

High Tech Tools to Assist in Land Use Planning for Livestock Production

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Introduction

A standard methodology for the evaluation of soil suitability in the prairie landscape for the application of swine manure was developed through the collaborative efforts of Research Branch and PFRA. The procedure involves the integration of soil, landscape and geological information to define environmental sensitivities and thus highlight management requirements to sustain soil and water quality. Resource information for both soils and geology has been standardized and integrated to define a series of nine soil management groups (SMGs). Example maps depicting the various components and the resultant soil management groups have been developed for three test areas encompassing rural municipalities or portions of counties in Alberta, Saskatchewan and Manitoba.

The main function of this methodology is firstly, to provide a standard description of the land resource base in terms of environmental limitations, and secondly, to serve as a decision support mechanism to link users directly to management information such as provincial farm practice guidelines through a menu-driven interactive process. The methodology will be used by resource specialists and land use planners at the provincial and local municipal level and will be applied at a broad level in the planning process. This decision support system is intended to assist resource specialists and planners in making environmentally sound decisions for the purpose of siting swine production units and in making recommendations for application of swine manure to the land base in an environmentally sustainable manner. The Research Branch in collaboration with PFRA, NRCan, and provincial resource specialists, developed this evaluation methodology using expertise in pedology, geology, hydrology, meteorology, soil chemistry, land use and manure management.

Methodology

The methodology is based on the premise that more and better use can be made of existing, albeit limited, technical resource information for land use planning purposes. By applying standard scientific principles and concepts to resource database information, a rational, systematic description of land units has been developed for land use planning. However, it is not intended that site-specific approval and development be by-passed in this process.

This bulletin fulfills the initial objectives of the original study, namely:

- i). to develop standardized structure for:
 - soils database and maps at 1:100 000 scale,

- geological (drill log and water well) database and surficial geology maps at 1:250000 scale, and
 - climatic risk maps for the Prairie region;
- ii). to develop a standard protocol for integrating resource data to define the environmental sensitivities of soil landscapes, and
 - iii). to propose a user-friendly method of linking resource constraints to relevant management information using geographic information system technology.

This project funded under the Hog Environmental Management Strategy (HEMS) has resulted in the development of a system to rate soils and landscapes in terms of the three major factors which influence risk to the environment, namely, a soil nutrient factor, a surface water factor and a groundwater factor. Data integration is based on the assumption that the physical environment can be described in terms of sensitivity factors for soil and water quality. These three resource factors are combined in a matrix fashion and subsequently grouped into a nine SMGs based on similar kinds and seriousness of limitations. The final groupings are presented in map or report format (Figure 1). The derivation of SMGs is based on intrinsic properties of the soils, landscapes and surficial geology which are available in electronic and geographic information system databases.

Nutrient Factor - based on the assumption that highly productive soils will have the best capacity to store and supply N to planted crops, ie. minimize the potential to have N in excess of crop requirements in the soil profile. This factor uses a sub-component of a soil productivity rating system to assess land suitability for spring-seeded small grains. The soil information is derived from detailed databases for soil series in each province.

Surface Water Factor - based on the geomorphic characteristics of the land surface, incorporates an index for risk of surface runoff derived from the soil and landscape database (including properties such as the soil erodibility, slope length and slope steepness).

Groundwater Factor - based on geologic drill logs, water well data and surficial geology, incorporates a Soil Leaching Index derived from the soil database (soil profile - 0 to 1 m), combined with a Geologic Materials Index derived from a standardized drill log database (describing the type, thickness, and permeability of geologic materials).

Each SMG can be treated as requiring unique management considerations. The user will be able to work through the methodology by interacting with menu-driven linkages to the appropriate databases describing the resource limitations, and the management considerations. Management guidelines and regulations will be those as provided in farm practices fact sheets and publications, and include information such as provincial set-back and manure application guidelines. The menu links to maps which indicate likelihood of adverse seasonal weather conditions, tables describing manure type and quality, methods of manure applications, rates of applications, timing of application, and example cropping systems that would optimize nutrient uptake and biomass production.

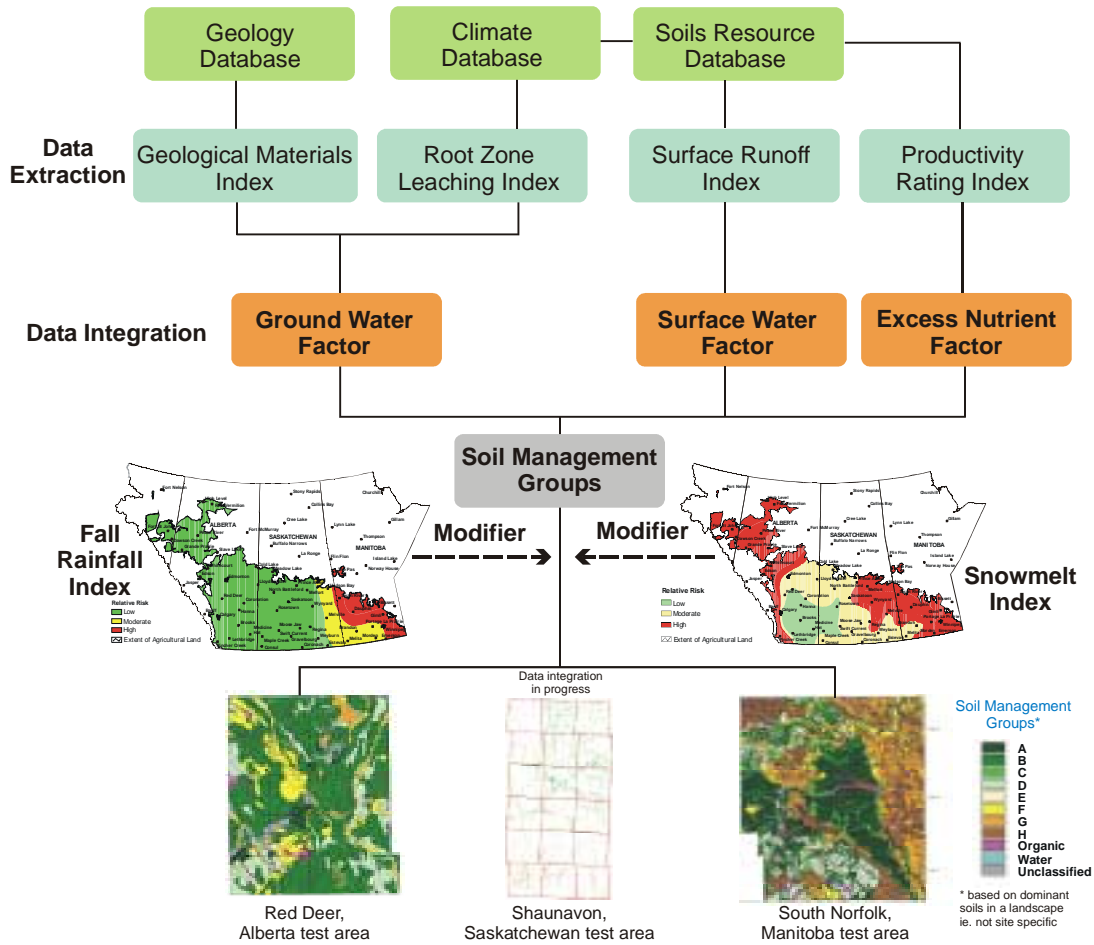


Figure 1. Summary of resource based analysis and data integration to derive Soil Management Group maps