Cannon, Karen R. 2002. *Alberta benchmark site selection and sampling protocols*, AESA Soil Quality Resource Monitoring Program , Edmonton, Alberta. Alberta's soil quality monitoring sites.

Alberta's soil quality monitoring sites are discussed.

Castillo, Xiomara, and Rainer Georg Jörgensen. 2001. Impact of ecological and conventional arable management systems on chemical and biological soil quality indices [*viz.* indicators] in Nicaragua. Presentation at: *Deutscher Tropentag 2002 Kassel-Witzenhausen: Organic Farming and Sustainable Land Use in the Tropics and Subtropics*, 1591-1597. Kassel University Press.

Lab analysis of soil samples from 25 sites in volcanic ash, vitric Andosol soils of Nicaragua: --15 sites were under conventional management, with burning of crop residue done post-harvest of cotton & sugar cane/soybean; --10 sites were under ecological management, with crop rotation & fertilizer use. Lab test methods are outlined & replicable, in this field-scale study. Soil attributes were: basal respiration, biomass C, biomass P, ergosterol (as an indicator of fungal biomass), CO_2, & qCO_2, + ratios of biomass C to P, and biomass C to total C. The study used fumigation & gas chromatography lab methods. Arithmetic means of soil properties were subjected to 2-factorial analysis of variance with subplot & soil depth, to evaluate effects of soil types & management systems. There does seem to be misuse in this study of term "index" in place of S.Q. "indicators" (--ch notes).

Castrignano, A., G. Convertini, D. Ferri, and N. Martinelli. 2001. Application of a new soil quality index based on multivariate geostatistics. From European web site for: Leibniz-Zentrum für Agrarlandschafts- und Landnutzungsforschung (ZALF) e.V. at URL: http://www.zalf.de/essc/valbook3.htm

This static, field-level study, from Italy, includes modelling and development of an integrated overall index of a complex "multiple-variable indicator transform" (MVIT) and kriging. Four soil chemical properties (N, P_2O_5, K_2O, & pH) and data from 118 sample positions, on a quadrangle grid pattern, in a 10000 x 10000 m. area, produced a probability map for landscapes, showing potential areas of high SQ and low SQ.

Castrignano, A., G. Convertini, D. Ferri, and N. Istituto Sperimentale Agronomico Via C. Ulpiani 5 70125 Bari Italy Martinelli. 2002. Application of multivariate geostatistics to develop soil quality index. In: *Man and soil at the Third Millennium;* Proceedings [of the] International Congress of the European Society for Soil Conservation, Valencia, Spain, 28 March-1 April, 2000. Volume 1:887-896. J. L. Rubio, R. P. C. Morgan, S. Asins, and V. Andreu, editors. Logrona, Spain: GEOFORMA Edicions, S.L. From URL: http://www.zalf.de/essc/valindex.htm#indexval

Awareness of the importance of soil quality for agricultural sustainability has increased in the last ten years. To quantify soil quality, specific soil indicators need to be measured spatially. The list of parameters proposed by researchers to assess soil quality is broad and includes physical, chemical and biological parameters as well as nominal variables, such as soil map unit. For a given location, however, measurements of these soil quality indicators have to be combined in a global index. Such integration is rather complex and must be made in a fashion that combines and weights each factor appropriately. We applied an approach that utilizes multiple-variable indicator system, which transforms measured data values into an overall index according to specified criteria. The criteria, developed independently for each indicator, assume the form of critical values or ranges of values representing the best estimate of good soil quality. Following this approach, soil quality is evaluated on a landscape basis as the probability of areas having good soil quality. To determine such a probability a particular technique of non-parametric geostatistics, called indicator kriging, was utilized which uses the transformed data to estimate values for locations that have not been sampled. To integrate several individual indicators into a new single indicator, we have defined 'good' soil as soil that meets all threshold criteria for all soil parameters. Thus, the integrative soil indicator is coded 0 or 1, if and only if all the individual indicator-transformed values are equal to 0 or 1, respectively. In the other cases, when one or more of the individual soil parameters fails to meet its critical threshold, the combined indicator is coded in a number varying between 0 and 1, obtained weighting each indicator according to its local importance. These weights assume the form of standardized scoring coefficients resulting from multivariate factor analysis. To illustrate the method, we present an example data set containing four soil parameters (N, P2O5, K2O and pH) for each of 118 positions located in a quadrangular grid pattern within a 10 000 by 10 000 m zone of Apulia region (south Italy). Through the estimation procedure, maps are developed that indicate the probability of meeting a specific soil quality criterion on the landscape level. The map of the overall index has allowed to indicate the areas on the landscape that have a high probability of having good soil quality according to predetermined criteria. In addition, it has allowed the identification of the indicator parameter(s) responsible for zones of low soil quality so that specific management plans or land use policies may be developed**.** *--Authors' abstract.*

Canadian Council of Ministers of the Environment (CCME), Soil Quality Task Group. 2003. *CCME Soil quality guidelines for the protection of environmental and human health* . From CCME website at URL: http://www.ccme.ca/initiatives/soil.html?category_id=44

"As part of the Canadian Environmental Quality Guidelines, CCME's soil quality guidelines are derived for the protection of environmental and human health in different land use categories. They are developed using "A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines" (CCME 1996). The CCME soil quality guidelines are derived to approximate a "no- to low-" effect level (or threshold level) based only on toxicological information and other scientific data. Nonscientific factors (socio-economic, technological, or political) are to be considered by site managers on a site-specific level as part of the risk management process. The soil quality guidelines are generic values and are not intended to be applied to all contaminated sites in Canada without a proper site characterization."

Clerck, F. de, M. J. Singer, and P. Lindert. 2003. A 60-year history of California soil quality using paired samples Additional Title: Special issue: The assessment of soil quality. *Geoderma—Special Issue: The Assessment of Soil Quality* 114, no.3/4: 215-230.

These authors recovered archived soil samples from the 1940s & 1950s, and also took 2001 samples from throughout California -- primarily the Central Valley -- and from varying land use types, to compare basic indicator measurements through lab analyses: pH, electrical conductivity, available Olsen-P, total N & C, C/N ratio, clay/silt/sand texture, % clay, chroma/color value. They used JMP version 4.0 statistical software to run parametric t-tests to compare the 1945 to 2001 values; --Found "increases, decreases, or little change in parameter values. Did not weight or score soil attributes, or combine into a SQ Index, citing Sojka & Upchurch (1999, 2003) to justify the complexities involved in soil quality indexing attempts (p.228), and so not doing so. Found "no significant decrease" in soil quality in California. This attempted a state-scale comparison, but using point samples (so no spatial variability could be tracked, nor replicable. (ch notes).

Coleman, D. C., P. F. Hendrix, and E. P. Odum. 1998. "Ecosystem health: an overview." *Soil chemistry and ecosystem health*, P. M. Huang, D. C. Adriano, T. J. Logan, and R. T. Checkai, editors. Madison , WI: Soil Science Society of America Inc. What are the "vital signs" of a healthy terrestrial ecosystem?

This discussion papers takes a soil ecology and systems approach to this topic, uses Doran & Parkin's (1994) definition of soil quality, sees soils as open systems wherein nutrients and energy flow through, enter, are replaced annually, and wherein microbial biomass communities adapt to the flow rate(s).—Roots, rhizosphere, enzymes, microbes all "interact", and **nematodes** are recognized as an indicator species for overall system health.—Section 1-5 (pp.12-17) discusses "Indexes of Soil "Quality".—Relates the Doran & Parkin (1994) major soil functions, then looks at chemical indexes of abundance/level of lignin, polyphenols, & C/N; Tian's (1993, 1995) plant residue quality index (PRQI) of C/N + lignin + polyphenol concentration of plant residues on mulching effect; enhanced macrofaunal activity (termites, earthworms); aeration; & nutrient mineralization. Next, the authors look at soil quality index extension to SOM as in Hu et al. (1995); C dynamics, soil biota effects, nutrient cycling, & carbohydrate ratios (mannose-xylose).
Methods: Field-scale, plots/subplots, root exclusion tests, in Ultisol, in SE-USA; on 40-year old mixed grass sod; used moldboard-plow, disk-harrow, rotary-till treatments, to 15cm depth; subplots sown to grain sorghum in summer & winter fallow post-tillage. Soil samples were taken in November 1990 & 1991, prior to harvest. They measured soil carbohydrates; found greater concentrations of microbial-derived carbohydrates (lab-tested samples), in ratio of mannose to xylose, as an indicator of carbohydrate origin. Microbial biomass was tested by fumigation-extraction method (after Vance et al., 1987); C & N calculated. Results: --C & N were lower in root exclusion & fungicide treatments than in control; earthworm & arthropod-inhibited treatment subplot samples.—Regression & analysis of variance were performed on the data, showing close linear relationship of biomass C & total carbohydrates in the soils.

Columbia University. Earth Institute, Center for International Earth Science Information Network (CIESIN) and Sustainable Rural Development Information System. 2002. "Land quality & sustainable land management indicators [web] sites."

Web page. Available at URL: http://www.ciesin.org/lw-kmn/slm/lqislmsites.html

Craft, E. M., R. M. Cruse, and G. A. Miller. 1992. Soil erosion effects on corn yields assessed by potential yield index model. *Soil Science Society of America Journal* 56: 878-883.

The authors utilized a Potential Yield Index on corn productivity and eroded soils plus tillage; on 4 soils from 16 major "soil associations" in Iowa. Soil physical and chemicals tested were: particle-size distribution, bulk density; soil pH; available water capacity; available P & K to a depth of 1.5 m.; and in the context of available growing season data on daily soil temperature (with depth), and average seasonal rainfall, percolation, and runoff. These data were used to predict root growth potential for corn, nutrient uptake, water uptake; and compared 10-year estimates (1984).Then, they used the derived PY Index correlations to examine eroded soils, fertilizer application effects on soil fertility levels for non-eroded and eroded soils (restoration impacts), and prediction from root-growth simulations to responses to changing soil factors. This research found that erosion factors could be balanced by plow-layer soil fertility restoration.