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FINAL REPORT:
**SOIL HEALTH ASSESSMENT IN
ORGANIC FARMING SYSTEMS**

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EXECUTIVE SUMMARY

All life is rooted in the soil. All living things, including humans, need food of one kind or another. Life also depends on air and water, but nothing can live with air and water alone. Living things not directly rooted in the soil – things that live in the sea, on rocks, or on trees, for example – still require minerals that come from the earth. They must have “soil” from somewhere. Living things other than plants get their food from plants or from other living things that feed on plants, and plants feed on the soil. By one means or another, all life is rooted in the soil. The purpose of a sustainable agriculture is to sustain human life, and thus, sustainable farming must be rooted in the soil.

- John Ikerd (2002)

1.0 INTRODUCTION

Soil health is a central tenet of organic agriculture, and is critical to sustainable agriculture. Soil health assessment is an information gathering process intended to contribute to soil health management decisions.

The purpose of this community-based action research project conducted in the Similkameen Valley (British Columbia, Canada) with organic growers and local resource people, was:

- 1) To describe organic growers' current approaches to soil health assessment; and
- 2) To explore the concept of collaborative, bioregionally-adapted soil health assessment as a means of improving British Columbia organic growers' capacity for soil health assessment. (BOX 1.1 outlines the key principles of collaborative, bioregionally-adapted soil health assessment.)

The intent of this project was not to develop new assessment methods *per se*, but to provide a process for the development of a soil health assessment strategy that builds on existing research about soil health indicators and assessment methods, and adapts it to the site- and context-specific needs of British Columbia's organic growers.

This report provides an overview of the research methods, findings, conclusions and recommendations. For more detailed data, discussion, and literature review, please refer to my forthcoming Master's thesis (to be submitted to The University of British Columbia library, Spring/Summer 2005) ¹.

¹ M.Sc. thesis to be submitted to UBC Library, Spring/Summer 2005: Wagner, Julia M. 2005. A Process for the Development of Collaborative, Bioregionally-Adapted Soil Health Assessment: A Community-Based Action Research Project with Organic Growers in the Similkameen Valley, British Columbia, Canada.

BOX 1.1. Key principles of collaborative, bioregionally-adapted soil health assessment.

1. Holistic soil health assessment: Assessment on individual farms using some set of *chemical, physical and biological indicators* of soil health.
2. *Bioregionally-adapted* approach to soil health assessment: farms in a given region use a common set of soil health indicators that are selected for their relevance to that particular region's soils and production systems and the participants' objectives.
3. *Collaborative* approach: growers and local resource people working and learning together to assess soil health and identify and address soil management issues. Shared, consistent soil health assessment methods allow comparison between farms.

2.0 METHODS

This project was based on a Community-Based Action Research methodology: community-based action research involves collaborative and participatory approaches to empower stakeholders to create mutually acceptable change. In this research project, growers' knowledge, along with other local stakeholders' knowledge, served as a starting point for understanding as well as for seeking appropriate means of improving the 'current situation' (the situation existing at the time the project was initiated) in terms of growers' capacity for soil health assessment.

The community-based action research project included the participation of Similkameen Valley organic growers as well as local resource people. Growers representing approximately 20 certified organic farms in the Similkameen Valley accepted the invitation to participate. The majority of these growers were tree fruit growers, however, a small number of ground crop growers also participated to varying degrees. The participants whom I refer to as 'local resource people' are professionals with the potential to contribute relevant knowledge or experience relating to soils and soil health assessment, Similkameen Valley or organic production systems, and capacity-building. In total, nine resource people participated in various stages of the research project including: a B.C. Ministry of Agriculture, Food and Fisheries representative, an Agriculture and Agri-Food Canada research scientist, two Similkameen Valley and surrounding area private field advisors, an organic certification verification officer, an organic certification committee member, a Soil Foodweb, Inc. Certified Advisor, a soil and tissue analysis laboratory representative, and a tree fruit packing house horticulture field service representative.

The project activities included: an initial workshop; individual written questionnaires; individual interviews; analysis of growers' historical soil test records; a field day; trials of a collaborative, bioregionally-adapted soil health assessment strategy; a 'final' workshop to report and discuss results of the soil health assessment trials and evaluate the project; and an individual written evaluation.

The details of the collaborative, bioregionally-adapted soil health assessment strategy, including indicators, assessment methods, sampling strategies (selection of benchmark plot, replications of

assessments), frequency of assessments, and references which were reviewed to develop the assessment, were compiled into a guidebook titled *“A GUIDE to proposed SOIL HEALTH ASSESSMENT for organic farmers in the Similkameen Valley.”* The guidebook is included in the report’s Appendix III.

3.0 FINDINGS

The findings are presented in three parts: 1) the Similkameen Valley growers’ current approaches to soil health assessment; 2) the soil health assessment trials; 3) the collaborative approach.

3.1 Current Approaches to Soil Health Assessment

Soil health assessment was primarily an informal, individual activity carried out by growers as an integrated aspect of their management activities. Growers relied primarily on sensory observation and perceptions of the effects of management practices (‘management-based assessments’) to understand and assess soil health. The majority made limited use of laboratory analyses (such as soil tests) to assess soil health. They were generally not using ‘alternative’ assessment methods - defined as those methods developed with the intent of being ‘farmer-friendly,’ allowing for on-farm assessments of soil health, or of providing means of assessing physical and biological aspects of soil health not assessed by the traditional soil test. (Examples of alternative assessment methods include: Solvita® Soil Life Test, USDA Soil Quality Test Kit, Soil Foodweb, Inc. laboratory analyses).

We identified several challenges of relying on sensory observation and management-based assessments of soil health, including:

- challenges of sensory observation for new, inexperienced growers;
- challenges of distinguishing the degree to which crop health observations are a reflection of soil factors versus non-soil factors;
- a desire for an improved capacity to recognise changes in the soil and thereby manage soil health proactively to prevent the development of soil-related crop health problems; and
- uncertainties about the overall effects of management practices on soil health.

The participants’ perspectives suggested that there are several factors related to growers’ limited use of laboratory soil tests, including:

- lack of clarity of purpose for soil testing;
- technical knowledge requirements;
- perceived capacity of management to change soil characteristics;
- lack of relevance to growers’ priorities for nitrogen management;
- questions regarding their relevance to biological perspectives of soil management;
- sampling concerns.

Growers expressed interest in alternative assessment methods, and particularly emphasised a desire for improved capacity for assessment of soil biological health.

Overall, despite the wealth of growers' experiential knowledge, without clearly defined soil health parameters or documentation of soil health assessments, growers would have difficulty communicating or demonstrating to outsiders the status of their soil health and how it is changing over time.

Many of the participants recognised the complexity of soil health and reflected on the challenges this complexity posed to implementing reliable yet practical assessment. Both growers and resource people voiced concerns about the knowledge and time required to conduct more systematic soil health assessments, and ultimately, the value – whether the benefits of the information obtained would outweigh the costs.

The complexity of soil health, and the knowledge gaps which exist in both growers' and scientists' understanding of soil health, suggests that it may not be appropriate to require growers to develop and implement systematic soil health assessment. Instead, it supports the concept of encouraging growers to participate in a learning process with resource people to build our collective understanding of soil health, with the objectives of improving short-term management as well as long-term stewardship, to the mutual benefit of all.

3.2 Soil Health Assessment Trials

The trials provided an opportunity to evaluate the potential of a more systematic soil health assessment strategy to reduce existing uncertainty, as expressed by many participants, about the status of soil health in the Similkameen Valley and how it is changing over time.

Overall, the growers indicated that they considered the systematic soil health assessment a valuable process for obtaining more knowledge about their soils. Growers learned about the general characteristics of Similkameen Valley soils, the health of their soils in particular, and soil health issues shared with other growers. Growers emphasised that one of the most useful aspects of the systematic soil health assessment was the opportunity to compare their results to those of other growers. Growers also found it useful to be able to compare their soil test results to the two 'native' (never cultivated) soil results.

The soil health assessment strategy developed for the Similkameen Valley was not designed to quantify the relationships between specific management practices and soil characteristics. This would have required a larger sample size to allow for statistical analysis, as well as more control over the diversity of management practices to reduce the number of confounding variables. Nevertheless, the trials allowed us to identify issues and develop hypotheses about potential contributing factors. Therefore, the soil health assessment strategy followed in this study can be considered as the problem identification stage of adaptive management. Further investigation is required to diagnose the 'cause(s)' of problems and identify effective 'solutions' or management adaptations to improve the situation. More scientific investigations or experimental designs that allow for statistical testing can be useful complements to this type of soil health assessment.

The soil health assessment trials also provided an opportunity to evaluate different types of indicators and assessment methods:

- Growers' evaluations indicated that the use of the soil test in the collaborative setting improved their capacity to understand the results. The soil test results provided growers with new information about their soil and was therefore a useful tool in the soil health assessment toolbox. The soil test results also suggested that laboratory analyses have value in revealing characteristics that are not readily observable (by sensory means, e.g. soil chemical characteristics).
- The field descriptive (e.g. soil texture and soil structure) and field analytical (e.g. compaction tester) assessments provided an opportunity for grower engagement in the assessment of soil physical and biological characteristics and the systematisation allowed for comparison across plots. However, our experience with these on-farm assessments also raised questions about the experience required for these assessments, the degree of precision required for identification of critical thresholds requiring management adjustments, and therefore their reliability for comparing results across plots and over time.
- Several growers were not satisfied with the earthworm count as an assessment of biological soil health: growers' desire for improved capacity for assessment of biological aspects of soil health, as identified in the initial project activities, was not fulfilled. However, the scientific literature acknowledges that our knowledge of biological aspects of soil health is still in its infancy. This study suggests the value of growers being involved in this process of identifying appropriate indicators and assessment methods for farm-based assessments of soil health. As part of this process, growers would benefit from opportunities to learn more about the current state of scientific knowledge about soil biology and its assessment.
- The Similkameen Valley soil health assessment trial was based primarily on scientific methods: either analytical techniques or scientific terminology. Because these assessments are systematised, they are more suited to comparison in a collaborative setting. However, growers' perceptions of crop health were included in the soil health assessment trials in an effort to begin to document growers' knowledge. Unfortunately, this effort was not very successful: most growers did not complete the crop health observations. Therefore, determining how to appropriately balance or integrate scientific and grower knowledge in the development of a collaborative soil health assessment strategy requires further consideration.

Many of the challenges we experienced reflect issues also identified in the soil quality/soil health literature, and reflect the general need for further research to improve our understanding of soil health and its meaningful assessment.

Given the information intensive nature of the soil health assessments, strong coordination is likely required to facilitate their development and implementation, as well as the management and interpretation of the data generated. If a coordinator or facilitator is hired, it is important that the growers remain engaged in the soil health assessment process sufficiently to understand the results and continue to contribute their experiential knowledge. The systematic soil health assessments can be considered a valuable complement to, and not a substitute for, growers' experiential observation.

In both the plenary evaluation at the final workshop and in their individual written evaluations, the majority of growers indicated that they wanted to carry out future assessments to monitor trends in soil health indicators. The soil health assessment trials ought to be considered a first iteration: growers, along with resource people, can improve the systematic soil health assessment approach through on-going collaborative evaluation and adaptation. This is the key concept of the community-based action research process: it is a continuous learning-action-evaluation and adaptation cycle.

3.3 Collaborative Approach

The initial project activities revealed that, in general, organic growers in the Similkameen Valley have limited soil health learning resources, including limited collaboration with other growers or resource people:

- 1) Soil health assessment or more general soil health learning were characterised as individual activities or one-on-one interactions.
- 2) There are few formal discussion or learning forums for organic growers, in the Similkameen Valley or in BC in general, related to soil health or otherwise.
- 3) Existing soil health resources (research and information materials) are not relevant or not appropriate to growers' learning styles/needs, or growers are not aware of the resources.

This situation suggests that some information/knowledge system is required to assist growers in finding answers to their many soil health related questions - whether it be helping them learn about existing knowledge or identifying knowledge gaps and working to create new knowledge. This situation also suggests a gap between growers and scientists, a gap that is both mental and physical: growers and scientists have different ways of knowing, and few opportunities exist for sharing or cross-breeding of these ways of knowing.

Limited public resources for research and information dissemination requires at least some degree private initiative. Growers need to be proactive learners, taking personal responsibility for acquiring necessary knowledge and information to assess and manage soil health. However, doing so individually would likely be difficult and have high resource requirements. Furthermore, although growers have a role in knowledge creation, they also have practical farming priorities to which they must attend.

The collaboration between and among growers and resource people was not an entirely new phenomenon in the Similkameen Valley. Therefore, this study built on existing collaboration and relationships, as well as forging new relationships. The community-based action research approach undertaken by this study provided a more formalised forum to connect growers, scientists and other resource people to address the gaps in the existing soil health knowledge system.

The collaborative process nurtured social energy and built learning networks which may increase the likelihood of on-going collaboration and learning. In the project evaluations, the growers

reflected that comparing their soil health assessment results with other growers they not only helped them to develop a better understanding of their individual results, but also helped them to develop a common ground with other growers.

There was general consensus among the participants in the final workshop plenary evaluation that the group wanted to continue to work together. Growers expressed the desire to: i) generally, continue to discuss soil health issues with other growers; ii) continue the collective approach to the systematic soil health assessment to monitor soil health trends, and iii) collaborate with resource people to investigate specific soil health issues (research questions). On their part, the scientists at the workshop indicated their willingness to explore research partnerships.

Growers specifically discussed the need for a “*coordinator/pusher/puller*” or facilitator to organise on-going collaborative efforts. Our experiences suggested that there is a role for resource people in contributing to growers’ capacity for soil health assessment, to provide skills and knowledge complementary to those of growers. However, good facilitation is important to find an appropriate balance of stakeholders’ roles and knowledge in this collaborative process, and to stimulate learning for the generation of locally relevant knowledge.

Given the short-time frame of the project, we can only report on the establishment of the collaboration. Further research would be beneficial to learn whether or how this collaboration is sustained. Based on participants’ perspectives and literature review, the following elements were tentatively proposed as relevant to effective, sustained collaboration: growers driving the process; availability of resource people; value placed on learning and cooperation; and short-term benefits perceived by participants. Our experience demonstrated that cooperation between growers of different scales, production systems, and management philosophies was possible. However, further research is required to investigate the degree of commonality required for effective collaborative learning processes, including the possibility of collaboration between organic and conventional growers.

Overall our experience in the Similkameen Valley, supported by insights from experiences elsewhere, suggests that community-based action research can be an effective approach for:

- 1) Pooling resources and building local capacity to identify and address farm management and resource management issues at a regional level.
- 2) Contributing to our collective understanding of soil health with producers, scientists and other resource people working together and sharing different types of knowledge about soil health.

We need to continue to improve our ability to communicate about soils in common terms, and thereby improve our understanding of soil health and sustainable soil management. This was but a start of a learning process: further iterations of the action-learning-evaluation and adaptation cycle ought to build on and improve this first experience of a community-based action research approach to soil health assessment.

4.0 CONCLUSIONS

Overall, the community-based action research process in the Similkameen Valley provided a forum for growers and resource people to share and integrate our diversity of knowledge, experiences, and perspectives. This contributed to our collective understanding of soil health assessment, including:

- a picture of the current situation (existing prior to/at the time of the study);
- identification of key issues, including factors impinging on growers' capacity for soil health assessment and management, as well as questions, concerns or general knowledge gaps;
- development of and implementation of a plan of action intended to begin to improve the current situation, by building on the strengths and addressing some of the key issues;
- evaluation of how that action contributed to improving our understanding of soil health, to in turn inform further action.

The community-based action research process revealed many questions or issues requiring further research to improve our capacity for soil health assessment and management.

Based on our experience in the Similkameen Valley, I have outlined a proposed framework for the development of collaborative, bioregionally-adapted soil health assessment strategies (APPENDIX VII: "Process for Development of Collaborative, Bioregionally-Adapted Soil Health Assessment"). Further experiences with this framework in other communities or regions, and with longer time frames, are necessary to evaluate its effectiveness and relevance in different contexts.

5.0 RECOMMENDATIONS:

The recommendations are presented in three categories, although there is some overlap among them: 1) recommendations for collaboration between growers and resource people; 2) recommendations for improved understanding of and effective implementation of soil health assessment strategies and methods; and 3) recommendations for research to improve the knowledge base from which we develop soil health assessment strategies and interpret the results for improved soil health management.

5.1 Collaboration Recommendations

Both soil health assessment and collaborative approaches have their challenges. However, a community-based action research process is recommended to address these challenges through communication between resource people and growers. I recommend the proposed "Process for development of collaborative, bioregionally-adapted soil health assessment" (APPENDIX VII) as a framework to guide the collaboration.

I also provide recommendations for the identification of resource people to collaborate with growers; development of a network of community-based action research soil health assessment initiatives; and means of facilitating grower self-reliance in the education-learning-research process.

5.2 Assessment Recommendations

From snapshot to trends, and more comprehensive, long-term evaluation: I recommend further evaluation of the proposed “Process for development of collaborative, bioregionally-adapted soil health assessment” (APPENDIX VII). Continue the Similkameen Valley soil health assessments and repeat similar soil health assessment trials in other communities/regions, with longer-term evaluation to further identify principles of successful community-based action research processes.

I also provide recommendations for improvement of future iterations of the Similkameen Valley soil health assessment strategy, and for improvement of BC organic growers’ capacity to gain value from soil tests as a component of soil health assessment.

5.3 Research Recommendations

The community-based action research approach to soil health assessment can be complemented by other forms of research, such as experimental research to answer specific questions related to soil health issues. I recommend that the scientific community contribute by conducting research that is holistic and interdisciplinary, and remains embedded in a collaborative process.

In addition to general soil health assessment research needs, I provide recommendations for research related to soil tests as well as to other assessment methods; research of specific soil health issues in the Similkameen Valley; and research of soil health assessment within broader contexts, including the overall farm sustainability context and the even broader context of food systems and societal values.

I recommend that funding agencies improve commitment to collaborative research processes to improve our capacity to integrate scientist and practitioner knowledge.

RESOURCES:

Resource List

A resource list is included in the appendix of the report as a starting point for other groups seeking information to develop their collaborative, bioregionally-adapted soil health assessment strategies (APPENDIX VI). The resource list includes internet and hard copy resources for the following topics: local portals to soil resources on the internet, soil health assessment methods, equipment suppliers, laboratories, local soil information, sampling, finding resource people in British Columbia.

Technical Bulletin

A technical bulletin to be distributed to BC organic growers includes the key principles and proposed process for the development of collaborative, bioregionally-adapted soil health assessment (APPENDIX VIII).