97	5.72	3.49	2.83	11.28	1.01	31.32
P_Olsen	Kastanozems	K/D2	46	4.04	5.31	131	2.21	1.23	1.20	4.34	0.60	23.40
P_Olsen	Kastanozems	K/D3	42	3.47	4.97	143	1.73	0.97	0.93	3.45	0.10	25.50
P_Olsen	Kastanozems	K/D4	39	3.63	4.15	115	1.86	1.46	0.98	4.29	0.10	17.10
P_Olsen	Kastanozems	K/D5	38	3.83	4.33	113	2.13	1.48	0.79	4.99	0.20	18.76
P_Olsen	Luvisols	L/D1	18	10.34	12.56	122	5.22	3.31	2.88	13.61	1.48	55.14
P_Olsen	Luvisols	L/D2	18	8.93	15.26	171	3.66	3.14	1.67	7.78	0.10	62.75
P_Olsen	Luvisols	L/D3	18	3.48	4.90	141	1.35	1.10	0.55	4.12	0.00	16.80
P_Olsen	Luvisols	L/D4	17	2.73	3.96	145	1.90	1.48	0.45	3.64	0.00	16.80
P_Olsen	Luvisols	L/D5	16	2.62	2.46	94	2.44	1.54	0.70	3.58	0.10	9.65
P_Olsen	Phaeozems	H/D1	9	3.99	2.02	51	3.36	0.92	2.40	5.66	1.72	7.45
P_Olsen	Phaeozems	H/D2	9	1.11	0.66	60	1.10	0.43	0.53	1.42	0.36	2.50
P_Olsen	Phaeozems	H/D3	9	0.71	0.53	76	0.68	0.42	0.22	1.20	0.00	1.45
P_Olsen	Phaeozems	H/D4	9	0.89	1.02	115	0.50	0.50	0.14	1.36	0.00	3.20
P_Olsen	Phaeozems	H/D5	7	1.15	1.84	160	0.34	0.34	0.00	2.00	0.00	5.03
P_Olsen	Vertisols	V/D1	19	13.68	9.55	70	10.60	4.16	6.45	20.00	3.20	39.60
P_Olsen	Xerosols	X/D1	36	12.98	14.05	108	7.03	4.47	3.88	17.66	1.03	60.45
P_Olsen	Xerosols	X/D2	36	6.15	8.11	132	2.88	1.76	1.18	6.07	0.64	33.70
P_Olsen	Xerosols	X/D3	30	6.21	8.36	135	2.00	1.12	1.30	7.01	0.67	33.70
P_Olsen	Xerosols	X/D4	29	4.48	5.26	117	2.43	1.33	1.30	5.71	0.50	21.37
P_Olsen	Xerosols	X/D5	29	3.88	4.31	111	2.63	1.25	1.34	3.83	0.59	20.00
P_retention	Acrisols	A/D1	143	47.15	22.85	48	43.00	17.50	28.00	65.60	1.00	96.20
P_retention	Acrisols	A/D2	144	48.87	21.15	43	47.15	16.15	32.25	66.04	9.70	97.80
P_retention	Acrisols	A/D3	143	49.04	20.61	42	48.20	16.70	31.50	65.30	10.60	97.75
P_retention	Acrisols	A/D4	141	48.25	20.88	43	46.40	15.40	31.50	63.60	10.00	98.50
P_retention	Acrisols	A/D5	129	47.09	22.22	47	43.00	15.00	29.50	64.90	8.60	99.00
P_retention	Andosols	T/D1	432	72.21	22.90	32	78.00	16.50	56.97	91.68	4.00	100.00
P_retention	Andosols	T/D2	432	77.02	23.15	30	85.68	12.68	60.44	96.74	4.00	100.00
P_retention	Andosols	T/D3	408	72.17	27.80	39	84.00	15.00	47.95	97.00	2.15	100.60
P_retention	Andosols	T/D4	367	68.15	31.14	46	80.00	19.00	39.10	97.00	0.00	101.00
P_retention	Andosols	T/D5	312	63.66	32.61	51	71.00	27.00	31.00	97.00	0.00	100.05
P_retention	Arenosols	Q/D1	72	19.62	13.57	69	15.97	7.72	10.00	24.79	0.00	53.25

Variable	FAO74_NAME	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_retention	Arenosols	Q/D2	72	20.59	14.05	68	17.65	9.00	11.81	28.20	0.00	73.75
P_retention	Arenosols	Q/D3	64	18.12	14.23	79	14.40	8.35	8.81	24.00	0.00	88.00
P_retention	Arenosols	Q/D4	60	16.44	14.25	87	13.00	6.60	6.25	21.23	0.00	88.00
P_retention	Arenosols	Q/D5	52	15.10	14.46	96	11.82	5.82	6.00	18.73	0.00	91.00
P_retention	Cambisols	B/D1	531	46.25	23.68	51	40.40	16.45	28.20	64.24	2.00	100.00
P_retention	Cambisols	B/D2	527	46.30	24.80	54	40.30	17.30	25.90	66.55	2.60	100.00
P_retention	Cambisols	B/D3	487	42.13	26.31	62	34.85	16.75	20.90	60.00	0.00	100.00
P_retention	Cambisols	B/D4	431	38.34	25.92	68	31.10	15.10	18.00	54.00	0.00	100.00
P_retention	Cambisols	B/D5	370	34.35	25.67	75	26.27	12.27	15.63	45.00	0.00	100.00
P_retention	Chernozems	C/D1	95	26.65	15.41	58	22.10	6.40	16.75	32.00	4.00	91.00
P_retention	Chernozems	C/D2	91	27.17	15.16	56	23.40	7.10	17.00	32.20	6.00	70.00
P_retention	Chernozems	C/D3	90	26.94	15.91	59	23.80	7.50	16.95	31.61	3.60	75.90
P_retention	Chernozems	C/D4	86	24.50	14.53	59	20.92	7.72	15.38	30.51	3.00	73.00
P_retention	Chernozems	C/D5	75	22.50	13.19	59	19.00	7.00	14.00	28.10	4.00	78.00
P_retention	Ferralsols	F/D1	65	52.58	17.33	33	53.00	13.20	39.80	66.47	14.00	88.80
P_retention	Ferralsols	F/D2	65	58.56	19.02	32	61.90	13.60	44.35	71.78	18.50	98.00
P_retention	Ferralsols	F/D3	64	59.32	20.52	35	62.35	16.63	42.25	74.93	17.20	99.10
P_retention	Ferralsols	F/D4	55	58.01	21.29	37	60.00	18.15	40.00	74.60	13.10	100.00
P_retention	Ferralsols	F/D5	51	58.59	21.35	36	59.00	17.90	36.90	75.90	23.00	99.00
P_retention	Fluvisols	J/D1	16	21.11	13.09	62	20.00	7.20	12.70	29.44	1.75	52.50
P_retention	Fluvisols	J/D2	16	21.31	15.10	71	17.78	4.75	13.48	23.48	2.80	58.80
P_retention	Fluvisols	J/D3	15	19.95	16.91	85	13.85	6.85	8.00	27.20	5.00	62.10
P_retention	Fluvisols	J/D4	14	20.14	21.68	108	12.75	7.85	7.57	24.39	0.25	73.00
P_retention	Fluvisols	J/D5	14	20.57	19.94	97	13.55	9.60	9.37	24.09	0.00	64.45
P_retention	Gleysols	G/D1	167	39.87	19.08	48	38.00	12.00	26.00	51.00	0.00	97.30
P_retention	Gleysols	G/D2	180	38.19	20.22	53	35.50	12.40	23.89	48.95	0.00	99.00
P_retention	Gleysols	G/D3	170	32.72	20.80	64	28.00	11.93	18.49	44.08	0.00	98.50
P_retention	Gleysols	G/D4	153	30.41	20.49	67	25.00	11.00	17.00	40.15	0.00	98.65
P_retention	Gleysols	G/D5	137	28.67	20.14	70	23.00	11.00	15.23	40.00	0.00	99.00
P_retention	Histosols	O/D1	23	49.83	24.98	50	48.30	18.70	27.50	67.00	18.00	95.00
P_retention	Histosols	O/D2	27	54.16	20.97	39	51.00	14.96	36.20	73.00	28.25	95.00
P_retention	Histosols	O/D3	24	54.88	22.98	42	50.15	17.60	34.63	72.81	15.00	96.00
P_retention	Histosols	O/D4	20	52.22	30.55	59	37.50	25.00	28.50	77.75	10.00	100.00
P_retention	Histosols	O/D5	19	52.14	26.99	52	51.00	22.00	29.00	74.00	12.00	99.25
P_retention	Kastanozems	K/D1	376	26.30	15.22	58	22.00	7.10	16.00	31.50	3.40	85.00
P_retention	Kastanozems	K/D2	373	27.54	16.13	59	22.85	7.60	16.10	33.67	2.00	96.00
P_retention	Kastanozems	K/D3	332	28.03	17.92	64	23.00	8.00	16.00	33.22	2.00	97.00
P_retention	Kastanozems	K/D4	283	27.76	18.69	67	22.00	9.00	15.00	35.75	2.00	99.50
P_retention	Kastanozems	K/D5	234	28.32	19.85	70	21.00	8.00	15.00	35.00	2.00	100.00
P_retention	Luvisols	L/D1	276	32.80	19.12	58	27.23	10.23	18.47	42.94	6.00	95.60
P_retention	Luvisols	L/D2	269	32.10	16.95	53	28.25	9.25	20.00	42.00	2.65	92.10
P_retention	Luvisols	L/D3	256	31.00	15.87	51	28.25	10.25	19.00	40.15	0.00	84.00
P_retention	Luvisols	L/D4	244	30.61	16.17	53	29.00	11.00	18.00	39.35	0.00	91.60
P_retention	Luvisols	L/D5	228	29.96	17.53	59	26.10	10.10	17.16	38.72	0.00	93.00
P_retention	Phaeozems	H/D1	30	32.09	18.32	57	29.63	12.00	16.92	37.75	11.00	77.50
P_retention	Phaeozems	H/D2	31	35.27	21.03	60	31.00	12.00	19.00	47.95	11.00	88.85
P_retention	Phaeozems	H/D3	27	36.15	21.52	60	29.50	9.30	21.00	49.65	13.20	89.60
P_retention	Phaeozems	H/D4	26	33.78	23.12	68	26.02	7.80	20.13	39.89	5.00	86.00
P_retention	Phaeozems	H/D5	23	30.50	20.27	66	24.00	6.50	19.25	33.85	10.00	85.00
P_retention	Podzols	P/D1	283	40.50	25.14	62	36.80	20.60	19.65	62.33	0.00	97.50
P_retention	Podzols	P/D2	296	51.58	27.54	53	46.10	22.50	28.06	76.00	0.00	100.00
P_retention	Podzols	P/D3	281	44.90	26.98	60	37.20	17.20	23.00	66.45	0.00	100.00
P_retention	Podzols	P/D4	250	35.39	24.57	69	26.13	11.10	17.31	48.04	0.00	100.00
P_retention	Podzols	P/D5	204	25.72	20.11	78	19.00	9.00	13.00	33.22	0.00	99.00
P_retention	Podzoluvisols	D/D1	26	33.34	18.27	55	28.42	7.71	22.91	36.72	8.10	77.50
P_retention	Podzoluvisols	D/D2	26	28.86	14.32	50	27.20	5.80	19.00	32.51	8.50	71.20

Variable	FAO74_NAME	FAO74_LAY	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_retention	Podzoluvisols	D/D3	22	23.18	11.73	51	22.88	3.92	15.16	26.71	5.50	61.00
P_retention	Podzoluvisols	D/D4	22	20.94	12.18	58	19.90	3.72	13.65	23.44	1.00	61.00
P_retention	Podzoluvisols	D/D5	21	19.95	12.82	64	19.00	8.00	12.35	27.50	1.00	61.00
P_retention	Ranker	U/D1	6	48.17	26.44	55	52.50	20.00	20.75	71.75	17.00	74.00
P_retention	Regosols	R/D1	51	24.57	15.45	63	21.55	9.95	12.50	35.35	0.00	74.84
P_retention	Regosols	R/D2	48	25.17	13.88	55	24.05	9.60	13.35	33.20	0.00	54.00
P_retention	Regosols	R/D3	47	22.44	12.82	57	20.31	7.39	13.00	30.00	0.00	54.05
P_retention	Regosols	R/D4	41	19.95	12.12	61	17.00	7.05	11.15	31.45	0.00	47.00
P_retention	Regosols	R/D5	34	22.59	15.34	68	17.23	6.22	12.50	31.00	1.00	56.15
P_retention	Rendzinas	E/D1	6	43.71	21.78	50	45.88	16.75	24.25	64.13	10.00	69.00
P_retention	Solonetz	S/D1	12	19.89	12.28	62	14.54	4.54	10.88	25.75	9.80	45.75
P_retention	Solonetz	S/D2	12	26.26	14.63	56	23.88	11.80	12.85	36.79	8.05	54.90
P_retention	Solonetz	S/D3	12	30.88	20.76	67	26.65	11.57	14.61	40.95	7.10	74.60
P_retention	Solonetz	S/D4	11	33.13	23.97	72	23.00	9.00	14.00	54.00	5.60	81.00
P_retention	Solonetz	S/D5	11	34.08	27.94	82	21.30	12.30	11.90	55.95	9.00	83.20
P_retention	Vertisols	V/D1	27	33.92	12.14	36	29.57	7.12	25.00	41.00	18.50	62.50
P_retention	Vertisols	V/D2	26	34.03	12.60	37	29.95	8.65	25.81	42.50	13.50	67.50
P_retention	Vertisols	V/D3	26	34.61	15.27	44	30.13	8.25	22.00	43.19	15.00	73.00
P_retention	Vertisols	V/D4	26	34.24	16.03	47	32.60	10.50	19.24	43.00	12.45	73.00
P_retention	Vertisols	V/D5	25	35.18	20.16	57	29.30	11.30	19.65	45.50	11.80	86.00
P_retention	Xerosols	X/D1	79	22.63	15.01	66	19.29	6.99	12.30	27.00	4.60	83.45
P_retention	Xerosols	X/D2	79	26.04	18.10	70	21.85	7.65	15.00	31.00	3.35	88.00
P_retention	Xerosols	X/D3	63	30.79	22.52	73	22.00	10.40	14.45	39.10	1.45	92.25
P_retention	Xerosols	X/D4	59	33.75	24.07	71	25.40	13.60	14.00	53.80	1.00	93.50
P_retention	Xerosols	X/D5	55	35.99	26.82	75	25.00	15.65	13.00	61.85	1.00	94.00
P_retention	Yermosols	Y/D1	8	40.77	24.20	59	29.40	10.70	21.31	69.00	16.65	75.00
P_retention	Yermosols	Y/D2	6	23.09	11.14	48	22.00	6.53	13.50	31.16	10.50	42.00
P_retention	Yermosols	Y/D3	6	19.55	12.08	62	17.08	6.22	9.64	27.23	9.00	42.00

[a] Values of "0.00" for P refer to traces, see (NCSS 2010).

Appendix 4. Descriptive statistics for soil P, clustered according to FAO soil group and textural class[1], for five fixed-depth layers

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	Acrisols	A/D1-C	38	66.67	119.94	179.89	14.82	13.29	3.19	86.65	0.60	586.17
P_BRAY1	Acrisols	A/D1-M	208	25.88	54.28	209.72	7.40	5.40	3.00	22.31	0.00	449.70
P_BRAY1	Acrisols	A/D1-V	37	21.49	63.73	296.55	2.95	2.65	0.99	7.91	0.00	313.00
P_BRAY1	Acrisols	A/D2-C	25	26.43	40.83	154.49	9.00	7.90	2.22	32.80	0.32	169.60
P_BRAY1	Acrisols	A/D2-M	148	11.56	34.35	297.15	2.00	1.41	1.00	7.20	0.00	294.76
P_BRAY1	Acrisols	A/D2-V	60	16.89	54.54	322.88	0.64	0.64	0.11	6.06	0.00	282.02
P_BRAY1	Acrisols	A/D3-C	19	10.33	18.97	183.60	7.00	3.20	0.67	8.80	0.00	85.00
P_BRAY1	Acrisols	A/D3-M	112	7.19	21.33	296.52	1.45	1.15	0.42	4.32	0.00	164.00
P_BRAY1	Acrisols	A/D3-V	75	2.39	11.03	461.11	0.30	0.30	0.00	1.23	0.00	95.28
P_BRAY1	Acrisols	A/D4-C	19	7.32	13.02	177.83	5.50	4.50	0.50	8.00	0.10	58.91
P_BRAY1	Acrisols	A/D4-M	84	6.89	20.78	301.53	1.00	0.98	0.39	6.75	0.00	164.00
P_BRAY1	Acrisols	A/D4-V	72	1.04	2.21	213.38	0.30	0.30	0.00	1.00	0.00	14.65
P_BRAY1	Acrisols	A/D5-C	17	7.93	15.16	191.02	3.30	3.20	0.61	7.53	0.08	64.00
P_BRAY1	Acrisols	A/D5-M	63	6.23	21.48	344.74	0.60	0.60	0.04	3.13	0.00	164.00
P_BRAY1	Acrisols	A/D5-V	69	1.73	4.53	261.93	0.28	0.28	0.00	1.00	0.00	25.00
P_BRAY1	Andosols	T/D1-C	16	36.38	78.77	216.49	14.50	14.50	0.15	46.00	0.00	322.56
P_BRAY1	Andosols	T/D1-M	78	19.50	34.47	176.74	4.03	4.03	1.10	21.30	0.00	192.40
P_BRAY1	Andosols	T/D2-C	25	27.21	69.98	257.21	3.40	3.40	0.00	19.30	0.00	336.90
P_BRAY1	Andosols	T/D2-M	70	14.59	28.87	197.86	2.30	2.30	1.00	11.65	0.00	146.00
P_BRAY1	Andosols	T/D3-C	29	11.73	21.06	179.53	2.05	2.05	0.00	18.88	0.00	100.54
P_BRAY1	Andosols	T/D3-M	54	9.67	20.15	208.39	2.45	2.45	0.77	8.86	0.00	115.00
P_BRAY1	Andosols	T/D4-C	26	9.10	11.76	129.27	3.42	3.42	0.24	13.98	0.00	43.00
P_BRAY1	Andosols	T/D4-M	43	3.89	6.50	166.96	1.26	1.26	0.00	5.50	0.00	31.58
P_BRAY1	Andosols	T/D5-C	24	5.96	9.47	158.95	3.67	3.67	0.00	8.14	0.00	43.00
P_BRAY1	Andosols	T/D5-M	31	2.28	3.15	138.24	1.17	1.17	0.00	2.90	0.00	13.78
P_BRAY1	Arenosols	Q/D1-C	54	68.79	87.20	126.76	39.60	30.63	9.81	89.25	0.95	316.00
P_BRAY1	Arenosols	Q/D2-C	48	51.85	76.75	148.03	21.65	20.60	5.25	54.75	0.00	393.00
P_BRAY1	Arenosols	Q/D3-C	37	38.71	77.60	200.45	11.40	10.40	2.08	32.22	0.00	393.00
P_BRAY1	Arenosols	Q/D4-C	33	24.25	55.36	228.33	7.00	6.00	1.80	17.70	0.00	306.06
P_BRAY1	Arenosols	Q/D5-C	28	21.46	41.48	193.33	4.95	3.97	1.40	19.93	0.00	199.80
P_BRAY1	Cambisols	B/D1-C	75	65.28	86.82	132.99	38.50	30.89	10.25	80.00	0.00	478.00
P_BRAY1	Cambisols	B/D1-M	236	32.77	65.13	198.76	10.00	8.37	2.50	28.69	0.00	401.00
P_BRAY1	Cambisols	B/D1-V	33	13.98	22.45	160.62	3.60	3.60	0.47	15.38	0.00	86.00
P_BRAY1	Cambisols	B/D2-C	85	47.79	78.74	164.78	24.00	19.97	7.04	55.50	0.00	478.00
P_BRAY1	Cambisols	B/D2-M	196	14.53	39.38	271.06	3.31	2.51	1.32	12.94	0.00	401.00
P_BRAY1	Cambisols	B/D2-V	26	5.15	10.42	202.39	1.15	1.15	0.00	3.00	0.00	38.00
P_BRAY1	Cambisols	B/D3-C	69	24.70	37.47	151.67	13.91	11.59	4.29	27.50	0.00	219.30
P_BRAY1	Cambisols	B/D3-M	165	7.10	16.86	237.37	2.66	2.16	0.92	6.95	0.00	179.68
P_BRAY1	Cambisols	B/D3-V	19	2.41	4.57	189.38	0.50	0.50	0.00	1.85	0.00	17.65
P_BRAY1	Cambisols	B/D4-C	56	17.92	23.71	132.31	9.18	7.38	3.15	21.17	0.00	117.20
P_BRAY1	Cambisols	B/D4-M	121	6.43	12.33	191.85	3.00	2.55	0.87	6.85	0.00	90.05
P_BRAY1	Cambisols	B/D4-V	18	2.00	4.12	205.72	0.41	0.41	0.00	1.02	0.00	15.20
P_BRAY1	Cambisols	B/D5-C	50	20.22	24.99	123.58	8.85	7.41	3.00	28.66	0.00	105.37
P_BRAY1	Cambisols	B/D5-M	84	5.84	10.21	174.71	2.60	2.35	0.40	6.30	0.00	75.00

[1] Codes for FAO74_text consist of abbrviations for FAO74 major soil grouping (e.g., B= Cambisols), depth layer (e.g., D1=0-20cm) and soil textural class, defined according to the Soil Map of the World, i.e. C- coarse, M -medium and V -fine (FAO, 1990). For details, see text.

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	Cambisols	B/D5-V	11	0.36	0.52	144.54	0.00	0.00	0.00	1.00	0.00	1.30
P_BRAY1	Chernozems	C/D1-C	6	5.22	6.00	114.95	3.50	3.35	0.22	10.50	0.00	15.00
P_BRAY1	Chernozems	C/D1-M	83	26.18	23.70	90.51	20.00	12.00	8.80	34.05	0.00	131.00
P_BRAY1	Chernozems	C/D1-V	6	19.45	17.20	88.43	14.50	9.55	5.43	33.58	4.00	49.55
P_BRAY1	Chernozems	C/D2-C	6	6.00	3.76	62.62	6.90	2.63	2.37	9.44	0.00	9.70
P_BRAY1	Chernozems	C/D2-M	55	20.82	24.56	117.93	10.00	8.14	5.60	32.60	0.08	131.00
P_BRAY1	Chernozems	C/D2-V	7	3.21	3.48	108.36	1.30	1.30	0.10	7.05	0.00	8.25
P_BRAY1	Chernozems	C/D3-C	8	4.63	4.61	99.64	2.46	2.46	0.47	10.00	0.00	10.20
P_BRAY1	Chernozems	C/D3-M	34	12.42	15.60	125.60	6.72	5.45	1.77	14.82	0.00	61.80
P_BRAY1	Chernozems	C/D3-V	6	1.48	2.12	142.95	0.27	0.27	0.00	3.94	0.00	4.65
P_BRAY1	Chernozems	C/D4-C	6	2.94	3.71	126.21	1.26	1.26	0.00	7.28	0.00	8.10
P_BRAY1	Chernozems	C/D4-M	26	10.94	12.72	116.26	6.00	5.00	1.04	21.25	0.05	44.85
P_BRAY1	Chernozems	C/D4-V	8	2.04	2.53	124.05	1.15	1.15	0.05	3.45	0.00	7.20
P_BRAY1	Chernozems	C/D5-C	7	4.32	4.91	113.77	1.44	1.44	0.10	8.20	0.00	12.50
P_BRAY1	Chernozems	C/D5-M	18	14.52	17.06	117.47	8.00	7.32	1.78	23.76	0.00	64.36
P_BRAY1	Chernozems	C/D5-V	6	2.93	2.30	78.56	3.50	1.65	0.22	5.07	0.00	5.30
P_BRAY1	Ferralsols	F/D1-M	6	12.87	20.48	159.10	5.73	4.60	0.97	21.08	0.87	53.70
P_BRAY1	Ferralsols	F/D1-V	19	6.37	15.17	238.34	0.58	0.58	0.30	3.00	0.00	63.90
P_BRAY1	Ferralsols	F/D2-M	7	1.21	0.81	66.94	1.00	0.01	1.00	1.92	0.00	2.56
P_BRAY1	Ferralsols	F/D2-V	20	0.72	1.62	226.88	0.18	0.18	0.00	0.51	0.00	7.10
P_BRAY1	Ferralsols	F/D3-M	11	0.58	0.80	138.98	0.15	0.15	0.05	1.00	0.00	2.70
P_BRAY1	Ferralsols	F/D3-V	15	0.58	0.72	124.54	0.20	0.20	0.00	1.00	0.00	2.00
P_BRAY1	Ferralsols	F/D4-M	8	0.39	0.42	108.12	0.15	0.10	0.10	0.90	0.00	1.00
P_BRAY1	Ferralsols	F/D4-V	9	0.41	0.59	145.94	0.00	0.00	0.00	1.00	0.00	1.50
P_BRAY1	Ferralsols	F/D5-M	7	0.56	0.45	81.50	0.60	0.40	0.10	1.00	0.00	1.00
P_BRAY1	Ferralsols	F/D5-V	8	0.35	0.58	164.49	0.05	0.05	0.00	0.80	0.00	1.50
P_BRAY1	Fluvisols	J/D1-C	8	37.87	29.14	76.96	25.98	7.47	20.07	45.06	17.00	105.00
P_BRAY1	Fluvisols	J/D1-M	39	28.66	34.55	120.57	17.40	12.30	6.00	40.70	0.00	155.75
P_BRAY1	Fluvisols	J/D2-C	9	14.84	11.37	76.62	12.43	9.03	4.09	27.60	0.06	30.40
P_BRAY1	Fluvisols	J/D2-M	36	16.61	22.58	135.99	7.70	5.70	3.00	19.00	0.00	90.20
P_BRAY1	Fluvisols	J/D3-C	8	18.51	25.28	136.54	11.55	10.50	1.25	22.75	0.00	77.00
P_BRAY1	Fluvisols	J/D3-M	35	10.18	14.59	143.35	5.45	3.45	2.80	10.00	0.00	68.80
P_BRAY1	Fluvisols	J/D4-C	8	16.68	25.74	154.36	8.34	6.86	0.74	21.80	0.00	77.00
P_BRAY1	Fluvisols	J/D4-M	27	11.57	12.49	107.97	8.00	2.10	5.00	10.00	0.22	53.00
P_BRAY1	Fluvisols	J/D5-C	6	24.33	28.11	115.52	13.13	8.75	5.49	44.75	2.15	77.00
P_BRAY1	Fluvisols	J/D5-M	24	13.97	14.41	103.12	8.90	5.47	4.59	19.71	0.00	46.00
P_BRAY1	Gleysols	G/D1-C	29	81.68	88.20	107.98	58.00	49.00	15.88	126.50	0.00	375.00
P_BRAY1	Gleysols	G/D1-M	161	41.72	47.37	113.54	27.50	25.00	5.22	63.50	0.00	376.00
P_BRAY1	Gleysols	G/D1-V	52	48.40	49.15	101.56	37.65	33.51	5.30	73.69	0.00	188.00
P_BRAY1	Gleysols	G/D2-C	33	44.82	73.42	163.81	17.84	15.09	9.25	46.88	0.00	375.00
P_BRAY1	Gleysols	G/D2-M	146	16.44	24.74	150.50	9.75	8.15	3.19	22.23	0.00	247.00
P_BRAY1	Gleysols	G/D2-V	57	27.00	31.53	116.77	17.65	16.49	3.15	40.00	0.00	163.90
P_BRAY1	Gleysols	G/D3-C	30	20.84	31.53	151.28	9.40	7.40	2.00	19.23	0.00	128.00
P_BRAY1	Gleysols	G/D3-M	128	9.06	18.40	203.09	4.60	3.47	2.00	10.60	0.00	192.00
P_BRAY1	Gleysols	G/D3-V	61	9.89	13.26	134.10	5.10	4.05	1.65	9.84	0.00	56.80
P_BRAY1	Gleysols	G/D4-C	22	28.61	73.50	256.91	4.53	3.70	2.11	20.92	0.00	342.60
P_BRAY1	Gleysols	G/D4-M	94	8.53	13.38	156.79	4.10	3.10	1.35	11.04	0.00	108.70
P_BRAY1	Gleysols	G/D4-V	54	7.00	8.17	116.69	5.00	4.00	1.00	10.23	0.00	35.05
P_BRAY1	Gleysols	G/D5-C	15	3.67	3.81	103.67	1.80	1.65	1.00	7.82	0.00	12.10
P_BRAY1	Gleysols	G/D5-M	61	8.26	11.23	135.86	4.90	3.20	2.03	9.90	0.00	73.00
P_BRAY1	Gleysols	G/D5-V	41	9.30	14.14	152.14	3.65	3.05	1.00	11.77	0.00	62.00
P_BRAY1	Histosols	O/D1-M	9	7.91	19.85	250.81	0.25	0.25	0.00	5.01	0.00	60.50
P_BRAY1	Histosols	O/D2-M	16	3.14	10.47	333.24	0.00	0.00	0.00	1.15	0.00	42.25
P_BRAY1	Histosols	O/D3-M	17	3.01	8.88	295.40	0.20	0.20	0.00	1.20	0.00	37.00
P_BRAY1	Histosols	O/D4-M	9	2.16	2.41	111.77	1.00	1.00	0.43	4.78	0.00	6.00

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	Histosols	O/D5-M	7	2.36	2.69	114.04	1.00	1.00	0.00	6.00	0.00	6.00
P_BRAY1	Kastanozems	K/D1-C	26	58.53	77.73	132.81	27.85	21.35	9.75	79.58	3.50	327.40
P_BRAY1	Kastanozems	K/D1-M	188	31.04	36.91	118.91	22.50	16.80	7.00	43.61	0.00	326.27
P_BRAY1	Kastanozems	K/D1-V	30	12.38	14.50	117.18	7.10	6.37	1.44	16.54	0.00	48.84
P_BRAY1	Kastanozems	K/D2-C	20	38.11	57.57	151.06	16.00	13.90	4.03	34.88	0.00	223.00
P_BRAY1	Kastanozems	K/D2-M	147	16.73	20.55	122.81	10.55	9.55	1.75	25.80	0.00	119.00
P_BRAY1	Kastanozems	K/D2-V	49	6.20	10.54	169.87	2.10	2.00	0.44	6.11	0.00	44.00
P_BRAY1	Kastanozems	K/D3-C	16	15.03	31.90	212.20	4.57	3.63	1.75	15.99	0.90	132.00
P_BRAY1	Kastanozems	K/D3-M	117	9.73	14.68	150.87	3.07	2.73	1.38	11.40	0.00	74.00
P_BRAY1	Kastanozems	K/D3-V	41	4.00	6.71	167.84	1.00	1.00	0.36	4.40	0.00	29.00
P_BRAY1	Kastanozems	K/D4-C	18	9.01	15.82	175.59	2.85	2.10	1.45	12.00	0.00	67.80
P_BRAY1	Kastanozems	K/D4-M	90	6.98	10.88	155.89	2.26	1.81	1.00	8.74	0.00	49.90
P_BRAY1	Kastanozems	K/D4-V	31	3.52	7.02	199.34	0.60	0.60	0.10	2.60	0.00	28.00
P_BRAY1	Kastanozems	K/D5-C	14	7.93	7.86	99.14	4.10	2.30	2.53	13.69	1.00	24.20
P_BRAY1	Kastanozems	K/D5-M	78	6.14	10.06	164.04	2.00	1.90	0.85	7.25	0.00	49.90
P_BRAY1	Kastanozems	K/D5-V	22	2.49	4.43	178.18	0.97	0.95	0.15	2.01	0.00	17.80
P_BRAY1	Luvisols	L/D1-C	94	67.08	81.77	121.89	32.00	27.59	9.63	97.00	0.80	364.00
P_BRAY1	Luvisols	L/D1-M	499	38.52	48.68	126.37	20.75	15.75	8.46	49.45	0.00	342.60
P_BRAY1	Luvisols	L/D1-V	52	28.21	47.90	169.81	7.36	5.14	2.85	29.54	0.00	211.95
P_BRAY1	Luvisols	L/D2-C	67	35.79	46.21	129.13	16.00	13.40	4.33	49.00	0.00	244.00
P_BRAY1	Luvisols	L/D2-M	385	17.49	34.72	198.45	7.00	5.40	2.65	19.00	0.00	509.40
P_BRAY1	Luvisols	L/D2-V	108	10.01	22.88	228.50	2.78	2.58	0.81	10.23	0.00	204.20
P_BRAY1	Luvisols	L/D3-C	51	26.08	35.66	136.77	13.95	10.95	3.50	27.00	1.05	181.60
P_BRAY1	Luvisols	L/D3-M	276	11.32	33.81	298.63	3.60	2.60	1.23	10.00	0.00	504.40
P_BRAY1	Luvisols	L/D3-V	139	7.84	20.18	257.40	2.00	1.95	0.35	5.00	0.00	182.43
P_BRAY1	Luvisols	L/D4-C	36	20.91	29.34	140.31	9.59	7.61	3.00	25.90	0.00	120.00
P_BRAY1	Luvisols	L/D4-M	192	10.16	33.14	326.23	2.80	2.22	1.00	8.43	0.00	409.50
P_BRAY1	Luvisols	L/D4-V	113	8.34	18.17	217.76	1.00	1.00	0.20	5.00	0.00	122.00
P_BRAY1	Luvisols	L/D5-C	29	9.57	15.52	162.13	5.00	3.11	1.95	8.95	0.00	57.90
P_BRAY1	Luvisols	L/D5-M	153	10.35	29.45	284.55	2.00	2.00	1.00	9.60	0.00	313.27
P_BRAY1	Luvisols	L/D5-V	74	11.09	29.19	263.28	1.00	1.00	0.20	3.33	0.00	160.83
P_BRAY1	Phaeozems	H/D1-C	13	77.51	80.99	104.49	57.10	37.90	23.58	97.00	3.53	306.00
P_BRAY1	Phaeozems	H/D1-M	137	59.04	82.85	140.34	39.00	23.00	19.50	64.29	1.00	616.00
P_BRAY1	Phaeozems	H/D1-V	24	39.39	46.43	117.88	26.70	8.92	15.13	32.47	1.00	210.00
P_BRAY1	Phaeozems	H/D2-C	12	37.82	34.34	90.81	26.00	9.93	18.50	49.45	1.56	105.90
P_BRAY1	Phaeozems	H/D2-M	100	41.29	76.89	186.24	20.02	13.81	8.60	41.24	0.00	594.00
P_BRAY1	Phaeozems	H/D2-V	32	13.72	19.81	144.43	4.82	4.16	1.11	18.82	0.00	83.90
P_BRAY1	Phaeozems	H/D3-C	14	20.50	25.30	123.39	16.58	10.10	5.44	25.75	1.46	102.00
P_BRAY1	Phaeozems	H/D3-M	78	18.10	47.11	260.21	5.80	4.60	2.33	14.38	0.00	316.00
P_BRAY1	Phaeozems	H/D3-V	35	10.31	17.37	168.54	3.80	2.80	1.48	13.70	0.03	74.75
P_BRAY1	Phaeozems	H/D4-C	14	28.58	55.25	193.33	17.68	8.09	3.75	24.19	0.80	217.80
P_BRAY1	Phaeozems	H/D4-M	66	11.82	20.83	176.21	4.78	3.77	1.80	14.52	0.00	143.00
P_BRAY1	Phaeozems	H/D4-V	29	14.95	29.28	195.87	3.30	3.00	1.00	12.27	0.00	131.90
P_BRAY1	Phaeozems	H/D5-C	13	9.83	6.65	67.59	7.60	4.50	4.00	14.40	1.70	23.00
P_BRAY1	Phaeozems	H/D5-M	47	14.16	22.63	159.90	4.95	4.59	1.00	18.76	0.00	118.00
P_BRAY1	Phaeozems	H/D5-V	24	13.10	31.44	239.96	5.68	4.88	1.24	11.52	0.00	157.25
P_BRAY1	Planosols	W/D1-M	9	21.71	17.32	79.77	19.00	7.00	11.88	23.50	3.30	64.35
P_BRAY1	Planosols	W/D3-V	8	4.80	4.30	89.57	5.13	3.50	0.25	7.79	0.00	11.95
P_BRAY1	Planosols	W/D4-V	7	11.01	16.42	149.04	5.20	5.20	0.00	21.10	0.00	44.30
P_BRAY1	Podzols	P/D1-C	22	24.18	30.60	126.55	8.77	5.78	5.17	30.05	1.53	92.67
P_BRAY1	Podzols	P/D1-M	20	15.75	16.46	104.50	12.41	10.59	1.73	31.49	0.00	51.34
P_BRAY1	Podzols	P/D2-C	18	14.02	19.05	135.93	4.55	3.50	1.99	21.89	0.73	58.25
P_BRAY1	Podzols	P/D2-M	16	5.30	10.02	189.10	2.67	1.52	1.02	4.20	0.00	41.50
P_BRAY1	Podzols	P/D3-C	13	21.82	24.48	112.19	10.00	9.00	4.23	46.75	0.30	64.70
P_BRAY1	Podzols	P/D3-M	14	7.04	12.59	178.73	2.15	1.15	1.00	4.11	0.94	41.50

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_BRAY1	Podzols	P/D4-C	11	32.18	35.13	109.18	22.00	18.00	4.00	49.60	1.00	108.15
P_BRAY1	Podzols	P/D4-M	9	17.45	19.80	113.46	8.20	6.39	3.50	27.49	1.81	63.06
P_BRAY1	Podzols	P/D5-C	14	24.13	31.59	130.90	14.07	11.00	4.75	31.52	1.00	124.02
P_BRAY1	Podzoluvisols	D/D1-M	25	23.49	27.94	118.95	11.00	9.00	5.13	35.30	0.00	96.10
P_BRAY1	Podzoluvisols	D/D2-M	20	15.04	18.66	124.05	7.64	6.06	1.89	25.90	0.62	67.00
P_BRAY1	Podzoluvisols	D/D3-M	13	10.78	13.52	125.38	5.60	4.82	0.91	17.60	0.30	46.40
P_BRAY1	Podzoluvisols	D/D4-M	9	4.88	6.53	133.61	3.44	2.94	0.45	7.50	0.38	19.80
P_BRAY1	Regosols	R/D1-C	28	42.38	43.28	102.11	35.30	21.33	11.19	55.53	0.40	220.00
P_BRAY1	Regosols	R/D1-M	32	24.89	31.10	124.92	10.05	9.10	5.67	36.13	0.00	138.15
P_BRAY1	Regosols	R/D1-V	7	19.32	14.30	74.03	14.75	1.25	13.50	18.00	8.00	51.00
P_BRAY1	Regosols	R/D2-C	19	29.41	38.95	132.45	18.80	14.80	5.85	45.17	0.00	171.70
P_BRAY1	Regosols	R/D2-M	28	5.99	8.49	141.70	3.42	3.10	0.26	7.09	0.00	32.90
P_BRAY1	Regosols	R/D3-C	13	25.81	40.35	156.33	8.05	7.15	5.10	31.55	0.00	151.00
P_BRAY1	Regosols	R/D3-M	24	6.11	10.30	168.72	1.95	1.70	0.96	5.91	0.00	45.10
P_BRAY1	Regosols	R/D4-C	10	16.86	15.03	89.14	12.63	3.85	7.00	21.89	2.80	47.50
P_BRAY1	Regosols	R/D4-M	21	3.00	3.92	130.65	1.55	0.95	0.62	3.50	0.00	14.00
P_BRAY1	Regosols	R/D5-C	7	15.76	12.04	76.42	10.20	4.80	8.00	24.00	4.00	39.00
P_BRAY1	Regosols	R/D5-M	23	3.30	4.69	142.32	1.24	0.79	0.50	4.00	0.00	15.80
P_BRAY1	Solonetz	S/D1-M	15	24.79	23.19	93.55	16.33	9.32	7.00	38.00	2.15	92.00
P_BRAY1	Vertisols	V/D1-M	8	29.11	27.20	93.43	24.30	17.45	7.70	43.78	0.00	82.00
P_BRAY1	Vertisols	V/D1-V	64	21.39	25.35	118.51	11.50	10.20	2.55	35.89	0.00	122.95
P_BRAY1	Vertisols	V/D2-V	53	11.89	19.23	161.80	2.84	2.84	1.00	15.30	0.00	88.00
P_BRAY1	Vertisols	V/D3-V	43	8.28	17.06	206.10	1.00	1.00	0.00	5.82	0.00	79.25
P_BRAY1	Vertisols	V/D4-V	40	9.90	19.02	192.14	1.00	1.00	0.50	6.94	0.00	79.60
P_BRAY1	Vertisols	V/D5-V	29	14.49	24.95	172.20	1.87	1.87	0.80	19.35	0.00	108.10
P_BRAY1	Xerosols	X/D1-C	16	16.64	11.03	66.26	16.05	8.13	7.91	24.75	1.50	39.75
P_BRAY1	Xerosols	X/D1-M	51	14.99	10.89	72.65	15.10	9.65	4.20	23.60	0.00	40.50
P_BRAY1	Xerosols	X/D2-C	10	4.97	6.74	135.69	2.00	2.00	0.00	11.43	0.00	19.00
P_BRAY1	Xerosols	X/D2-M	43	2.91	5.33	183.19	1.00	1.00	0.00	3.85	0.00	30.00
P_BRAY1	Xerosols	X/D2-V	8	6.78	17.50	258.00	0.00	0.00	0.00	2.56	0.00	50.00
P_BRAY1	Xerosols	X/D3-C	11	3.85	4.63	120.37	1.30	0.95	0.60	7.75	0.20	13.35
P_BRAY1	Xerosols	X/D3-M	23	1.19	1.54	129.74	1.00	1.00	0.00	1.00	0.00	5.30
P_BRAY1	Xerosols	X/D3-V	7	7.69	18.68	243.06	0.30	0.30	0.00	2.50	0.00	50.00
P_BRAY1	Xerosols	X/D4-C	15	3.22	4.63	143.50	1.00	1.00	0.00	2.70	0.00	12.45
P_BRAY1	Xerosols	X/D4-M	15	2.17	2.95	136.11	1.00	1.00	0.00	4.00	0.00	8.60
P_BRAY1	Xerosols	X/D4-V	6	8.85	20.17	227.86	1.00	0.55	0.00	13.32	0.00	50.00
P_BRAY1	Xerosols	X/D5-C	14	4.80	8.12	169.10	1.00	1.00	0.00	5.25	0.00	26.80
P_BRAY1	Xerosols	X/D5-M	10	2.10	3.44	164.29	1.00	0.50	0.00	1.99	0.00	11.00
P_BRAY1	Xerosols	X/D5-V	6	0.83	0.75	90.33	1.00	0.50	0.00	1.25	0.00	2.00
P_BRAY1	Yermosols	Y/D1-C	8	8.51	5.99	70.41	9.63	5.03	2.56	13.54	0.00	17.00
P_BRAY1	Yermosols	Y/D1-M	9	7.35	4.50	61.27	7.60	3.90	3.47	11.75	0.00	12.67
P_BRAY1	Yermosols	Y/D2-C	10	5.72	5.66	98.88	5.75	4.38	0.00	9.06	0.00	17.00
P_BRAY1	Yermosols	Y/D3-C	12	5.06	5.18	102.37	3.80	3.45	0.32	9.14	0.00	17.00
P_BRAY1	Yermosols	Y/D4-C	10	3.76	4.12	109.59	2.88	2.88	0.00	8.39	0.00	10.00
P_BRAY1	Yermosols	Y/D5-C	9	3.09	3.67	118.82	2.00	2.00	0.00	6.00	0.00	10.00
P_H2O	Acrisols	A/D1-M	11	0.07	0.09	123.15	0.05	0.04	0.00	0.09	0.00	0.30
P_H2O	Acrisols	A/D2-M	9	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
P_H2O	Acrisols	A/D3-M	9	0.02	0.04	206.25	0.00	0.00	0.00	0.03	0.00	0.10
P_H2O	Acrisols	A/D4-M	9	0.02	0.04	198.43	0.00	0.00	0.00	0.05	0.00	0.10
P_H2O	Acrisols	A/D5-M	7	0.02	0.04	226.88	0.00	0.00	0.00	0.01	0.00	0.10
P_H2O	Cambisols	B/D1-M	12	0.17	0.35	208.01	0.09	0.09	0.00	0.10	0.00	1.24
P_H2O	Cambisols	B/D2-M	11	0.04	0.05	129.27	0.00	0.00	0.00	0.10	0.00	0.10
P_H2O	Cambisols	B/D3-M	10	0.06	0.07	116.53	0.05	0.05	0.00	0.10	0.00	0.20
P_H2O	Cambisols	B/D4-M	8	0.12	0.16	133.05	0.10	0.08	0.00	0.15	0.00	0.50
P_H2O	Cambisols	B/D5-C	6	0.04	0.06	155.48	0.00	0.00	0.00	0.10	0.00	0.12

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_H2O	Cambisols	B/D5-M	6	0.13	0.10	77.46	0.10	0.05	0.08	0.22	0.00	0.30
P_H2O	Gleysols	G/D1-M	12	0.15	0.28	186.37	0.08	0.08	0.00	0.17	0.00	1.00
P_H2O	Gleysols	G/D2-M	9	0.06	0.07	124.86	0.03	0.03	0.00	0.12	0.00	0.20
P_H2O	Gleysols	G/D3-M	8	0.07	0.07	100.70	0.07	0.05	0.00	0.11	0.00	0.20
P_H2O	Kastanozems	K/D1-M	6	0.34	0.29	86.96	0.23	0.15	0.09	0.65	0.07	0.80
P_H2O	Luvisols	L/D1-M	18	0.29	0.30	100.98	0.15	0.10	0.10	0.47	0.00	0.90
P_H2O	Xerosols	X/D1-M	7	0.60	0.36	59.68	0.60	0.28	0.32	0.93	0.05	1.02
P_H2O	Xerosols	X/D2-M	7	0.38	0.29	77.43	0.39	0.13	0.10	0.52	0.00	0.90
P_H2O	Xerosols	X/D3-M	7	0.25	0.14	57.35	0.20	0.10	0.16	0.30	0.05	0.50
P_H2O	Xerosols	X/D4-M	6	0.18	0.06	31.40	0.17	0.03	0.13	0.22	0.10	0.26
P_H2O	Xerosols	X/D5-M	7	0.10	0.08	77.08	0.10	0.09	0.01	0.20	0.00	0.20
P_Mehlich3	Acrisols	A/D1-M	8	51.19	49.00	95.71	27.14	19.72	15.51	108.55	1.33	125.93
P_Mehlich3	Acrisols	A/D2-M	8	9.48	17.51	184.75	2.07	1.11	1.66	9.70	0.27	51.96
P_Mehlich3	Acrisols	A/D2-V	6	2.04	2.45	120.24	0.77	0.43	0.36	4.35	0.30	6.30
P_Mehlich3	Acrisols	A/D3-V	10	1.61	1.89	117.46	0.93	0.69	0.27	2.77	0.10	5.46
P_Mehlich3	Acrisols	A/D4-M	6	2.01	3.42	169.96	0.65	0.45	0.25	3.31	0.10	8.92
P_Mehlich3	Acrisols	A/D4-V	8	1.21	1.23	101.85	0.81	0.54	0.35	1.77	0.10	3.88
P_Mehlich3	Acrisols	A/D5-V	9	1.52	1.52	99.71	1.10	0.66	0.35	2.67	0.01	4.40
P_Mehlich3	Arenosols	Q/D1-C	34	23.48	15.24	64.92	21.54	8.14	13.13	28.18	8.52	85.27
P_Mehlich3	Arenosols	Q/D2-C	34	7.43	12.70	170.86	3.20	1.77	1.79	7.49	0.80	72.24
P_Mehlich3	Arenosols	Q/D3-C	34	3.43	6.81	198.57	1.48	0.45	1.09	2.29	0.55	38.53
P_Mehlich3	Cambisols	B/D1-M	19	18.46	27.31	147.94	10.59	5.23	6.04	16.20	2.55	123.65
P_Mehlich3	Cambisols	B/D2-C	7	8.69	8.13	93.54	3.95	3.44	2.35	17.60	0.51	19.50
P_Mehlich3	Cambisols	B/D2-M	17	6.59	6.39	97.00	4.61	2.91	1.95	10.78	0.20	21.00
P_Mehlich3	Cambisols	B/D3-C	8	13.26	16.02	120.80	7.18	6.13	1.65	20.90	0.60	47.92
P_Mehlich3	Cambisols	B/D3-M	13	6.40	6.73	105.19	4.41	3.62	0.85	12.81	0.00	21.27
P_Mehlich3	Cambisols	B/D4-C	6	23.11	20.42	88.36	17.68	12.48	7.15	41.18	1.30	57.00
P_Mehlich3	Cambisols	B/D4-M	11	6.13	5.62	91.63	4.47	3.17	1.30	12.52	0.00	16.00
P_Mehlich3	Cambisols	B/D5-C	8	16.84	14.15	84.01	13.70	5.06	7.63	21.63	1.30	47.80
P_Mehlich3	Cambisols	B/D5-M	7	6.56	10.84	165.20	2.37	2.17	0.20	8.60	0.10	30.15
P_Mehlich3	Chernozems	C/D1-M	6	17.18	16.40	95.46	11.39	8.30	3.69	36.13	1.88	38.97
P_Mehlich3	Gleysols	G/D1-M	22	40.71	39.08	96.00	22.94	19.26	6.09	78.75	1.84	114.00
P_Mehlich3	Gleysols	G/D2-M	23	15.23	16.35	107.35	10.16	5.62	4.63	19.98	0.44	72.20
P_Mehlich3	Gleysols	G/D3-M	20	9.05	10.81	119.40	5.26	3.62	2.83	10.74	0.01	41.21
P_Mehlich3	Gleysols	G/D4-M	17	8.37	10.29	122.86	3.88	3.35	0.95	13.62	0.09	37.69
P_Mehlich3	Gleysols	G/D4-V	6	6.09	3.17	52.16	5.36	1.75	3.50	8.30	3.20	11.90
P_Mehlich3	Gleysols	G/D5-C	6	7.06	4.88	69.10	7.50	3.90	2.65	11.49	0.40	12.35
P_Mehlich3	Gleysols	G/D5-M	16	10.67	14.72	137.93	6.13	5.93	0.37	14.21	0.00	56.60
P_Mehlich3	Gleysols	G/D5-V	6	6.48	3.32	51.17	5.24	1.38	4.51	9.58	2.55	11.90
P_Mehlich3	Kastanozems	K/D1-M	51	26.91	25.01	92.95	22.25	15.28	6.43	36.20	1.60	104.65
P_Mehlich3	Kastanozems	K/D1-V	7	23.66	20.85	88.14	20.00	13.38	6.62	47.05	3.80	57.12
P_Mehlich3	Kastanozems	K/D2-C	6	19.18	20.47	106.71	11.86	8.96	3.19	36.69	2.30	55.00
P_Mehlich3	Kastanozems	K/D2-M	41	13.87	15.79	113.87	8.00	6.15	2.59	18.00	0.50	62.20
P_Mehlich3	Kastanozems	K/D2-V	15	7.94	9.77	123.06	4.20	1.74	3.06	9.32	0.89	38.20
P_Mehlich3	Kastanozems	K/D3-C	8	9.07	6.00	66.09	10.35	3.68	2.76	12.48	1.16	18.71
P_Mehlich3	Kastanozems	K/D3-M	35	11.29	14.89	131.88	3.81	3.01	1.37	15.10	0.00	57.00
P_Mehlich3	Kastanozems	K/D3-V	19	10.36	17.04	164.56	2.00	1.77	0.40	9.24	0.10	66.20
P_Mehlich3	Kastanozems	K/D4-C	7	11.23	4.29	38.18	12.07	0.43	11.60	12.50	2.15	16.10
P_Mehlich3	Kastanozems	K/D4-M	36	12.22	17.66	144.44	3.50	2.78	1.54	15.00	0.00	66.20
P_Mehlich3	Kastanozems	K/D4-V	16	9.82	14.87	151.44	2.07	1.96	0.16	14.52	0.10	43.64
P_Mehlich3	Kastanozems	K/D5-C	7	8.83	6.02	68.21	11.50	4.60	1.99	13.80	1.56	16.10
P_Mehlich3	Kastanozems	K/D5-M	30	12.78	18.49	144.69	3.70	3.21	1.35	17.33	0.13	59.87
P_Mehlich3	Kastanozems	K/D5-V	19	12.97	18.35	141.56	1.56	1.36	0.64	24.07	0.10	55.80
P_Mehlich3	Luvisols	L/D1-C	11	30.10	37.34	124.04	17.90	8.00	9.90	28.35	3.14	131.61
P_Mehlich3	Luvisols	L/D1-M	28	61.71	103.57	167.85	17.23	13.81	5.17	87.00	1.40	470.48

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_Mehlich3	Luvisols	L/D2-C	11	11.05	9.45	85.50	9.61	5.79	3.38	14.62	1.15	31.07
P_Mehlich3	Luvisols	L/D2-M	25	18.03	27.40	152.02	4.59	3.71	1.27	29.16	0.27	96.95
P_Mehlich3	Luvisols	L/D2-V	8	5.09	7.65	150.34	3.06	2.32	0.46	5.32	0.00	23.30
P_Mehlich3	Luvisols	L/D3-M	28	5.99	12.24	204.23	2.00	1.47	0.80	5.95	0.10	63.00
P_Mehlich3	Luvisols	L/D3-V	11	1.81	1.98	109.28	0.80	0.80	0.08	4.32	0.00	5.13
P_Mehlich3	Luvisols	L/D4-M	31	4.68	7.16	152.97	2.25	1.65	0.80	5.05	0.30	33.60
P_Mehlich3	Luvisols	L/D4-V	8	1.70	1.78	104.38	1.19	1.19	0.06	3.39	0.00	4.64
P_Mehlich3	Luvisols	L/D5-M	30	4.31	6.49	150.60	1.85	1.23	0.74	4.30	0.30	29.64
P_Mehlich3	Luvisols	L/D5-V	7	1.90	1.39	73.38	1.76	0.78	0.60	2.54	0.10	4.30
P_Mehlich3	Phaeozems	H/D1-M	21	32.38	70.81	218.68	8.20	7.13	1.63	29.58	0.55	319.30
P_Mehlich3	Phaeozems	H/D2-M	13	18.44	35.12	190.45	3.66	1.81	2.35	13.01	0.63	118.22
P_Mehlich3	Phaeozems	H/D2-V	11	3.58	9.09	254.07	1.12	0.55	0.18	1.30	0.00	30.90
P_Mehlich3	Phaeozems	H/D3-M	11	6.36	8.55	134.62	2.63	1.43	1.89	7.20	0.50	30.40
P_Mehlich3	Phaeozems	H/D3-V	12	1.87	2.44	130.32	0.88	0.88	0.07	2.85	0.00	7.71
P_Mehlich3	Phaeozems	H/D4-M	12	9.18	15.99	174.14	2.25	1.57	0.84	8.11	0.49	51.20
P_Mehlich3	Phaeozems	H/D4-V	11	2.63	4.68	178.27	0.47	0.47	0.00	3.52	0.00	15.10
P_Mehlich3	Phaeozems	H/D5-M	11	6.60	12.84	194.40	1.20	0.76	0.80	7.49	0.26	44.00
P_Mehlich3	Phaeozems	H/D5-V	12	6.63	11.87	179.10	0.45	0.45	0.08	8.19	0.00	36.58
P_Mehlich3	Vertisols	V/D1-V	8	40.73	50.60	124.24	19.28	12.22	6.58	85.76	4.45	135.65
P_Mehlich3	Vertisols	V/D2-V	8	22.20	27.56	124.15	7.05	6.23	1.57	48.24	0.77	72.23
P_Mehlich3	Vertisols	V/D3-V	7	7.39	8.99	121.69	4.20	3.44	0.76	13.00	0.70	25.36
P_Mehlich3	Vertisols	V/D4-V	8	10.81	12.07	111.63	5.69	5.18	0.90	20.96	0.29	32.90
P_Mehlich3	Vertisols	V/D5-V	7	11.05	11.21	101.52	8.70	7.54	1.16	16.60	0.80	32.90
P_Mehlich3	Xerosols	X/D1-M	14	77.15	67.59	87.60	39.30	16.42	23.70	160.66	15.15	175.00
P_Mehlich3	Xerosols	X/D2-C	6	10.45	9.32	89.23	8.23	4.30	3.37	16.14	2.51	27.80
P_Mehlich3	Xerosols	X/D2-M	10	35.14	37.16	105.75	24.21	16.46	9.85	53.14	0.30	124.86
P_Mehlich3	Xerosols	X/D3-M	8	24.25	20.38	84.06	24.32	15.12	5.28	36.85	0.14	61.50
P_Mehlich3	Xerosols	X/D4-M	8	19.05	15.75	82.71	17.73	13.59	4.90	34.20	0.00	39.04
P_Mehlich3	Xerosols	X/D5-M	9	18.36	14.78	80.52	19.20	11.30	3.94	29.45	0.76	44.10
P_Olsen	Cambisols	B/D1-M	18	5.40	4.88	90.50	3.72	1.65	2.11	7.02	0.69	16.60
P_Olsen	Cambisols	B/D2-M	14	1.43	1.69	118.08	0.85	0.60	0.28	2.17	0.00	5.13
P_Olsen	Cambisols	B/D2-V	7	8.02	15.66	195.20	1.86	1.76	1.30	3.97	0.10	43.40
P_Olsen	Cambisols	B/D3-M	13	1.49	2.14	143.50	0.50	0.50	0.20	2.16	0.00	7.30
P_Olsen	Cambisols	B/D3-V	8	3.66	5.19	141.94	1.60	1.24	0.76	4.77	0.05	15.82
P_Olsen	Cambisols	B/D4-M	14	1.65	2.10	126.77	0.86	0.55	0.34	2.74	0.00	7.34
P_Olsen	Cambisols	B/D4-V	7	1.87	1.78	95.43	1.64	0.74	0.90	2.18	0.00	5.55
P_Olsen	Cambisols	B/D5-M	11	1.92	2.41	125.83	0.80	0.80	0.50	2.27	0.00	8.10
P_Olsen	Cambisols	B/D5-V	6	2.34	2.21	94.47	1.50	0.95	0.82	4.44	0.00	6.00
P_Olsen	Chernozems	C/D1-M	13	10.83	9.31	85.94	7.20	4.89	2.50	18.77	2.20	31.32
P_Olsen	Chernozems	C/D2-M	11	3.73	4.17	111.84	1.61	0.75	0.98	6.65	0.09	13.40
P_Olsen	Chernozems	C/D3-M	10	3.02	5.05	167.37	1.06	0.35	0.75	2.79	0.00	16.38
P_Olsen	Chernozems	C/D4-M	7	3.95	5.95	150.91	0.97	0.97	0.30	6.99	0.00	16.24
P_Olsen	Chernozems	C/D5-M	6	7.71	10.51	136.28	2.39	2.03	0.49	17.64	0.10	25.90
P_Olsen	Gleysols	G/D1-M	6	8.93	9.68	108.35	4.98	3.38	2.40	17.31	0.00	26.02
P_Olsen	Kastanozems	K/D1-M	36	8.19	8.86	108.15	5.24	3.29	2.02	9.15	1.01	31.32
P_Olsen	Kastanozems	K/D1-V	8	10.81	6.81	62.97	9.85	4.63	4.97	14.93	4.03	24.10
P_Olsen	Kastanozems	K/D2-M	28	4.89	6.57	134.30	2.21	1.28	1.13	4.38	0.66	23.40
P_Olsen	Kastanozems	K/D2-V	15	2.73	1.85	67.79	2.00	1.05	1.20	4.60	0.60	6.46
P_Olsen	Kastanozems	K/D3-M	23	3.34	5.65	169.05	1.50	0.92	0.58	2.80	0.20	25.50
P_Olsen	Kastanozems	K/D3-V	14	4.36	4.64	106.50	2.33	1.85	1.33	7.31	0.10	15.27
P_Olsen	Kastanozems	K/D4-C	6	1.41	0.39	27.86	1.45	0.35	1.00	1.80	0.98	1.80
P_Olsen	Kastanozems	K/D4-M	21	2.89	3.77	130.53	1.48	1.16	0.56	3.29	0.10	14.00
P_Olsen	Kastanozems	K/D4-V	12	6.02	4.87	80.96	4.44	3.09	2.47	9.97	0.39	17.10
P_Olsen	Kastanozems	K/D5-M	23	3.52	4.92	139.70	2.00	1.27	0.73	3.00	0.20	18.76
P_Olsen	Kastanozems	K/D5-V	10	5.85	3.08	52.68	5.26	1.69	3.89	8.65	0.70	11.11

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_Olsen	Luvisols	L/D1-C	6	7.85	5.27	67.05	7.15	4.38	2.80	12.65	2.70	15.62
P_Olsen	Luvisols	L/D1-M	11	12.41	15.47	124.63	5.50	4.03	3.28	15.30	1.48	55.14
P_Olsen	Luvisols	L/D2-C	7	4.36	2.63	60.36	3.78	1.42	2.78	7.35	0.20	7.68
P_Olsen	Luvisols	L/D2-M	8	16.13	21.17	131.24	7.15	3.82	3.41	26.83	2.01	62.75
P_Olsen	Luvisols	L/D3-M	11	3.39	4.42	130.23	1.40	1.11	0.87	5.36	0.22	15.18
P_Olsen	Luvisols	L/D4-M	12	1.76	1.52	86.56	1.44	0.99	0.43	3.07	0.22	4.65
P_Olsen	Luvisols	L/D5-M	10	2.27	1.82	80.30	2.52	1.35	0.60	3.54	0.10	5.89
P_Olsen	Phaeozems	H/D1-M	9	3.99	2.02	50.60	3.36	0.92	2.40	5.66	1.72	7.45
P_Olsen	Phaeozems	H/D3-V	6	0.44	0.41	94.82	0.40	0.32	0.03	0.79	0.00	1.10
P_Olsen	Phaeozems	H/D4-V	6	0.37	0.40	109.58	0.26	0.22	0.05	0.65	0.00	1.10
P_Olsen	Vertisols	V/D1-V	17	11.14	5.91	53.09	10.40	3.95	6.45	15.30	3.20	22.60
P_Olsen	Xerosols	X/D1-C	8	2.99	1.49	49.77	2.56	0.70	2.00	4.26	1.03	5.65
P_Olsen	Xerosols	X/D1-M	24	16.16	15.84	98.00	8.64	5.09	4.68	24.72	1.70	60.45
P_Olsen	Xerosols	X/D2-C	8	2.04	1.86	91.41	1.22	0.43	0.95	2.95	0.64	6.15
P_Olsen	Xerosols	X/D2-M	23	6.37	7.70	120.88	2.98	1.76	1.30	5.83	0.83	25.80
P_Olsen	Xerosols	X/D3-C	8	2.69	2.77	103.20	1.23	0.44	0.96	5.70	0.67	7.36
P_Olsen	Xerosols	X/D3-M	19	6.40	7.85	122.74	1.90	1.04	1.50	8.35	0.86	25.80
P_Olsen	Xerosols	X/D4-C	6	1.94	1.66	85.54	1.15	0.28	0.89	3.14	0.82	5.08
P_Olsen	Xerosols	X/D4-M	20	5.12	5.72	111.79	2.58	1.30	1.65	6.86	0.50	21.37
P_Olsen	Xerosols	X/D5-C	9	3.35	4.12	122.91	2.41	1.03	1.02	3.38	0.90	14.00
P_Olsen	Xerosols	X/D5-M	18	4.10	4.62	112.61	2.85	1.30	1.48	4.87	0.59	20.00
P_retention	Acrisols	A/D1-C	9	21.48	20.63	96.05	13.00	6.00	7.40	30.95	6.00	68.75
P_retention	Acrisols	A/D1-M	94	45.25	22.12	48.89	38.75	13.25	27.00	63.38	1.00	96.20
P_retention	Acrisols	A/D1-V	39	57.21	19.68	34.41	60.00	14.00	41.40	73.50	8.30	95.00
P_retention	Acrisols	A/D2-C	8	32.72	28.83	88.10	21.55	11.70	10.05	55.75	9.70	87.80
P_retention	Acrisols	A/D2-M	71	44.07	19.77	44.86	42.00	12.40	29.15	54.40	10.00	97.80
P_retention	Acrisols	A/D2-V	62	56.63	18.69	33.00	54.00	17.17	42.83	74.68	20.50	94.35
P_retention	Acrisols	A/D3-C	8	40.78	28.28	69.35	28.25	15.32	17.23	68.20	10.60	84.35
P_retention	Acrisols	A/D3-M	66	41.30	18.05	43.71	40.90	12.63	26.69	52.44	11.80	96.40
P_retention	Acrisols	A/D3-V	66	57.18	18.47	32.30	56.85	13.52	43.90	73.18	16.50	94.00
P_retention	Acrisols	A/D4-C	8	30.58	25.69	84.02	19.95	5.85	13.55	58.38	10.00	73.00
P_retention	Acrisols	A/D4-M	65	40.46	17.60	43.49	38.00	11.75	26.90	51.90	14.00	96.00
P_retention	Acrisols	A/D4-V	65	57.18	18.67	32.65	58.00	16.00	41.50	73.50	15.00	91.90
P_retention	Acrisols	A/D5-C	15	26.82	20.39	76.05	18.70	8.30	14.80	28.80	8.60	78.70
P_retention	Acrisols	A/D5-M	52	40.49	18.23	45.03	37.63	12.35	25.55	50.80	13.00	96.00
P_retention	Acrisols	A/D5-V	60	56.90	19.96	35.07	55.13	17.88	41.30	73.78	15.00	91.00
P_retention	Andosols	T/D1-C	79	56.63	27.03	47.73	57.20	18.75	39.00	79.94	4.00	99.00
P_retention	Andosols	T/D1-M	293	75.44	20.04	26.56	79.77	14.37	63.35	92.25	8.00	100.00
P_retention	Andosols	T/D1-V	9	76.71	31.68	41.30	95.00	5.00	50.75	98.06	11.73	100.00
P_retention	Andosols	T/D2-C	103	68.08	27.63	40.59	73.00	23.70	46.00	96.55	4.00	100.00
P_retention	Andosols	T/D2-M	278	78.48	20.77	26.46	85.88	12.13	63.94	96.00	6.60	100.00
P_retention	Andosols	T/D3-C	119	69.73	29.11	41.74	79.65	19.35	51.00	97.00	2.15	100.60
P_retention	Andosols	T/D3-M	246	71.35	27.22	38.14	81.30	17.30	43.80	95.85	4.00	100.00
P_retention	Andosols	T/D4-C	125	64.36	33.84	52.58	75.00	24.00	33.72	96.00	0.00	101.00
P_retention	Andosols	T/D4-M	204	67.73	29.82	44.03	79.32	19.67	43.00	95.68	3.00	100.00
P_retention	Andosols	T/D5-C	114	58.89	35.40	60.11	59.83	36.05	25.00	97.00	0.00	100.05
P_retention	Andosols	T/D5-M	165	64.06	31.09	48.53	71.00	27.00	35.00	96.10	3.00	100.00
P_retention	Andosols	T/D5-V	7	67.15	31.16	46.41	80.05	18.95	29.00	99.00	25.00	99.00
P_retention	Arenosols	Q/D1-C	67	18.77	12.98	69.16	15.65	7.65	8.35	24.00	0.00	50.35
P_retention	Arenosols	Q/D2-C	67	19.90	13.58	68.24	17.00	8.00	11.75	28.20	0.00	73.75
P_retention	Arenosols	Q/D3-C	60	17.95	14.17	78.94	14.40	7.65	8.81	23.85	0.00	88.00
P_retention	Arenosols	Q/D4-C	58	16.82	14.35	85.30	13.00	6.10	7.07	22.33	0.00	88.00
P_retention	Arenosols	Q/D5-C	50	15.46	14.63	94.63	12.00	6.00	6.00	19.27	0.00	91.00
P_retention	Cambisols	B/D1-C	134	34.90	19.14	54.83	31.00	9.38	23.00	42.13	2.00	100.00
P_retention	Cambisols	B/D1-M	346	49.04	23.75	48.43	45.85	17.56	31.00	68.04	3.00	100.00

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_retention	Cambisols	B/D1-V	41	57.95	24.74	42.70	61.75	21.25	36.10	78.70	15.00	97.10
P_retention	Cambisols	B/D2-C	170	36.91	21.59	58.50	33.00	12.43	21.24	47.05	2.60	100.00
P_retention	Cambisols	B/D2-M	312	49.02	24.72	50.43	43.00	18.05	29.00	68.31	3.50	100.00
P_retention	Cambisols	B/D2-V	35	61.41	24.61	40.07	64.50	21.70	39.00	83.00	18.00	98.00
P_retention	Cambisols	B/D3-C	188	33.82	22.45	66.37	29.77	12.63	17.48	43.83	0.00	100.00
P_retention	Cambisols	B/D3-M	261	46.03	27.12	58.91	39.00	19.00	23.00	68.00	2.00	100.00
P_retention	Cambisols	B/D3-V	28	54.89	24.50	44.63	55.00	20.52	33.25	74.25	15.00	99.10
P_retention	Cambisols	B/D4-C	186	29.95	21.82	72.86	25.00	11.00	14.58	38.00	0.00	100.00
P_retention	Cambisols	B/D4-M	212	42.99	26.49	61.61	36.00	15.60	22.66	62.00	2.00	100.00
P_retention	Cambisols	B/D4-V	27	55.74	26.04	46.71	60.50	21.50	30.90	77.00	13.00	99.30
P_retention	Cambisols	B/D5-C	185	28.33	21.98	77.59	22.00	11.00	14.00	37.40	0.00	99.60
P_retention	Cambisols	B/D5-M	155	37.70	26.78	71.03	28.00	12.00	19.40	53.00	2.00	100.00
P_retention	Cambisols	B/D5-V	25	56.28	26.69	47.43	57.00	23.40	31.50	77.00	13.00	100.00
P_retention	Chernozems	C/D1-C	14	19.76	21.01	106.31	16.27	2.55	11.04	17.29	4.00	91.00
P_retention	Chernozems	C/D1-M	77	27.50	13.85	50.37	23.10	7.20	17.50	33.70	6.00	71.60
P_retention	Chernozems	C/D2-C	17	22.57	16.77	74.31	18.00	9.00	10.00	30.10	6.00	70.00
P_retention	Chernozems	C/D2-M	63	28.38	14.59	51.39	24.40	7.40	17.60	33.90	10.20	68.00
P_retention	Chernozems	C/D2-V	11	27.29	15.89	58.21	25.25	8.25	16.44	28.50	12.50	60.00
P_retention	Chernozems	C/D3-C	20	16.62	8.74	52.60	15.65	7.65	9.00	25.17	3.60	31.00
P_retention	Chernozems	C/D3-M	55	29.97	16.84	56.18	25.20	8.20	18.00	35.40	5.05	75.90
P_retention	Chernozems	C/D3-V	15	29.58	14.70	49.68	27.00	6.40	19.00	33.40	14.90	73.00
P_retention	Chernozems	C/D4-C	19	15.21	8.16	53.64	15.00	5.00	8.80	20.00	3.00	33.85
P_retention	Chernozems	C/D4-M	52	27.08	14.92	55.11	22.52	7.97	16.00	32.60	8.75	68.00
P_retention	Chernozems	C/D4-V	15	27.34	15.29	55.93	24.00	7.00	17.00	38.00	14.85	73.00
P_retention	Chernozems	C/D5-C	16	20.70	17.39	84.01	17.00	8.00	9.25	26.56	4.00	78.00
P_retention	Chernozems	C/D5-M	47	22.73	12.81	56.38	19.00	6.15	14.00	30.00	4.25	60.00
P_retention	Chernozems	C/D5-V	11	25.18	7.14	28.37	25.40	3.00	18.00	28.00	15.65	40.00
P_retention	Ferralsols	F/D1-M	14	51.65	21.05	40.76	46.78	19.17	32.46	69.31	24.50	84.80
P_retention	Ferralsols	F/D1-V	48	54.17	15.63	28.86	55.00	12.00	43.00	66.51	28.00	88.80
P_retention	Ferralsols	F/D2-M	14	53.17	24.40	45.90	48.72	18.27	33.50	71.02	18.50	92.00
P_retention	Ferralsols	F/D2-V	47	58.57	16.39	27.98	61.90	10.95	46.85	71.55	28.40	95.00
P_retention	Ferralsols	F/D3-M	19	58.36	25.19	43.16	62.91	22.91	34.00	83.20	17.20	95.00
P_retention	Ferralsols	F/D3-V	41	58.01	17.38	29.96	62.00	13.10	44.38	72.00	29.00	90.90
P_retention	Ferralsols	F/D4-M	15	57.46	27.96	48.67	67.22	27.23	32.00	84.00	13.10	95.00
P_retention	Ferralsols	F/D4-V	37	55.75	16.78	30.11	59.00	12.00	42.00	66.38	28.20	90.00
P_retention	Ferralsols	F/D5-M	15	58.19	25.39	43.63	66.75	23.75	34.00	81.00	23.00	95.00
P_retention	Ferralsols	F/D5-V	33	55.68	17.62	31.64	58.00	12.00	40.60	69.50	28.00	92.10
P_retention	Fluvisols	J/D1-C	6	10.79	8.25	76.46	10.30	4.30	3.74	16.00	1.75	25.00
P_retention	Fluvisols	J/D1-M	10	27.31	11.57	42.39	23.42	6.25	19.50	34.70	14.00	52.50
P_retention	Fluvisols	J/D2-C	6	12.82	6.33	49.35	14.92	3.20	6.70	16.94	2.80	20.50
P_retention	Fluvisols	J/D2-M	10	26.41	16.77	63.49	22.20	7.64	15.34	37.08	5.00	58.80
P_retention	Fluvisols	J/D3-M	10	25.15	18.66	74.21	17.50	7.30	13.16	35.30	5.00	62.10
P_retention	Fluvisols	J/D4-C	9	15.38	22.26	144.69	10.00	6.80	2.90	15.15	0.25	73.00
P_retention	Fluvisols	J/D5-C	6	9.32	8.72	93.61	7.85	5.10	2.25	15.90	0.00	24.00
P_retention	Fluvisols	J/D5-M	7	24.01	18.53	77.19	16.15	4.15	13.50	24.35	12.00	64.45
P_retention	Gleysols	G/D1-C	25	24.22	13.48	55.65	23.25	7.00	17.13	32.10	1.00	61.30
P_retention	Gleysols	G/D1-M	83	41.33	18.47	44.70	37.10	9.10	28.00	50.00	17.00	97.30
P_retention	Gleysols	G/D1-V	39	49.10	15.55	31.66	49.20	10.40	36.05	59.60	18.00	81.00
P_retention	Gleysols	G/D2-C	36	29.11	27.01	92.79	22.00	12.95	9.13	35.88	0.00	99.00
P_retention	Gleysols	G/D2-M	92	37.28	16.39	43.98	33.50	11.50	24.85	47.00	2.40	99.00
P_retention	Gleysols	G/D2-V	34	44.05	12.30	27.93	43.00	8.30	35.75	52.69	21.50	67.35
P_retention	Gleysols	G/D3-C	38	25.53	23.30	91.26	21.50	14.00	7.00	35.75	0.00	97.30
P_retention	Gleysols	G/D3-M	84	30.17	17.13	56.77	25.98	8.58	18.25	40.65	0.30	85.00
P_retention	Gleysols	G/D3-V	31	38.34	13.82	36.05	35.00	10.00	29.90	45.45	16.00	75.80
P_retention	Gleysols	G/D4-C	42	22.05	19.29	87.51	17.85	10.20	7.99	28.92	0.00	93.80

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_retention	Gleysols	G/D4-M	69	26.94	16.13	59.85	22.80	7.15	16.88	33.65	0.00	90.70
P_retention	Gleysols	G/D4-V	25	40.35	15.57	38.59	38.00	13.00	25.40	52.63	17.00	78.00
P_retention	Gleysols	G/D5-C	35	21.33	20.23	94.85	15.35	7.50	8.05	28.00	3.80	82.00
P_retention	Gleysols	G/D5-M	62	23.56	13.08	55.53	20.00	6.00	15.09	31.00	0.00	56.00
P_retention	Gleysols	G/D5-V	24	38.19	15.31	40.08	37.00	11.50	26.00	50.25	15.90	79.00
P_retention	Histosols	O/D2-M	11	55.50	18.79	33.86	52.00	19.00	41.60	74.25	32.55	85.60
P_retention	Histosols	O/D3-M	14	55.77	21.40	38.38	54.30	19.25	34.00	74.50	30.00	96.00
P_retention	Histosols	O/D4-M	12	44.15	27.27	61.78	32.45	9.92	26.50	71.95	10.00	96.00
P_retention	Histosols	O/D5-M	12	49.72	24.88	50.04	45.50	20.00	29.25	72.65	12.00	90.60
P_retention	Kastanozems	K/D1-C	36	18.15	8.53	47.01	16.00	6.35	13.00	25.69	3.40	35.20
P_retention	Kastanozems	K/D1-M	295	25.66	14.58	56.82	21.95	6.95	16.00	30.50	4.75	85.00
P_retention	Kastanozems	K/D1-V	33	40.67	17.84	43.88	36.65	12.65	24.83	53.00	14.80	78.25
P_retention	Kastanozems	K/D2-C	40	18.95	10.95	57.79	17.30	5.88	12.50	24.67	2.00	59.50
P_retention	Kastanozems	K/D2-M	269	26.63	14.93	56.08	22.30	7.05	16.00	32.00	5.70	96.00
P_retention	Kastanozems	K/D2-V	51	38.19	18.80	49.22	31.40	10.65	24.00	53.00	7.00	85.00
P_retention	Kastanozems	K/D3-C	44	19.70	14.13	71.73	15.75	4.85	11.05	24.35	2.00	71.10
P_retention	Kastanozems	K/D3-M	215	26.96	17.02	63.11	22.25	7.65	15.30	32.25	5.20	97.00
P_retention	Kastanozems	K/D3-V	60	36.63	18.12	49.48	31.30	10.39	23.20	53.00	13.00	92.20
P_retention	Kastanozems	K/D4-C	46	19.93	15.22	76.36	14.90	5.85	10.00	24.30	3.20	69.80
P_retention	Kastanozems	K/D4-M	183	27.59	18.73	67.88	22.10	8.60	15.00	33.80	2.00	92.40
P_retention	Kastanozems	K/D4-V	42	36.40	17.19	47.22	31.45	11.65	21.60	52.59	10.00	79.00
P_retention	Kastanozems	K/D5-C	42	20.64	17.47	84.63	13.85	6.30	10.00	23.75	3.00	77.20
P_retention	Kastanozems	K/D5-M	148	28.67	19.42	67.73	22.00	8.00	16.00	34.97	2.00	88.79
P_retention	Kastanozems	K/D5-V	31	34.81	18.50	53.14	29.50	11.30	19.00	50.00	9.30	80.80
P_retention	Luvisols	L/D1-C	49	23.95	17.08	71.32	20.95	5.55	15.25	26.75	6.00	93.40
P_retention	Luvisols	L/D1-M	198	33.36	18.93	56.75	28.00	10.70	19.00	42.00	6.60	95.60
P_retention	Luvisols	L/D1-V	29	43.92	17.34	39.49	45.00	11.00	31.70	54.50	10.00	76.55
P_retention	Luvisols	L/D2-C	39	25.65	14.15	55.17	23.00	7.00	16.00	31.00	6.00	70.95
P_retention	Luvisols	L/D2-M	186	31.55	17.08	54.14	27.35	8.77	19.90	38.20	2.65	92.10
P_retention	Luvisols	L/D2-V	44	40.14	15.92	39.66	42.00	10.80	28.50	48.24	13.60	76.20
P_retention	Luvisols	L/D3-C	40	25.11	13.32	53.06	22.27	6.28	16.00	29.13	8.00	65.00
P_retention	Luvisols	L/D3-M	148	28.68	15.51	54.07	27.00	9.70	16.92	36.50	0.00	81.00
P_retention	Luvisols	L/D3-V	68	39.51	14.90	37.71	38.00	9.20	27.50	47.30	13.00	84.00
P_retention	Luvisols	L/D4-C	42	21.64	14.19	65.58	17.25	7.00	12.31	28.30	0.00	58.40
P_retention	Luvisols	L/D4-M	142	29.91	16.18	54.09	27.42	9.60	18.00	38.00	0.00	91.60
P_retention	Luvisols	L/D4-V	60	38.53	13.76	35.70	38.10	9.05	29.25	49.05	13.00	74.45
P_retention	Luvisols	L/D5-C	39	20.88	13.43	64.34	18.85	5.85	13.00	25.00	0.00	65.00
P_retention	Luvisols	L/D5-M	142	29.71	17.80	59.90	25.75	9.75	17.00	38.00	0.00	93.00
P_retention	Luvisols	L/D5-V	47	38.25	16.00	41.82	36.50	9.55	27.10	47.40	13.00	82.00
P_retention	Phaeozems	H/D1-M	21	34.46	17.80	51.65	31.80	7.80	22.00	39.50	11.75	77.50
P_retention	Phaeozems	H/D2-C	6	26.60	23.61	88.76	18.50	6.13	12.50	37.28	11.00	73.35
P_retention	Phaeozems	H/D2-M	16	39.85	23.50	58.98	32.97	14.18	22.00	57.54	14.00	88.85
P_retention	Phaeozems	H/D2-V	9	32.90	13.05	39.66	35.00	12.95	19.63	42.17	16.50	55.00
P_retention	Phaeozems	H/D3-M	14	36.70	24.84	67.69	28.52	8.95	19.42	44.06	13.20	89.60
P_retention	Phaeozems	H/D3-V	8	33.69	14.16	42.05	29.05	8.05	21.13	49.72	21.00	55.00
P_retention	Phaeozems	H/D4-C	6	43.46	33.68	77.49	36.88	25.88	14.00	80.75	5.00	86.00
P_retention	Phaeozems	H/D4-M	15	29.00	19.83	68.39	23.00	5.50	17.50	31.00	10.10	85.00
P_retention	Phaeozems	H/D5-C	6	32.20	22.57	70.09	26.50	7.30	17.34	44.26	11.60	75.50
P_retention	Phaeozems	H/D5-M	11	29.22	21.85	74.78	21.50	7.50	14.00	38.60	10.00	85.00
P_retention	Phaeozems	H/D5-V	6	31.17	18.33	58.80	24.65	5.80	19.52	41.50	17.50	67.00
P_retention	Podzols	P/D1-C	115	28.11	23.83	84.78	20.00	11.00	10.42	36.80	0.00	97.50
P_retention	Podzols	P/D1-M	145	48.23	22.03	45.68	48.25	17.25	29.28	64.60	2.00	97.00
P_retention	Podzols	P/D2-C	143	43.64	28.15	64.50	33.50	15.50	21.30	68.60	0.00	100.00
P_retention	Podzols	P/D2-M	125	58.14	24.28	41.77	56.00	21.25	35.60	80.15	16.60	100.00
P_retention	Podzols	P/D3-C	155	38.75	26.16	67.52	29.61	12.21	20.45	51.00	0.00	99.00

Variable	FAO74_ NAME	FAO74_ text	N	AVG	SD	CV	MED	MAD	Q1	Q3	Min	Max
P_retention	Podzols	P/D3-M	103	51.22	26.06	50.88	46.00	21.00	27.20	76.60	13.00	100.00
P_retention	Podzols	P/D4-C	149	32.08	24.88	77.54	23.00	8.80	15.82	41.30	0.00	99.00
P_retention	Podzols	P/D4-M	82	38.05	22.27	58.52	32.25	13.90	20.81	50.75	0.30	100.00
P_retention	Podzols	P/D5-C	135	22.70	18.92	83.36	17.00	8.00	10.85	28.90	0.00	97.58
P_retention	Podzols	P/D5-M	55	30.45	21.01	69.01	24.45	9.35	16.00	36.00	0.00	99.00
P_retention	Podzoluvisols	D/D1-M	22	34.15	19.26	56.39	32.25	8.15	22.91	36.72	8.10	77.50
P_retention	Podzoluvisols	D/D2-M	21	30.56	13.88	45.42	29.00	5.30	21.73	32.67	8.50	71.20
P_retention	Podzoluvisols	D/D3-M	18	25.75	11.44	44.41	24.75	2.47	20.80	26.81	5.50	61.00
P_retention	Podzoluvisols	D/D4-C	6	13.76	3.55	25.84	13.30	3.05	10.65	17.54	9.15	18.40
P_retention	Podzoluvisols	D/D4-M	15	23.21	13.58	58.52	22.50	2.70	19.50	24.00	1.00	61.00
P_retention	Podzoluvisols	D/D5-C	10	17.51	8.23	47.03	17.00	5.85	10.02	23.80	6.00	31.00
P_retention	Podzoluvisols	D/D5-M	10	21.39	16.65	77.87	19.70	5.55	12.43	27.30	1.00	61.00
P_retention	Regosols	R/D1-C	42	24.46	15.80	64.60	19.33	8.33	12.45	33.59	0.00	74.84
P_retention	Regosols	R/D1-M	8	23.36	14.54	62.26	24.02	12.60	9.25	36.53	3.60	44.50
P_retention	Regosols	R/D2-C	41	24.23	12.91	53.27	23.75	8.75	13.68	31.55	0.00	52.38
P_retention	Regosols	R/D2-M	6	27.43	18.51	67.48	29.30	12.00	10.25	41.25	2.00	54.00
P_retention	Regosols	R/D3-C	40	21.28	11.46	53.88	19.76	6.68	12.99	26.67	0.00	52.00
P_retention	Regosols	R/D3-M	7	29.06	18.61	64.02	32.40	13.60	13.00	46.00	2.00	54.05
P_retention	Regosols	R/D4-C	36	19.06	11.05	57.98	16.90	5.95	11.50	25.75	0.00	47.00
P_retention	Regosols	R/D5-C	29	21.15	14.75	69.76	17.00	6.00	12.00	27.38	1.00	56.15
P_retention	Solonetz	S/D1-M	6	13.84	3.45	24.94	12.60	1.50	11.55	16.85	10.20	19.75
P_retention	Solonetz	S/D2-M	7	16.16	6.36	39.33	16.00	4.20	11.80	20.95	8.05	26.80
P_retention	Solonetz	S/D3-M	8	21.57	11.97	55.49	18.92	6.48	12.79	30.17	7.10	44.00
P_retention	Solonetz	S/D4-M	9	31.38	25.63	81.68	22.00	8.00	14.00	53.42	5.60	81.00
P_retention	Solonetz	S/D5-M	6	26.17	28.38	108.47	17.25	6.15	9.00	36.78	9.00	83.20
P_retention	Vertisols	V/D1-V	25	34.72	12.23	35.22	29.75	7.30	25.65	42.50	18.50	62.50
P_retention	Vertisols	V/D2-V	24	35.18	12.33	35.06	31.63	7.80	27.00	43.50	13.50	67.50
P_retention	Vertisols	V/D3-V	23	35.91	15.60	43.44	34.00	10.00	22.00	43.75	15.00	73.00
P_retention	Vertisols	V/D4-V	24	35.27	16.18	45.89	34.80	10.75	20.01	43.00	12.45	73.00
P_retention	Vertisols	V/D5-V	23	33.85	17.48	51.65	29.30	10.70	21.30	41.00	11.80	73.50
P_retention	Xerosols	X/D1-C	11	15.16	7.76	51.18	15.40	6.80	8.00	19.29	5.80	29.75
P_retention	Xerosols	X/D1-M	65	23.51	15.61	66.41	20.65	7.65	12.82	27.60	4.60	83.45
P_retention	Xerosols	X/D2-C	7	15.40	8.58	55.70	11.65	4.65	9.00	19.80	7.00	31.35
P_retention	Xerosols	X/D2-M	66	26.30	18.64	70.88	21.76	6.76	15.00	29.88	3.35	88.00
P_retention	Xerosols	X/D2-V	6	35.56	15.36	43.18	29.73	5.53	25.10	47.38	22.40	63.50
P_retention	Xerosols	X/D3-C	11	14.60	9.30	63.69	11.20	3.10	9.00	15.00	7.00	39.20
P_retention	Xerosols	X/D3-M	46	32.36	22.57	69.75	23.00	8.35	16.17	41.64	1.45	92.25
P_retention	Xerosols	X/D3-V	6	48.48	23.59	48.65	39.03	10.05	33.49	77.22	19.95	77.90
P_retention	Xerosols	X/D4-C	13	28.25	21.44	75.89	17.25	10.25	10.80	52.10	1.00	60.10
P_retention	Xerosols	X/D4-M	38	33.03	22.82	69.08	23.70	10.05	15.98	51.72	2.00	93.50
P_retention	Xerosols	X/D4-V	7	51.93	29.61	57.02	56.75	21.05	14.00	77.80	9.70	82.60
P_retention	Xerosols	X/D5-C	16	29.35	21.98	74.88	21.50	9.82	13.00	52.19	1.00	67.00
P_retention	Xerosols	X/D5-M	31	36.25	27.13	74.84	23.80	15.70	14.20	61.85	2.60	94.00
P_retention	Xerosols	X/D5-V	7	54.44	30.20	55.48	63.70	25.30	33.00	81.00	7.00	89.00
P_retention	Yermosols	Y/D1-M	7	41.88	25.92	61.90	25.75	9.10	20.75	72.00	16.65	75.00

Appendix 5. Key to abbreviations for soil analytical methods

Analyte_abbrev	Analyte_name	Uom_abbrev	Description[a]
c_tot	Carbon, Total	% wt	Total carbon is a measure of all organic and inorganic nitrogen, including that found in organic minerals.
cec_nh4	CEC, NH4OAc, pH 7.0	cmol(+)/kg	CEC by NH4OAC is the cation exchange capacity of the sample, determined by 1N NH4OAC in a system highly buffered at pH 7.0. It is reported as meq per 100 grams sample, on a <2 mm base.
CEC_SUM	Cation Exchange Capacity, Sum of Cations	cmol(+)/kg	This is the calculated CEC at pH 8.2. It is calculated by (BASE_SUM+ACID_TEA). It is reported as meq per 100 grams sample on a <2 mm base CMS derived value default
clay_tot_psa	Clay, total	% wt	Total clay is the soil separate with <0.002 mm particle diameter. Clay size carbonate is included. Total clay is reported as a weight percent of the <2 mm fraction.
k_nh4	Potassium, NH4OAc Extractable	cmol(+)/kg	NH4OAC extractable potassium is the fraction removed by pH 7.0 NH4OAC. It is assumed to represent the exchangeable K. It is reported as meq per 100 grams on a <2 mm base.
oc	Carbon, Organic	% wt	CMS analyte. Organic carbon is a measure of all organic forms of carbon in the soil, including organic carbon within minerals.
ORCcon	Organic carbon	%wt	OC, resp. organic C derived from C_tot with a correction for C held in carbonates
p_bray1	Phosphorus, Bray-1 Extractable	mg/kg	This is the phosphorus extractable by the Bray-1 method, reported as milligrams per kilogram on a <2 mm base. It is used as an index of plant-available phosphorus. Bray-1 extracts adsorbed P.
p_bray2	Phosphorus, Bray-2 Extractable	mg/kg	This is the phosphorus extractable by the Bray-2 method, reported as milligrams per kilogram on a <2 mm base. Bray-2 extracts both adsorbed and easily acid-soluble forms of P.
P_H2O	Phosphorus, Water Soluble	mg/kg	The water soluble phosphorus is the fraction extracted by distilled water. It represents an attempt to approximate the P concentration in the soil solution, i.e. the mobile P.
p_nz	Phosphorus, New Zealand P Retention	% wt	The New Zealand phosphorus retention is the gravimetric percent phosphorus removed from a solution by equilibration with a sample. It is reported on a <2 mm base. High P retention indicates andic material.
p_olsn	Phosphorus, Olsen Extractable	mg/kg	The Olsen extractable phosphorus is used as an indicator of available phosphorus in calcareous soil materials.
ph_h2o	pH, 1:1 Soil-Water Suspension	(NA)	The pH, 1:1 soil-water suspension is the pH of a sample measured in distilled water at a 1:1 soil:solution ratio. If wider ratios increase the pH, salts are indicated.
sand_tot_psa	Sand, Total	% wt	Total sand is the soil separate with 0.05 to 2.0 mm particle diameter. It is reported a gravimetric percent on a <2 mm base.
silt_tot_psa	Silt, Total, S_SK prep	% wt	Total silt is the soil separate with 0.002 to 0.05 mm particle size. It is reported as a gravimetric percent on a <2 mm base.

[a] Descriptions derived from USDA-SSL data set (http://ssldata.nrcs.usda.gov/rptgen.htm)

World Soil Information

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