



## **A comparison between probability and information measures of uncertainty in a simulated soil map and the economic value of imperfect soil information.**

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Conventionally the uncertainty of a conventional soil map has been expressed in terms of the mean purity of its map units: the probability that the soil profile class examined at a site would be found to correspond to the eponymous class of the simple map unit that is delineated there (Burrough et al, 1971). This measure of uncertainty has an intuitive meaning and is used for quality control in soil survey contracts (Western, 1978). However, it may be of limited value to the manager or policy maker who wants to decide whether the map provides a basis for decision making, and whether the cost of producing a better map would be justified.

In this study I extend a published analysis of the economic implications of uncertainty in a soil map (Giasson et al., 2000). A decision analysis was developed to assess the economic value of imperfect soil map information for agricultural land use planning. Random error matrices for the soil map units were then generated, subject to constraints which ensure consistency with fixed frequencies of the different soil classes. For each error matrix the mean map unit purity was computed, and the value of the implied imperfect soil information was computed by the decision analysis.

An alternative measure of the uncertainty in a soil map was considered. This is the mean soil map information which is the difference between the information content of a soil observation, at a random location in the region, and the information content of a soil observation given that the map unit is known.

I examined the relationship between the value of imperfect soil information and the purity and information measures of map uncertainty. In both cases there was considerable variation in the economic value of possible maps with fixed values of the uncertainty measure. However, the correlation was somewhat stronger with the information measure, and there was a clear upper bound on the value of an imperfect soil map when the mean information takes some particular value. This suggests that the information measure may be a useful one for general communication of the value of soil and similar thematic data.

Burrough, P.A., Beckett, P.H.T., Jarvis, M.G., 1971. The relation between cost and utility in soil survey. *J. Soil Sci.* 22, 359-394.

Giasson, E., van Es, C, van Wambeke, A., Bryant, R.B. 2000. Assessing the economic value of soil information using decision analysis techniques. *Soil Science* 165, 971–978

Western, S., 1978. *Soil survey contracts and quality control*. Oxford Univ. Press, Oxford.