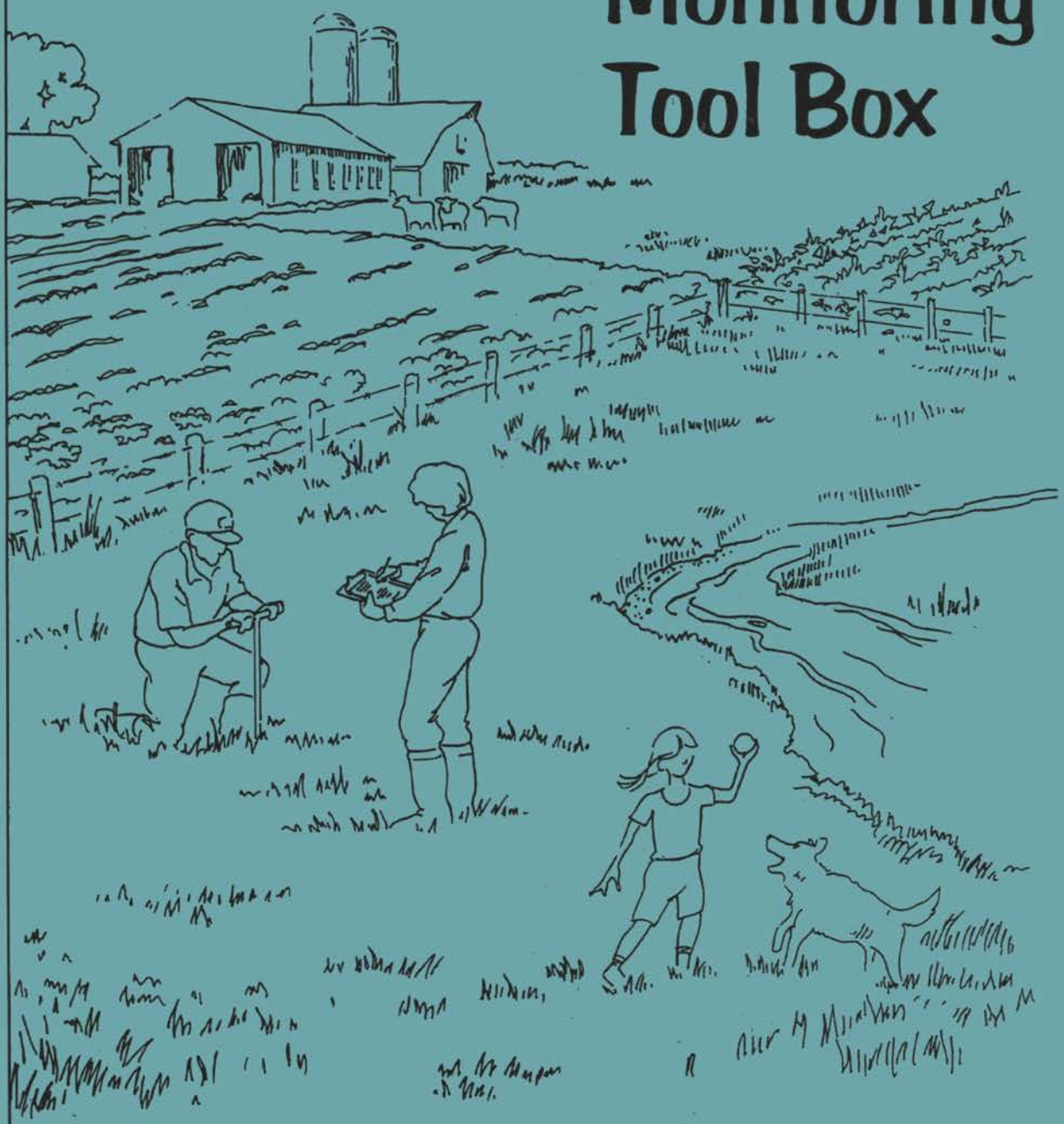
The Monitoring Tool Box



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Dear Friend,

On behalf of the Monitoring Project Team, I want to thank you for your interest in The Monitoring Tool Box. We hope you will find it a practical, informative, and even inspirational resource.

Two points to keep in mind as you explore the ideas, techniques, and references offered here:

1. Our primary interest is to provide landowners - farm families, rural residents, and urban citizens alike - with a powerful resource management tool. The Tool Box encourages intentional observations, and those work best in conjunction with goals you set for yourself, for your farm or backyard, and for your family and community.
2. Tremendous benefits and pleasure can be gained by teaming up with others to do this kind of on-site, goal-based monitoring over time. But there is much to be learned as an individual as well.

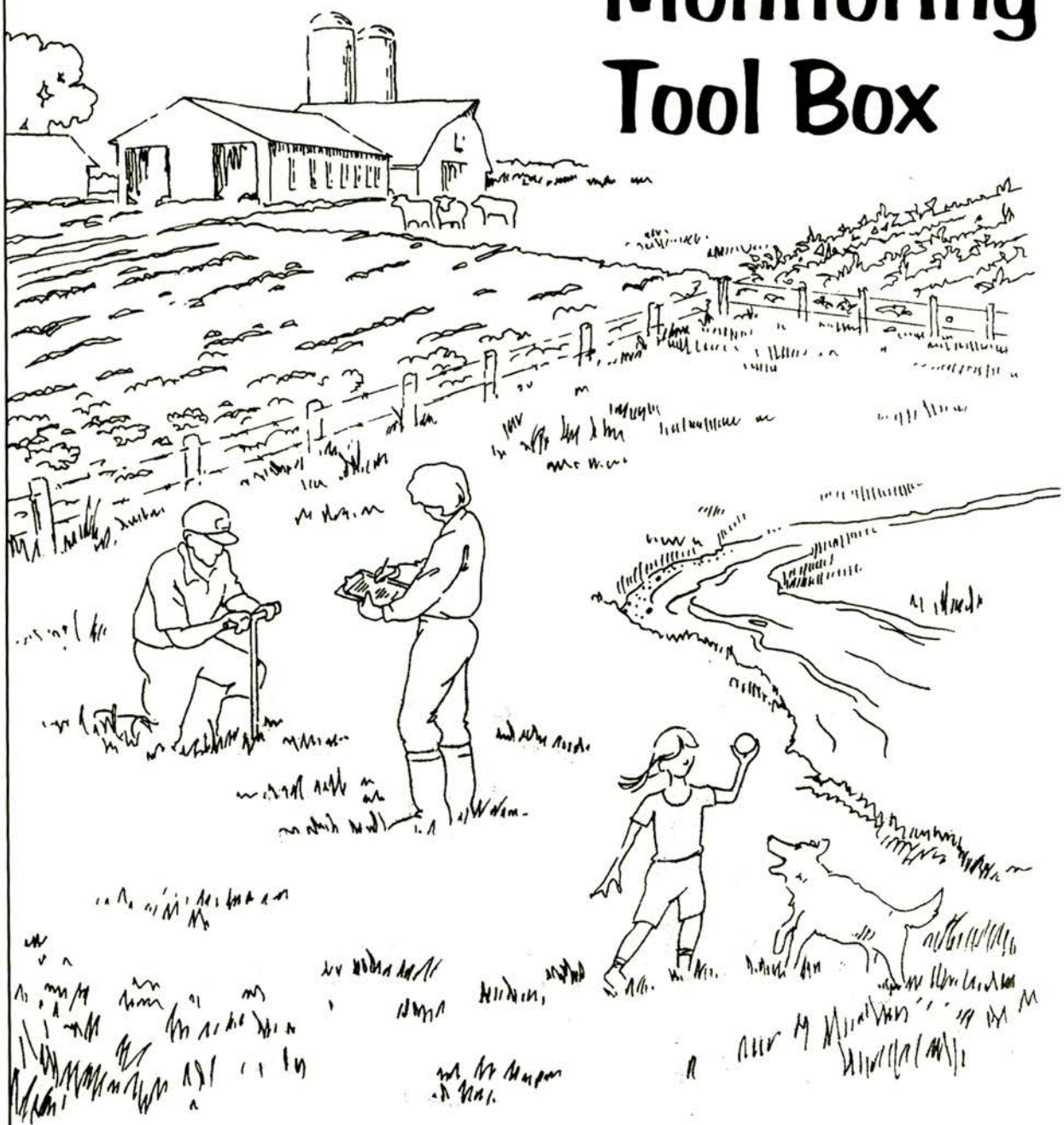
We strongly encourage linkages between families and their neighbors, along with natural resource agency personnel, university researchers, conservation groups, and other citizens concerned with the impact of land use decisions on their communities and the environment. Feel free to create these links on your own, or contact us at any of our three LSP offices to learn of monitoring groups near you.

Don't wait to get started!

Sincerely,
Caroline van Schaik
Caroline
LSP, White Bear Lake

P.S. Two additional chapters, "Monitoring Pests and Pesticide Usage" and "Monitoring Pasture Vegetation," are being developed and will be mailed to you when they are complete. We also will mail you the quarterly newsletter of monitoring stories, *Close to the Ground*, as it is prepared. Please send us your registration card so that we may keep in touch with you.

The Monitoring Tool Box



The Biological, Financial and Social Monitoring Project was convened in 1993 by the Land Stewardship Project and is a partnership with the Minnesota Institute for Sustainable Agriculture, the Sustainable Farming Association of Minnesota, participating agencies and individuals. The support, contributions and many hours of service of all involved is greatly appreciated.

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The Monitoring Tool Box is a Land Stewardship Project publication. Land Stewardship Project is a private, nonprofit organization committed to fostering an ethic of stewardship for farmland, promoting sustainable agriculture, and developing sustainable communities.

The Monitoring Project was made possible in part because of the funding and continued support of the Minnesota Institute for Sustainable Agriculture (MISA). MISA seeks to enhance the health of agriculture and rural communities by building partnerships and linkages among individuals and groups with diverse backgrounds and interests.

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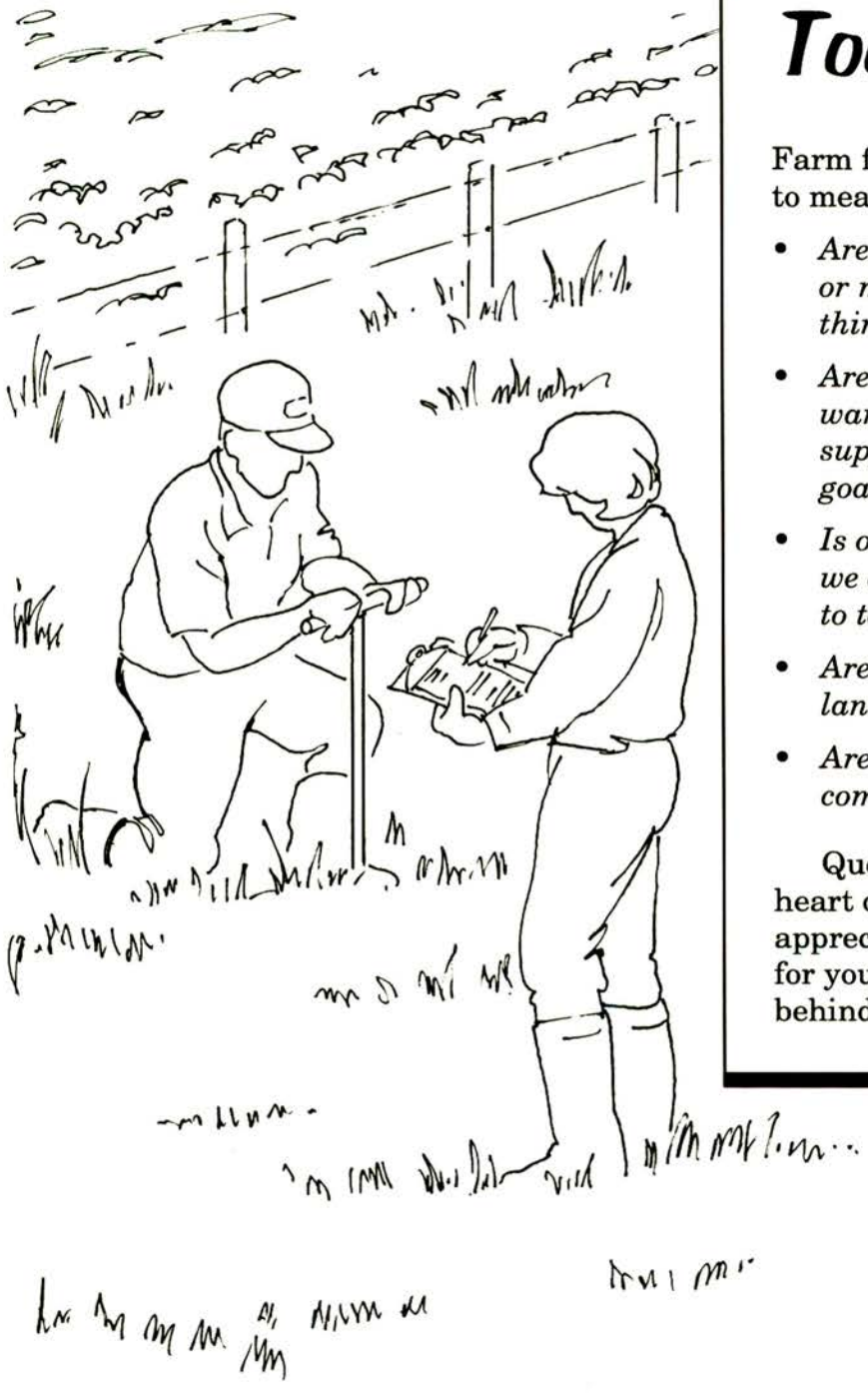
Making the Most of Your *Tool Box*



Farm families use many ways to measure the success of their farm:

- *Are our crop yields, or pigs per sow, or milk production per cow where we think they should be?*
- *Are we getting the return per acre we want? Is our net income sufficient to support our family's needs and goals?*
- *Is our farm a nice place to live? Do we enjoy our work? Do our kids want to take over the family farm?*
- *Are we being good stewards of the land and water?*
- *Are we good neighbors and good community members?*

Questions like these are at the heart of *The Monitoring Tool Box*. To appreciate what this workbook can do for you, consider the story and work behind its development.

The Story Behind *The Tool Box*

CHAPTER CONTENTS

In the early 1990s, several farmers connected with the Land Stewardship Project began talking with each other about changes they were making on their farms. These changes stemmed from the farmers' use of a more holistic, or whole farm, approach to farm management and centered around management intensive grazing.

A Whole Farm Management Approach

Three key parts of this whole farm approach to management sparked what has eventually become *The Monitoring Tool Box.*

Each farm family first set clear goals for their farm focusing on quality of life values, the profitability of the farm, and the environmental health of their land. Along with making good profits, the farmers identified issues like having fun, reducing soil erosion, improving the quality of their streams, improving animal health, and making sure their farms were welcoming to people and wildlife as important measures of success.

Based on these goals, a management plan for making changes on the farm was drawn up. From there, the farmers planned to monitor the effects of their management decisions to help them judge whether or not particular practices, like management intensive grazing, were leading them to their stated goals. If the evidence from monitoring did not support their goals, then they would figure out what they needed to change to get things moving in their desired direction.

Questions About Monitoring

The farmers' discussions with each other included questions about monitoring, such as:

- How do we measure progress in meeting goals like reducing erosion or making our farms a welcoming place for people and wildlife?
- We think our management changes are having positive effects on the environment. What kinds of things do we check for to make sure they really are beneficial?
- Are there ways to monitor farm profitability that take into account benefits to our rural communities?

Behind these questions was the fact that typical ways of monitoring the success of a farm tended to look only at productivity and profitability. The tools for looking at the whole picture of a farm were not readily available.

The farmers then invited various resource specialists into the discussions to talk about possible whole farm monitoring tools. The initiative called the **Biological, Financial and Social Monitoring Project**—referred to as "the Monitoring Project"—grew out of these joint discussions.

The Monitoring Project

In 1993, a diverse group of people—farmers, nonprofit organization staff, university researchers, government agency personnel, and private consultants—came together to form the Monitoring Project team. As a whole, the team brought together experience in soil science, plant pathology, wildlife ecology, hydrogeology, farm management, water quality, rural sociology, animal production (beef and dairy), crop production, agricultural economics, stream ecology, plant biology, on-farm research, management intensive grazing, and Holistic Management.

The Monitoring Project team's main objective was to develop a process for on-farm monitoring that allowed farm families to assess a variety of physical, chemical, biological, financial, and social measures in their quest to create and sustain a successful farm. Specifically, the team sought to ***document*** the types of observation and monitoring methods the farmers were already using, ***supplement*** these methods with ones developed from the experience of the other team members, and ***share*** all of these methods with as many others as possible.

The idea of a "monitoring tool box" was conceived as a way for the team to share its work with farmers and other professionals and to help these folks more effectively monitor changes on farms of all kinds.

The Monitoring Tool Box was also envisioned as a discussion starter for farmers and their neighbors, agricultural consultants, educators, researchers, and others concerned with the impact of farming on the environment and society. As people shared what they were learning with each other, the hope was that more and better monitoring methods could be identified and shared.

The First Edition

In its attempt to develop a process for on-farm monitoring to measure progress toward holistic goals, the Project's ground-breaking work was necessarily focused.

A Manageable Focus

In order to make the Project manageable, the greatest part of the team's efforts centered on finding tools for monitoring the impact of a specific farming practice (management intensive grazing) on the environmental health of a farm. The specific environmental indicators studied included birds, frogs and toads, soils, and streams.

For Farms of All Types and Sizes

Farms of all types and sizes can benefit from the process of monitoring. Lyle Wolle of Truman, Minnesota figured this out after reviewing a draft copy of the *The Monitoring Tool Box* :

> Monitoring is not a word I commonly use in my life and its application to the whole life of the farm took me off guard. At first I felt *The Monitoring Tool Box* was a little too general for the above average size farms located on the plains of Minnesota. I do not have any creeks or pasture! I had to study and understand what 'monitor' really meant to me.
>
> As I began to understand more of the monitoring concepts, I got more excited. This subject actually hits very close to home. I need to reevaluate my farming enterprise and I was only really using the financial approach. *The Tool Box* started raising my consciousness about my quality of life and how it is affected by all the other subjects monitored. Are we all business or a family too? Aren't we also socially intertwined with the land? I feel we are but that we deny most of those feelings. God always provides opportunities. Is this one of them?

A Powerful Way to Act

The Monitoring Project offered participants from diverse perspectives a context within which to build mutual respect, understanding and a common vision. The following comments by two Project Team members capture the essence of this positive side effect:

Dan French (dairy farmer):

I felt like I could trust Larry because when we talked about improving the stream, he was willing to work in a way that would be profitable. We were both challenged by this. What has occurred amongst this team is a breakdown in barriers between farmers and agencies, as well as an openness to using new management tools.

Larry Gates (Minnesota Department of Natural Resources):

I used to be involved in an awful lot of contentious resource issues filled with polarized arguments—a lot of we-they, you-them. And I was good at it.

But as far as good stuff getting accomplished, that was rare. I knew we had to do something about that in order to address big issues. The people on this team are generous, talking with one another, considering any idea, welcoming anybody to come in and discuss it. It's everybody's issue; it's everybody's problem. You see agreement on describing a kind of future. Speaking for the participating agencies, we embrace the opportunity to work directly with farmers again. This is a powerful way to act."

Finding ways to help farm families set and monitor goals—both for the farm and for their personal goals—also received the team's attention, with particular concern given to quality of life issues. The team's work on finances focused on ways to determine farm sustainability using financial data.

In addition, the topics of energy use, financial wealth generation, livestock health, pests and pesticide usage, and vegetation and plant diversity were studied; these will be the subject of upcoming materials. (For an overview of the Monitoring Project, see the video *Close to the Ground,* included with your Tool Box.)

A Work In Progress

Consider this first edition of *The Monitoring Tool Box* as "a work in progress." Along with developing more chapters, the plan is to allow *The Tool Box* to evolve and grow as farm families and others use it. And so, not only is your feedback welcome, it is vital to the ongoing development of the cooperative learning process originally envisioned by the Monitoring Project team.

Feel free to contact the Land Stewardship Project with feedback on the successes and challenges spawned from your work with *The Tool Box,* as well as with questions and requests for more information or assistance. Meanwhile, let this first edition introduce you and your family to the general idea and process of monitoring.

Monitoring and Whole Farm Management

As the story behind *The Monitoring Tool Box* clearly indicates, monitoring does not take place within a vacuum. It happens within a context of goals and plans. Most people have goals whether they are aware of them or not—things that are important to them, things they want to do or be—as well as some plan of how to achieve these goals. Likewise, most people keep track of their progress toward their goals in some way, even if just subconsciously.

The Tool Box builds upon this common experience and encourages you to see monitoring as an activity that is best done within the context of clear goals and a well-defined, goal-based management plan. It can also be a

useful, everyday tool that enhances your management skills and your enjoyment of life, as well as a springboard for creative, adaptive management.

Clear Goals and Well-Defined Plans

Monitoring can involve all kinds of activities, from checking for soil compaction to keeping a daily journal of insights and personal experiences. But, monitoring for its own sake is simply busywork. **To be an effective monitor, you will want to be clear about why you are gathering this information.**

In other words, monitoring is more worth your while if you do some prior work. The extent of that work is completely up to you. If curiosity is enough of a motivator for you, start at that level. The prior work of the Monitoring Project farmers involved a fairly comprehensive approach, one that included the following steps:

1. identifying all of the farm's resources including people (family, neighbors, local community), finances, land, and other physical resources;
2. setting clear goals that account for quality of life, profitability, and stewardship of the land;
3. establishing and implementing a plan of action in which management decisions are based on the identified goals and on what the environment can sustain; and
4. monitoring plans and actions to see if they are moving the farm in the desired direction.

This approach to whole farm management appealed to the Monitoring Project farmers because it offered them a way to manage their people, land, and money resources in a way that takes into account the interrelationships among these resources.

If you are unfamiliar with this holistic, goal-driven approach and would like to learn more about it, contact either the Land Stewardship Project or the Center for Holistic Management. The addresses for both are listed in the resources section at the end of this chapter.

Be assured, however, that even if you are unfamiliar with whole farm management, monitoring can still be a worthwhile activity for you. In fact, many of the tools in this workbook that apply to step four can also actually help you get started on the first three steps.

How to Use Your *Tool Box*

After you have read through this chapter, review the following chapter on "General Tools for Monitoring." It outlines some basic tools that can help you develop good observation skills and document your monitoring activities.

Then, leaf through all the specific monitoring chapters to get a feel for what they have to offer, and encourage other members of the family to do so as well. Each chapter includes

- *a number of monitoring tools related to the topic,*
- *suggestions about when to monitor,*
- *a list of materials needed,*
- *a cost estimate,*
- *an estimate of the time required, and*
- *a list of additional resources about the topic.*

At this point, decide how to proceed. At first you might just focus on the topics or activities that most interest you or your family. Or, if a particular topic or activity seems to make the most sense given your farming operation or family situation, start with that one. As your familiarity with the monitoring process grows through experience, you can modify or expand your game plan.

Most of all, approach the process with a sense of fun and openness.

How *The Tool Box* Can Help

Here are some ways *The Monitoring Tool Box* can help get you started on steps one through three of whole farm management:

Resource Inventory and Planning

Most, if not all, of the tools in this workbook can help you size up your farm's existing resources, determine problems and constraints, reveal untapped resources, and stir up innovative possibilities. All this information can then be used to clarify your goals and form a workable plan of action that moves your family closer to its vision.

Such a plan might include specific actions or practices that take into account considerations like the following:

- efficient cycling of nutrients
- water quality and soil health
- healthy crops, healthy livestock, and biological diversity
- improved wildlife habitat
- stability and resilience in the face of variable weather conditions
- pest and pesticide management with an eye toward minimizing adverse environmental impacts and pest problems
- tillage and other field operations that enhance soil and water resources
- processing and marketing options that add value to farm produce
- economic viability and financial independence
- generational transfer of the farming operation
- a happy, loving family life
- the impact of farm management decisions on the community at large

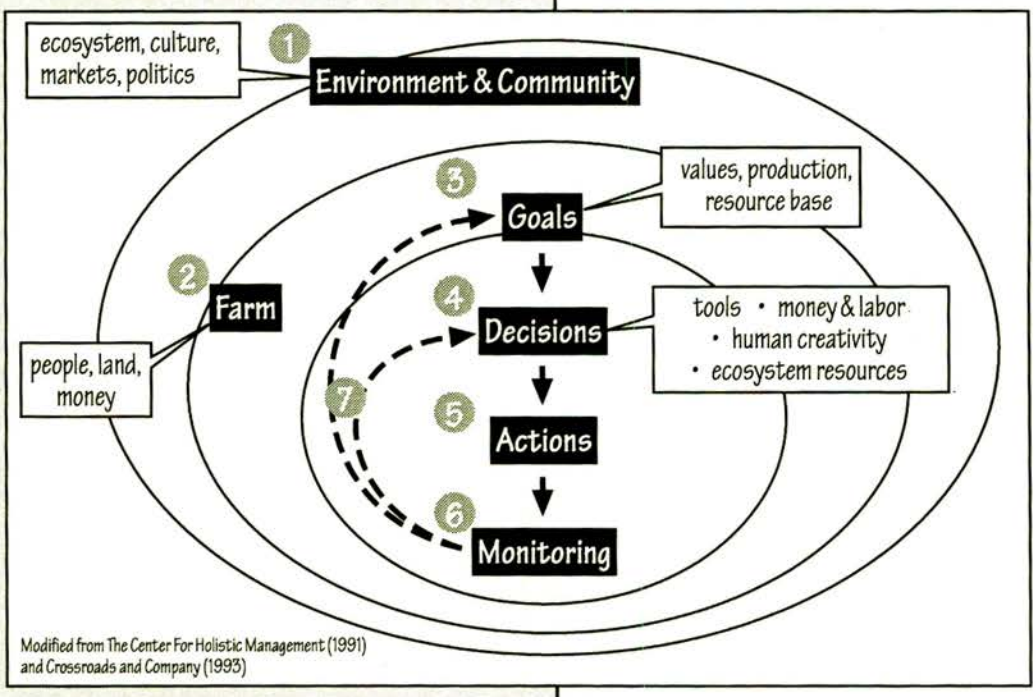
Once considerations like these are worked into a plan of action, they become the "yard sticks" or guidelines for monitoring activities.

Setting Goals

Ultimately, the purpose of setting goals is to make sure that what you are doing (or where you are heading) with your life and on your farm fits with your core values and meets your needs and desires. If you find this is not the case, take the opportunity to reevaluate your situation. Success and inner peace depend upon this consistency.

The chapter "Monitoring Quality of Life" offers tools that can help you and your family get started thinking about your quality of life values and how they shape your goals for the farm and the way you manage your farm. When all family members join together to create a quality of life vision, they form a powerful base from which to acheive their personal goals and their goals for the farm.

Managing Holistically



1. A farm does not exist within its own isolated world; it is connected to and dependent upon the greater community and the environment for its well-being.
2. A farm is made up of people, land, and financial resources; all these resources depend on and support each other.
3. Holistic goals for the farm take into account the values of all the people directly involved, the need for the farm to be profitable, and the needs of the farm's resource base so it can support profitability and the desired quality of life.
4. Decisions and plans flow directly from the goals set by the farm family. All available options, tools, and resources are considered when creating a plan.
5. Plans are put into action and consist of the mix of options, tools, and resources that seem most likely to achieve the desired goals.
6. Actions are monitored to see how they impact the people, land, and financial resources of the farm. "Is our plan helping us to achieve our goals?"
7. Based on the information from monitoring, *previous decisions* are reevaluated, *new plans* are made and put into action, and then monitored. From time to time, goals may also need to be reviewed and modified based on what is learned from monitoring.

A Vital, Everyday Tool

Within a whole farm, goal-driven management framework, regular monitoring can give you those early warning signals that things are not going according to your plan. This allows you to take steps to make changes before things get too far off course. And, if plans seem to be going in the right direction, monitoring helps you to concretely see this progress.

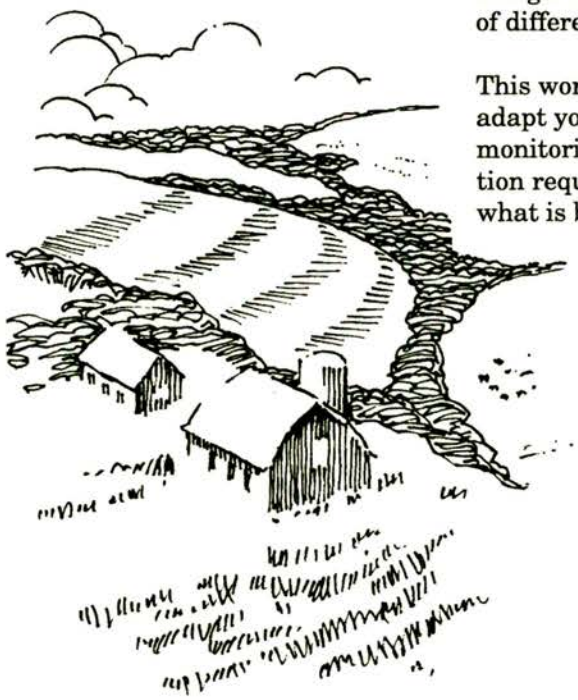
In essence, monitoring itself is simply a tool, albeit an invaluable one. The farmer members of the Monitoring Project stress this point. They all feel that regular, sometimes even daily, monitoring throughout the year provides them with the highest return on their investment, both in terms of profit and enjoyment.

Through the regular practice of monitoring you can also begin to cultivate a general and ever-deepening awareness of yourself, the people you love, and your living environment. Of the various reasons to make monitoring a deliberate, regular activity in your life, this may be the most rewarding.

A Creative Springboard for Management

Ideally, the information gathered from monitoring alerts you to when, where, and how your goals and plans need to change. In this way, monitoring can act as a springboard for finding creative ways to adapt your management.

Addressing the issues and problems identified by monitoring means that you need to understand the meaning of this information within the context of your farm. This may take some additional effort or investigation on your part. For instance, a particular observation, such as the absence of earthworms in your fields, could mean a number of different things. *The Monitoring Tool Box* provides some insights as to the meaning of different observations, but it is by no means comprehensive.



This workbook also purposely avoids laying out prescriptions on how to adapt your farm's management plan in light of the findings a certain monitoring tool might unearth. Again, the specifics of your farm's situation requires that you take a creative, proactive approach to figuring out what is best for it.

Sustaining the Farm

Although each of the farm families participating in the Monitoring Project has their own goals based on the land and people involved, they share some common principles of sustainability. These principles guide them in their goal-setting and decision-making process.

Stewardship. The principle of stewardship means leaving the land in better shape for future generations. It requires assessing current farming practices to determine if they are improving or degrading the environment, both on the farm and off. The Project farmers express this principle in different ways. One family sees it as developing a long-term vision of what their farm landscape should look like. Another family is intent on keeping a viable farm in the family for future generations. A third family wants their farm and family to be a good example of stewardship for others in their community.

Livestock are an important part of a healthy agricultural system. The Monitoring Project farmers insist that, with proper management, livestock can be a useful tool to restore the vitality of the land. They also agree that true wealth comes from the sun (solar wealth). One of their primary goals as farmers is to capture and convert the sun's energy into products that are useful to humans while maintaining or improving their resource base. Management intensive grazing of their livestock allows these farmers to achieve this goal.

A healthy ecosystem is the basis for a sustainable farm. The Project farmers recognize that biodiversity—in both flora and fauna—plays an important role in a healthy ecosystem. They also see interconnections between healthy soil, healthy plants, and healthy people and animals. And so, they are committed to working with natural processes for water and nutrient cycling and for pest control, and to reducing reliance on pesticides and other high-cost, energy-intensive approaches that substitute for natural processes.

Farming can be enjoyable and profitable and still preserve the resource base. For the Project farmers profitability, rather than production, determines their farm's viability. This focus on profitability keeps them mindful of sustaining the needs of their land and animals, as well as their own needs individually and as a family. Purposely focusing on family goals helps provide a more enjoyable quality of life for everyone in the family.

Making the Process Work

So far, this chapter has outlined a full hand of activities connected to monitoring:

- setting whole farm goals
- developing management plans based on these goals
- deciding what to monitor and how
- doing the actual monitoring
- adapting and changing management plans and goals

Addressing these activities is most workable if you start at a place and level with which you feel comfortable. The interconnected nature of these activities means that each of them can—eventually, and with persistence and openness on your part—lead you to the rest.

The analogy of learning to swim fits well here: at some point you need to get into the water. Some people feel comfortable just jumping into the deep end from the start. Others need to sit and dangle their feet in the water for a while before they even feel comfortable slipping into the shallow end. Trying some of the monitoring tools offered in this workbook may be a good way to "get your feet wet!"

Likewise, just as most people would not dream of learning how to swim on their own, learning the skills of monitoring and whole farm management is best done with a little help.

Community Resources

Many resources are available to you within your community—both people and information. Take some time to think of who or what might be available within your local community and make good use of these valuable gifts. Also, review the "Additional Resources" section at the end of each *Tool Box* chapter for suggestions on resources that can enhance your monitoring experience.

Join Up with Others

One powerful way to tap into your community's resources is to join up with other people who are also interested in whole farm monitoring. The farmer members of the Monitoring Project team stress that the likelihood for success in monitoring greatly increases by working with others. Not only does working with others increase your monitoring skills, it can also greatly enhance your creativity and enthusiasm when it comes to identifying and making the management changes needed to meet your goals.

You could join forces with a few family members, friends, or neighboring farmers. Other possibilities include the local ag or science teacher, school groups, youth clubs like 4-H, or environmentally concerned townspeople. An agency staff person from the Department of Natural Resources, the Department of Agriculture, Cooperative Extension Service, the Natural

Resource Conservation Service, or the U.S. Fish and Wildlife Service could also be a valuable addition to your own "monitoring team."

Contact the Land Stewardship Project for help in linking up with others or forming a local monitoring group.

Be Prepared to Learn and Grow

Monitoring can expand your awareness of yourself, your family and community, your farm's resources, and the natural world. It can stimulate creativity and improve problem solving skills. And, it can make life more interesting and fun.

The process can also challenge your assumptions and expose weaknesses in your way of thinking or doing things. Be prepared for both sides of the coin and allow yourself to learn and grow from the experience.

Additional Resources

To further explore goal-driven management, whole farm planning, and general information on monitoring, use the resources listed below.

Publications

Many of the following can be obtained from your local library through the interlibrary loan system, or purchased through your local bookstore.

Holistic Resource Management, by Allan Savory. (Washington, DC: Island Press, 1988.)

One of the most comprehensive texts on holistic goal setting, planning, and decision making. A revised edition is due to be published in the fall of 1998.

Holistic Resource Management Workbook, by Sam Bingham with Allan Savory. (Washington, DC: Island Press, 1990.)

The practical companion to the *Holistic Resource Management* textbook. Contains a wealth of information on financial, biological and land planning and monitoring. Includes a number of useful forms and observation sheets. An excellent resource.

Permaculture: A Practical Guide for a Sustainable Future, by Bill Mollison. (Washington, DC: Island Press. 1990.)

A comprehensive, thought-provoking guide for working with nature to design and maintain permanent, agriculturally productive ecosystems that mirror the diversity, stability, and resilience of natural ecosystems.

The Fifth Discipline: The Art and Practice of the Learning Organization, by Peter M. Senge. (New York: Doubleday, 1990.)

Describes how to build learning organizations—organizations where people continually expand their capacity to create the results they truly

desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together.

The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization, by Peter M Senge, Art Kleiner, Charlotte Roberts, Richard B. Ross and Bryan J. Smith. (New York: Doubleday, 1994.)

A pragmatic guide to building a shared vision, reinventing relationships, team learning, being loyal to the truth, developing personal mastery, designing a dialogue session, and more.

The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change, by Stephen R. Covey. (New York: Fireside/Simon and Schuster, 1990.)

Presents a step-by-step, principle-centered approach for managing one's personal and professional life that gives one the security to adapt to change, and the wisdom and power to take advantage of the opportunities that change creates.

The 10 Natural Laws of Successful Time and Life Management: Proven Strategies for Increased Productivity and Inner Peace, by Hyrum Smith. (New York: Warner Books, 1994.)

Outlines of a view of management—whether of time, life, farm or business—focused on making sure daily activities reflect core values. Smith's "Reality Model" is particularly helpful for seeing the direct connection between beliefs and actions.

Whole Farm Planning: Combining Family, Profit, and Environment. (St. Paul, MN: Minnesota Institute for Sustainable Agriculture and the University of Minnesota Extension Service, 1998.)

A practical guide to doing Whole Farm Planning (WFP). Outlines the four action steps involved, including how to develop a vision for your farm. Describes several WFP tools and provides a visual comparison guide to show the strengths and weaknesses of each suggested tool. Also suggests resources to contact as you plan. (Available from U of MN Extension Service Distribution Center: 1420 Eckles Avenue, St. Paul, MN 55108-6069. Or, call (800) 876-8636 or fax (612) 625-6281. Ask for publication number BU-6985.)

Newsletters

Holistic Management Quarterly. Published by the Center for Holistic Management: 1010 Tijeras NW, Albuquerque, NM 87102. (505) 842-5252. E-mail: chrm@igc.apc.org; web site: www.igc.org/holisticmanagement. $25/year, 4 issues.

The Land Stewardship Letter. Published by the Land Stewardship Project (LSP): 2200 4th Street, White Bear Lake, MN 55110. (612) 653-0618. E-mail: Brian.A.Devore-1@tc.umn.edu; web site: www.misa.umn.edu/lsphp.html. $30/year, six issues.

The Whole Farm Planner. Published by the Minnesota Project: 1885 University Avenue W, #315, St. Paul, MN 55104. (612) 645-6159. Free; also available on the Minnesota Project's web site: www.misa.umn.edu/mnproj.html.

Organizations

Center for Holistic Management is nonprofit organization working to restore the vitality of communities and the natural resources on which they depend. The Center offers courses and resources in Holistic Management and helps communities and families practice goal-based planning and decision making. The Center can be contacted at 1010 Tijeras NW, Albuquerque, NM 87102 or by telephone at (505) 842-5252. E-mail: chrm@igc.apc.org

Land Stewardship Project (LSP) is a nonprofit, membership organization whose goals include fostering an ethic of stewardship for farmland, promoting sustainable agriculture, and developing sustainable communities.

LSP is committed to building upon the initial work of the Monitoring Project. For more information, contact any one of LSP's three offices:

Twin Cities office: 2200 4th Street, White Bear Lake, MN 55110. (612) 653-0618.

Southeast Minnesota office: 180 E. Main St., P. O. Box 130, Lewiston, MN 55952. (507) 523-3366.

Western Minnesota office: 103 W. Nichols, Montivideo, MN 56265. (320) 264-2105.

LSP also offers courses and workshops in Holistic Management throughout the upper Midwest and publishes a newsletter, *The Whole Enchilada*, on its Holistic Management activities. For more information, contact Audrey Arner at LSP's Western Minnesota office.

Other Minnesota organizations actively involved in whole-farm planning networks include the following:

Minnesota Department of Agriculture's Energy and Sustainable Agriculture Program (ESAP) publishes the annual ***Greenbook***, a compilation of innovative activities of farmers, researchers and educators involved in the Sustainable Agriculture Grant Program. A good resource for possible management ideas. For more information about the *Greenbook*, contact Prescott Bergh at 90 West Plato Boulevard, St. Paul, Minnesota 55107. (612) 296-7673. For information about the MNDA's whole farm planning work, contact Wayne Monsen at (612) 282-2261.

Sustainable Farming Association (SFA) has a number of local chapters in Minnesota. The SFA and other grass-roots farmer organizations such as Practical Farmers of Iowa are invaluable sources of information and support. These organizations have field days and workshops where

holistic farming approaches are presented and discussed. For the SFA chapter nearest you contact De Etta Bilek at RR1 Box 4, Aldrich, MN 56434. (218) 445-5475.

The Minnesota Project addresses a board range of environmental issues of concern to rural communities. These include sustainable agriculture and water quality, renewable energy development, community sustainability/small town planning development, river protection and advocacy, and sustainable forestry. The Minnesota Project can be contacted at 1885 University Avenue West, #315, St. Paul, MN 55104. (612) 645-6159.

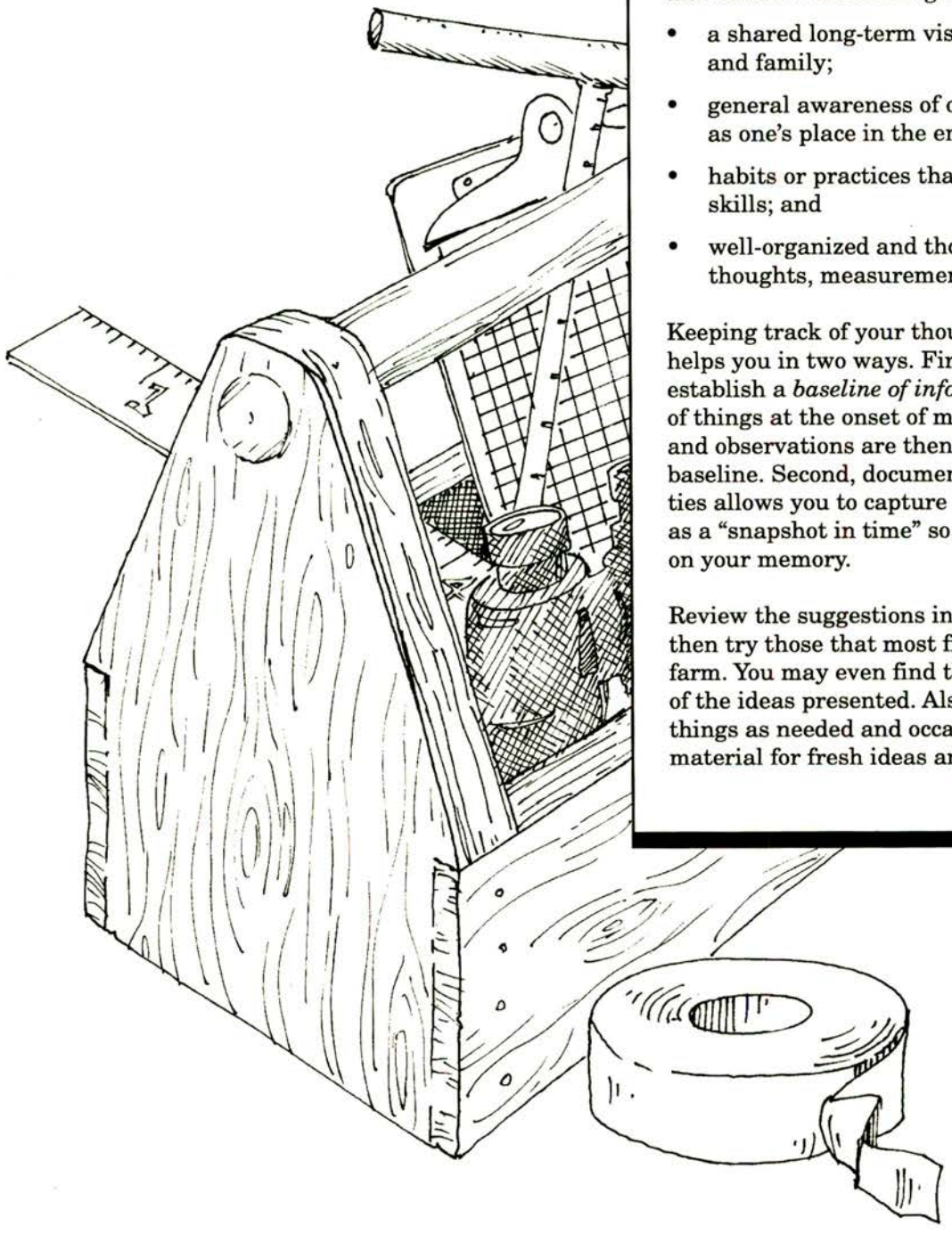
General Tools for Monitoring

The farmers of the Monitoring Project team found that effective monitoring is aided by

- a shared long-term vision or goal for your farm and family;
- general awareness of one's environment as well as one's place in the environment;
- habits or practices that enhance observation skills; and
- well-organized and thorough documentation of thoughts, measurements, and observations.

Keeping track of your thoughts and observations helps you in two ways. First, it enables you to establish a *baseline of information*, to see the status of things at the onset of monitoring. Future events and observations are then checked against this baseline. Second, documenting monitoring activities allows you to capture thoughts or observations as a "snapshot in time" so you do not have to rely on your memory.

Review the suggestions in this chapter carefully, then try those that most fit your style and your farm. You may even find that you already use many of the ideas presented. Also, feel free to modify things as needed and occasionally refer back to the material for fresh ideas and inspiration.



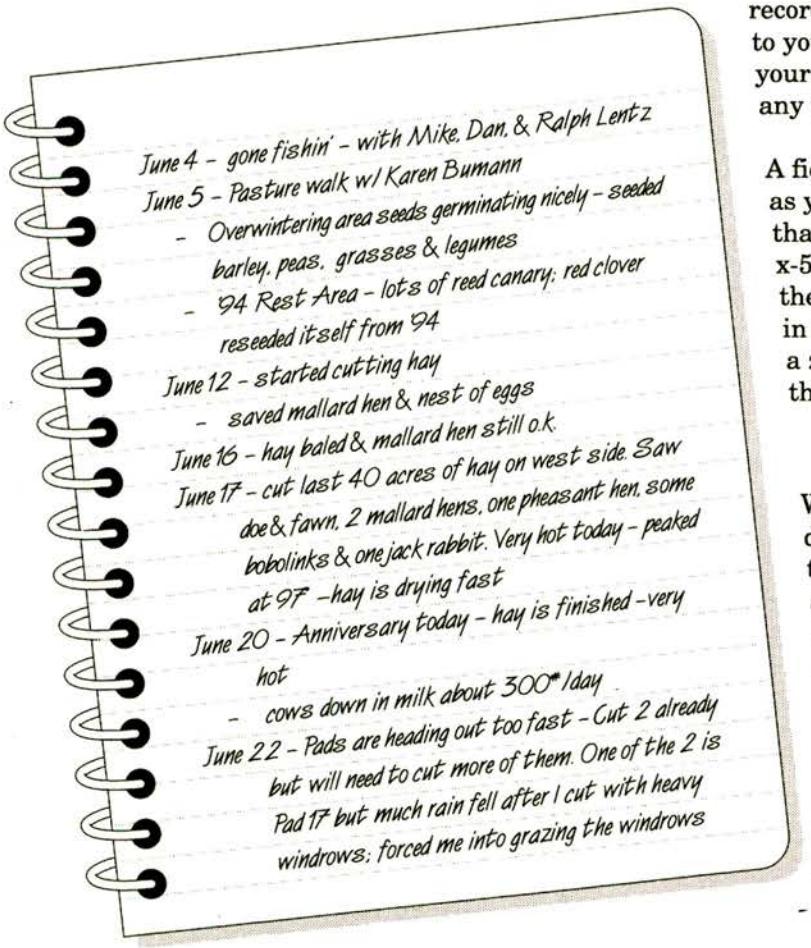
Documenting Tools

Chapter Contents

Members of the Monitoring Project Team found the following general tools very helpful for documenting monitoring activities.

Journals and Field Notebooks

Use a journal to record your thoughts and observations. A spiral bound notebook works well, or you can use a notebook specifically designed for journaling. The latter tends to have a hard cover and smaller pages than a spiral notebook and can be found at bookstores.



Keep your journal where it will remind you to record thoughts regularly, such as on the table next to your favorite chair, on your nightstand, or at your office desk. Jot down a few notes every day or any time something significant occurs.

A field notebook is a journal that can be with you as you do chores or walk around the farm. A size that is easy to carry around, such as a smaller 3-x-5-inch or 6-x-4-inch spiral memo pad, may be the best choice for this use. Stuff a pencil or pen in the spiral and carry it in your jacket pocket, in a ziplock bag on the 4-wheeler, or on the dash of the pickup.

Calendars

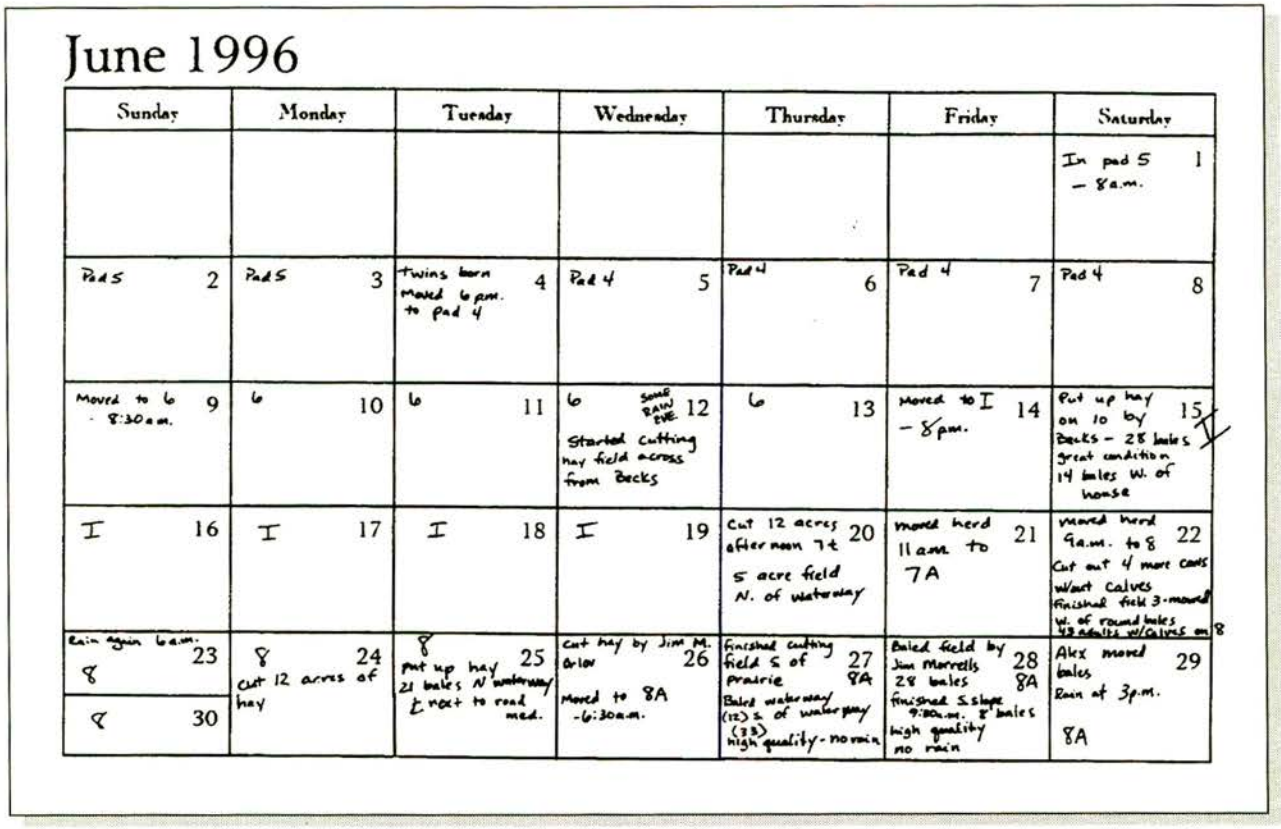
Wall calendars are a practical way of recording daily items such as rainfall or which paddock the grazing herd is in. Some folks record bird sightings directly on the calendar: "May 10 – first barn swallows seen." Kept for a number of years, calendars are a good way to review management decisions, weather records, or seasonal events.

Keep your monitoring calendar posted on the office wall or in the kitchen where you or other family members can note important events and observations. Use your journal to record more detailed descriptions of these events and observations.

Record Sheets

A well-designed record sheet can help capture a lot of information with a minimum of work or writing. Use record sheets in conjunction with a field notebook to capture additional information.

Most chapters of *The Monitoring Tool Box* contain record sheets related to specific monitoring activities. A master copy is included from which you can make copies at the local copy shop or library. Feel free to adapt these sheets to meet your needs or specific situation.



June 1996

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						In pad 5 1 – 8a.m.
Pad 5 2	Pad 5 3	twins born 4 moved 6 pm. to pad 4	Pad 4 5	Pad 4 6	Pad 4 7	Pad 4 8
Moved to 6 9 – 8:30 a.m.	6 10	6 11	6 SOME RAIN EVE. 12 Started cutting hay field across from Becks	6 13	Moved to I 14 – 8 pm.	Put up hay on 10 by 15 Becks – 28 bales great condition 14 bales W. of house
I 16	I 17	I 18	I 19	Cut 12 acres afternoon 7t 20 5 acre field N. of waterway	moved herd 11 am to 21 7A	moved herd 9a.m. to 8 22 Cut out 4 more cows w/out calves finished field 3 - moved W. of round bales 43 adults w/calves on 8
Rain again 6 a.m. 8 23	8 24 cut 12 acres of hay	8 put up hay 25 21 bales N waterway & next to road med.	cut hay by Jim M. 26 Arlow Moved to 8A – 6:30 a.m.	finished cutting field S of 27 prairie 8A Baled waterway (12) S of waterway (73) high quality - no rain	Baled field by 28 Jim Morrells 28 bales 8A finished S slope 9:30a.m. 8 bales high quality no rain	Alex moved 29 bales Rain at 3 p.m. 8A
8 30						

Computer Spreadsheets

Spreadsheets are computerized data programs made up of columns and rows that allow you to store information and show relationships between numbers. They make quick and easy work out of repetitive or complicated calculations, and of working up different planning scenarios. Examples include programs for financial planning and recordkeeping, and for enterprise or market analysis. Check with your local County Extension office or computer software store for available programs and their uses.

Charts and Graphs

Charts and graphs, either made by hand or with a spreadsheet, can show when events occur or track trends over time. Sometimes, visual images of observations or monitoring activities can be easier to interpret than numbers in a table. For example, a chart might be used to track non-renewable input costs (machinery, fertilizers, pesticides, energy) over time. Such a chart could point out progress in cost reduction, profitability, and sustainability.

Maps

Maps are a fun and useful tool for planning, recording changes, and documenting observations. A hand-drawn map can be used to identify landscape features, to show distances between objects, to site and find sampling locations, or to practice the non-satellite version of site-specific management. Use county topographical maps or soil survey maps to superimpose additional layers of information on your landscape drawing if helpful.

Photographs

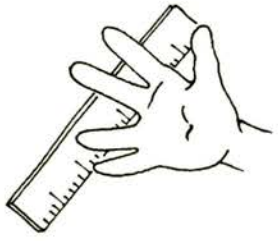
Photographs are an invaluable means of tracking changes over time and for capturing things that you might forget or not fully see at the present moment. Think of taking photographs to record intriguing events or unusual observations. Use them to tell a story.

Choose a good quality 35 mm camera, either the easy to use "point-and-shoot" kind or the single lens reflex (SLR) type, which allows you to switch lenses. Discount department stores carry many styles and brands of cameras at reasonable prices. If photography really interests you, visit your local camera store for more expert advice.

Buy good quality film, the right speed for the situation (indoor or outdoor), and use good quality processing. Also, work with the same processor and the same brand of film so you can make more accurate comparisons over time. Some film processing washes out colors, making it difficult to pick out features you saw in person. Try several film processors, compare pictures and stick with the one you like. And, different brands of film have different color characteristics; for example, Kodak has brighter reds and Fuji has brighter greens.

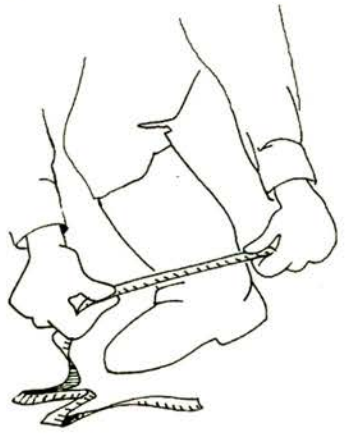
Other Equipment

Equipment such as binoculars and a magnifying glass can also facilitate observation. Binoculars bring you closer to objects that are best observed from a distance, allowing you to better identify characteristic traits. For up-close inspection, a hand-held magnifying glass often shows characteristics that help identify your subject and understand the structure or function of the details.



As you delve into the monitoring process, you may discover a need for other equipment to enhance your work. For example, some people find a flip chart stand handy for family goal-setting or monthly farm management meetings. Just be sure to weigh the cost of the equipment against the benefits it might bring to your monitoring work.

Natural Measuring Tools



Become familiar your natural measuring tools:

- the width of your outstretched hand
- the length of your shoe or boot
- the length of your stride
- the height (from the ground) to the top of your shoe, to your mid-calf, to your knee, and to your waist

These natural measuring tools can be used whenever you need to make note of size, height, and distance, especially when more specific measuring tools are not readily available.

Tips for Better Monitoring

The following tips can significantly enhance the quality and effectiveness of your monitoring activities.

Write Down Your Goals ✔

Monitoring your progress toward achieving your goals is much more effective if your goals are written down. Committing your goals to paper makes them clearer and more real and thus increases your ownership of them. Written goals also give you a tangible reminder of what is really important to you when making day-to-day decisions.

The following quote from *The Holistic Management Workbook* illustrates the importance of clear goals when creating a management plan, but it also hints at why having those goals written down is so helpful:

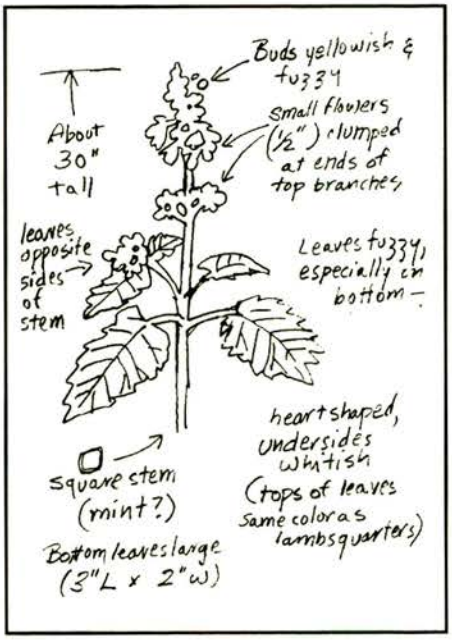
> A close family, creation or preservation of good land, public service, church work, education of your children, loyalty of relatives, and many other desires and duties all put demands on profit. If you do not have these things in mind when you plan your commitment of money and labor, you will make a plan that you will inevitably scrap the minute your higher goals demand it.
>
> On the other hand, clarity of goals will enable you to avoid temptations and opportunities of tremendous promise that nevertheless lead in the wrong direction—for you.
>
> "My neighbor is selling out. I could get a great deal on his hay machinery. Why not get it?"
>
> "The government has a cost-share program. Should I participate?"
>
> "My husband just won a trip for two to Maui. Should we go?"
>
> (Bingham and Savory, p. 4)

Take Good Notes ✔

Good note-taking is a big part of good monitoring. Keep the following suggestions in mind when jotting notes in your journal, field notebook, or on record sheets:

Be mindful of similarities and differences. For example: "Both birds had a red patch on the back of the head and a black and white ladder down the back, but one bird was bigger than the other."

Relate to something you know. For example: "August 1997: Very rainy. Pastures, usually brown and thin by now, are green and lush like during the spring flush in late May or early June."



Note identifying characteristics with sketches or detailed descriptions. This applies to weeds, grasses, other plants, birds, insects, soil texture and so forth. According to Vinson Brown in *The Amateur Naturalist's Handbook*, written observations and sketches build knowledge far better than just trying to keep what you see in your head. Look for these types of characteristics (not all will apply to every situation):

- color
- unusual markings
- size and shape
- feel or texture
- actions, time of activity, food source, growth pattern, reaction to stimuli
- abnormalities, diseases, pests, parasites
- voice, noise, sound
- location, physical and climatic features, soil characteristics
- relationship to other organisms or features
- time of day, time of year
- weather conditions at time of observation
- relationship to a weather event

Tell a Story ✔

If you see something that strikes your interest, try to understand and record it in the form of a story. Ask questions like these:

- What is happening?
- What does it mean?
- Why is it there?
- What other organisms are nearby?
- What are the dominant climatic features (shade, direct sun, cloudy)?

Working with another person can help you get a fuller sense of the story. Also, try thinking backwards to understand why something has occurred. Augment your story with information from books on nature, biology, geology, weather, and so forth.

Explore Your Farm ✔

Take a walk around your farm solely for the purpose of becoming more familiar with it. Explore niches through which you normally do not pass. Become aware of periods of maximum activity so you can catch blossoming wildflowers, nesting seasons, or bird migrations.

Improve your observation skills by inviting others—family members, friends, neighbors, other farmers, or resource people—to join you in your exploration. Also, learn to observe while you go about your daily activities; let this kind of "awareness" monitoring become second nature to you. Who knows what you might witness.

Look for Connections ✔

Learn to look for direct connections between management changes and their effects on the landscape, the environment, and on people, plants, and animals. Hone this skill by experimenting on a small scale. For example, forego mowing your road ditch and watch for changes in the plant community.

Apply this skill to the human or social components of your farm as well. For instance, note the effects of family goal-setting discussions on your children's interest in what goes on around the farm.

Additional Resources

Handbooks and Guides

The following offer general information on field observation and monitoring. These and many others are available at libraries or bookstores:

Holistic Resource Management Workbook, by Sam Bingham with Allen Savory. (Washington, DC: Island Press, 1990.)

The practical companion to the Holistic Resource Management textbook. Contains a wealth of information on financial, biological, and land planning and monitoring. Includes a number of useful forms and observation sheets. An excellent resource.

The Amateur Naturalist, by Gerald Durrell with Lee Durrell. (New York: Alfred A. Knops, 1982.)

An introduction to the naturalist's craft. What to look for and where, and how to interpret what you find. Takes you on walking tours of 17 different environments, from your own backyard to wetlands.

The Amateur Naturalist's Handbook, by Vinson Brown. (Englewood Cliffs, NJ: Prentice-Hall, 1980.)

A classic now revised and expanded to make all the outdoors your classroom. A comprehensive, but easy to understand introduction to the natural life sciences. Written especially for the amateur naturalist.

Through Minnesota's Seasons with Jim Gilbert, by Jim Gilbert. (Minneapolis: Minnesota Landscape Arboretum, 1987.)

A rich and varied book of observations on the changing seasons in Minnesota. Answers questions like "When is the best time to watch for meteor showers?," "Why do mosquito bites itch?," and "Why have bluebird populations declined?"

Journals

Several Monitoring Project members have been inspired by the following books, many of which are also available through your library. Most are the written record of seasonal events occurring on the farms and adjacent land of the author. These journals of observations and essays may also inspire you to become more aware of the seasonal changes around your home.

A Sand County Almanac and Sketches Here and There, by Aldo Leopold. (New York: Oxford University Press, 1949.)

> A classic by the famed naturalist and conservationist. A seasonal journal of Leopold's observations and musings on his farm in Sand County, Wisconsin, plus a number of insightful essays.

Birding from a Tractor Seat, by Charles Flugum. (Published by author and his son, 1973.)

> A compilation of Flugum's monthly columns written for *The Community Magazine* about his observations from the tractor seat on his farm near Albert Lea, Minnesota. (This book is out of print, but should be available through your local library.)

Explorations in the Ordinary: A Backyard Naturalist's View of Minnesota, by David Moffatt. (St. Cloud, MN: North Star Press, 1996.)

> Essays that remind the reader of things seen but too often forgotten.

Great Possessions: An Amish Farmer's Journal, by David Kline. (San Francisco: North Point Press, 1990.)

> A collection of essays, originally written for a column in *Family Life* magazine, showing how much activity occurs around the farm if one just takes the time to observe.

Natural Resource Agencies

Your local natural resource agency offices are also excellent sources of general tools and resources that can complement your monitoring activities. These agencies include the **Department of Natural Resources,** the **Natural Resources Conservation Service,** the **Cooperative Extension Service,** and the **U.S. Fish and Wildlife Service.**

Monitoring

Quality of Life

Farm sustainability not only requires concern for profitability and ecosystem health, but also for the quality of life of the people who live and work on the farm. When a farm family takes the time to talk about their values and to build a shared quality of life vision, they create a powerful base from which to achieve their personal goals and their goals for the farm.

What is It?

Monitoring quality of life begins with creating a vision of the quality of life desired by the whole family. Ideally this vision reflects each person's values and concerns. From there, simple tools are used to monitor the actions or behaviors needed to make this desired quality of life a day-to-day reality. This monitoring allows the family to make adjustments to both the vision and actions as needed.

Who Does It?

The entire family, including children, should be involved. You also may want to include others who regularly contribute labor or other assistance to the farm.

When?

Those tools that help the family create or revise its shared quality of life vision may only need to be used once or twice a year. The actual monitoring tools work well as monthly or weekly activities and can be part of your personal journal-writing time.

Time Required

Plan on three to four hours to complete the structured activities for creating a shared quality of life vision. Some individual preparation time is also required for these activities. How much time you give to making your vision a reality is up to you. Obviously, the more attention you give to it, the greater the likelihood of your success.

Materials and Cost

The main materials needed for the exercises include large sheets of paper and colored markers. You will also need to make photocopies of any worksheets you use. Twenty dollars should amply cover your costs.

Getting Started

CHAPTER CONTENTS

The introductory chapter, "Making the Most of Your *Tool Box,*" suggests that monitoring is best done within the context of clear whole farm goals that take into account the interrelationships between a farm's people, financial, and land resources. A good place to start identifying whole farm goals is to take into account quality of life considerations.

Like Beauty to the Beholder

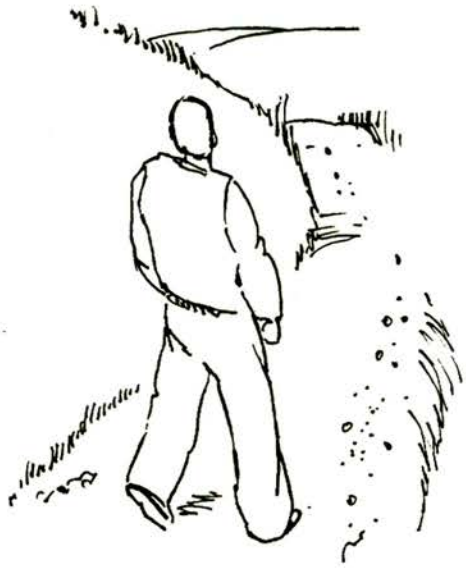
Quality of life considerations boil down to questions like the following:

- What are the most important things in life to each member of the family? What are their values, needs, desires, hopes, and dreams?
- What are the core beliefs, attitudes, and assumptions about life held by each member of the family?
- What is the communication, trust, and support climate within the family?

These questions reveal the personal, dynamic, and often challenging nature of quality of life issues. In the words of one of the Monitoring Project team members, "I think quality of life is like beauty to the beholder. It's different for each person and is shaped by the meaning one attaches to his or her everyday experiences." Thus, creating a quality of life vision that the whole family can embrace requires, among other things, a willingness to respect each family member's perspectives and needs.

Tools that give you and your family concrete ways to address these broad quality of life questions can ease this challenge to some degree. This is the goal of this chapter, and the tools offered fall into two categories:

1. tools that provide a framework for creating or revising a dynamic vision of the quality of life desired by the whole family, and
2. tools that provide simple ways to monitor how well your **desired** quality of life matches your **actual** quality of life on a day-to-day, month-to-month basis so that you can make the necessary adjustments along the way.



These tools take you through a process that moves from the broad to the specific, from identifying those values that are most important to you and translating those values into specific actions and behaviors that can be monitored.

Quality of Life and Whole Farm Goals

To link quality of life considerations with whole farm goals, you need to ask: How do all of the above (values, hopes and dreams, core beliefs, assumptions about life, the communication climate within the family, and so forth) influence the "make-up" of the farm and the way it is managed?

Quality of life questions, when answered honestly and without fear, can then be a creative springboard for shaping whole farm goals, helping to

- determine the best profit-producing enterprises and systems for the farm given the people involved;
- create a base of support for including "non-profit" components like flower gardens or wildlife reserve areas in the make-up of the farm; and
- influence the way the farm is managed so that each family member can contribute his or her talents and skills in ways that best serve the individual, the family, and the farm.

Full Family Participation

While full family participation is not required for monitoring soils or frogs and toads, it is of vital importance to formulating and monitoring quality of life.

Every family member's participation is necessary because no one person's values, desires, or beliefs can be assumed to represent those of the entire family. Each member of the family should be assured that their needs and concerns are taken into account. Family members may be more willing to actively participate in the process if they can see how they will directly benefit from it.

Ideally a climate of mutual support and respect permeates this process. Without such a climate, the quality of life concerns of individual family members are in danger of being ignored, frustrated, or undermined. Also, the process will work better if each person takes responsibility for their involvement in it: speaking up for themselves, honestly communicating with other family members, following up on plans or commitments, showing awareness of how their actions and decisions impact others, and so forth.

If considering quality of life issues appeals to you, gather your family together and explain to them why this topic interests you and why it is important for the whole family to participate. Share with them the tools offered in this chapter and ask who else would like to join you in a process of forming and monitoring a family quality of life vision. Together, decide which of these tools to use and develop a plan for how to proceed.

Neighbors, Community, and Quality of Life

Consider including the needs and concerns of your neighbors and your community when thinking about quality of life issues and whole farm goals. You might even consider getting together with your neighbors to talk about common concerns for the community. In the process you may discover ways in which you can help enhance each other's quality of life.

Tools for Creating a Quality of Life Vision

The following tools can help you and your family create a quality of life vision that reflects the concerns and interests of all members of the family.

Guided Discussions

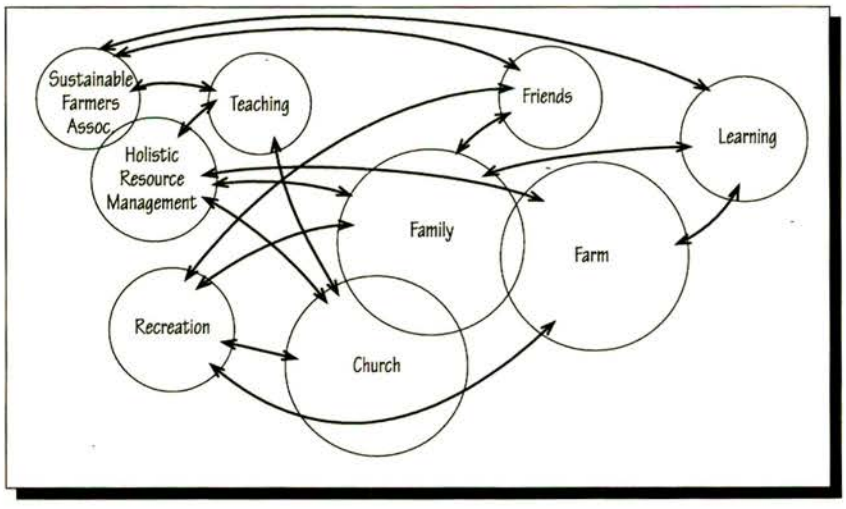
Guided discussions provide the family with a structured way to begin to address quality of life issues.

Use the Guided Discussion Questions worksheet provided with this chapter as a starting point for these family discussions. Make photocopies from the master provided and distribute a copy to each member of the family. In private, they should write down their answers and be prepared to share them with the rest of the family. Set a time when the whole family can come together for several hours and hold the discussion. For each question, allow each person to share their answer while everyone else listens. Then, open discussion on that question before going on to the next one.

You might consider asking someone from outside the immediate family—and with whom everyone in the family is comfortable, such as a local minister—to facilitate the discussion. A facilitator can help keep the discussion on track and create an atmosphere in which each member of the family feels free to contribute.

Values Diagrams

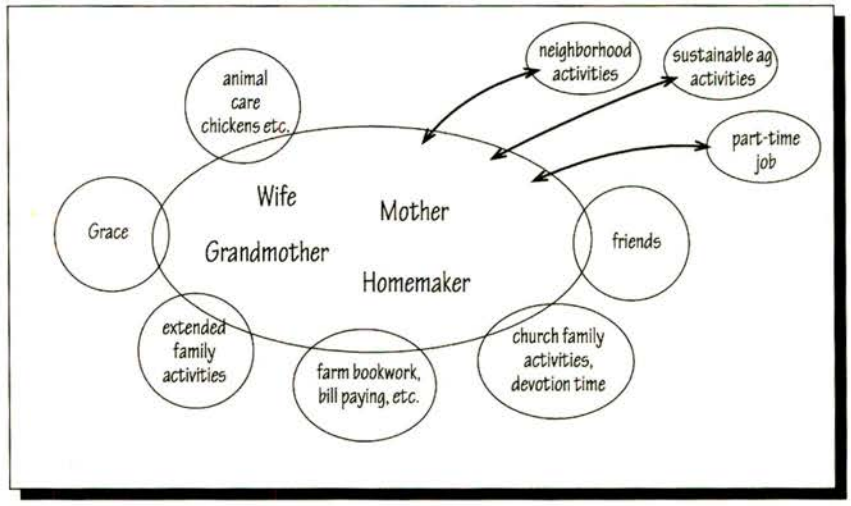
Values diagrams provides a visual complement to the guided discussions. This exercise focuses specifically on those aspects about life that you value most; it also gives you a way to see how you prioritize them and how they relate to each other.



Use the Diagramming Your Values worksheet provided at the end of the chapter for this exercise. Make enough photocopies from the master so that each family member has their own copy to complete privately. Then, come together and share your diagrams with each other. Feel free to ask questions of each other, such as "Why did you put that there?" or "Do you really value this thing more than that?" Let these discussions generate new insights and deepen your understanding of each other.

If you have young children who are too young to fully participate in previous two exercises, they can use a slight variation

of the Values Diagram. Instead of using words and circles, they can draw pictures of what they like about their life. Be sure to let them share their pictures with the rest of the family.



How to Build a Shared Vision

Throughout the process of discussing the guiding questions and sharing of your values diagrams, the family should pay attention to similarities and convergences, as well as differences and conflicts. These are the building materials of your shared quality of life vision.

Draft a Blueprint

Record these similarities and differences on large sheets of paper taped to the wall so that they can be easily seen by everyone. Then, on a separate sheet of paper, begin to draft a shared vision. Your written vision can be as detailed and descriptive as you like, or it could be as simple as an itemized list. Think of this written vision as you would a blueprint of a house. It is not "set in stone," but rather it gives you something to look at and play around with, something to change as needed.

Be Respectful and Creative

When building your shared vision, be especially mindful of finding respectful and creative ways to handle the differences and seeming conflicts in values between family members. Try to share any fears you might have and that could cause you to be defensive or distrustful. Within an atmosphere of mutual trust and support, the legitimate differences in values between family members need not be points of contention or conflict.

Make Periodic Revisions

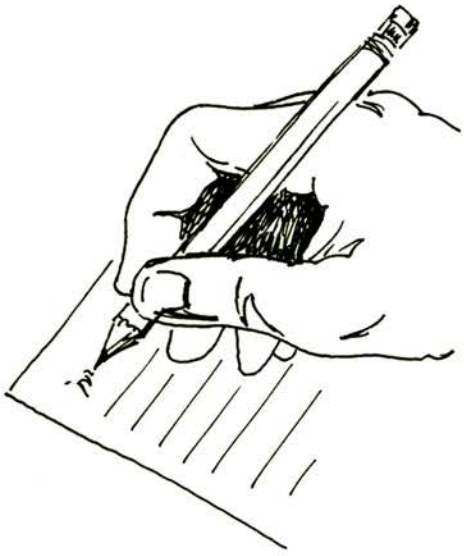
Visions, like the people who create them, are dynamic, changing realities. Periodically revisiting the above tools gives you a framework from which to adjust your quality of life vision to reflect the inevitable changes that occur within individuals, within family relationships, and in the situations and circumstances of the farm or in the community.

How often you hold guided discussions or diagram your values is up to you and your family. Many of the monitoring tools in the next section offer ways to keep quality of life questions and issues in the forefront of your day-to-day life. It is helpful, however, to take a look at the big picture at least once or twice a year; or when major changes occur, such as when a child heads off to college.

Tools For Monitoring Quality of Life

Monitoring quality of life is ideally something that becomes a regular part of your daily consciousness. If one pays attention, day-to-day life can reveal valuable insights and information, further clarifying what you really want in life and how to best achieve it.

Use the following tools to help you make your quality of life vision a reality and to keep track of your efforts.



Values-in-Action

One effective way to monitor your quality of life is to pay attention to how closely your professed values (what you say is important to you) match your "values-in-action." If, for example, you say that you really would like to see your children take over the farm when you retire, but do not take this into account in how you structure the farm or make provisions for it in your estate planning, your actions contradict your words. This kind of discontinuity can weaken the integrity of your quality of life vision.

A structured way to check for continuity between your stated values and your actions is to first list your values in your journal and then, give two or three concrete examples of ways you currently act on these values. If you are not currently acting upon a particular value, jot down ideas on how you could act upon it or reexamine that value to determine whether or not it is truly important to you. Also, consider if you regularly do things that go against any of your professed values. Describe these actions, the motivating factors behind them, and what you could do to change this situation.

Do this kind of self-examination from time to time to keep tabs on yourself. You might also consider asking for feedback from friends or other family members about the relationship between your professed values and your values-in-action. They may have a clearer perspective on the situation than you.

Beliefs and Assumptions

Core beliefs and assumptions about life play a big role in creating the day-to-day reality of life. In fact, the contradictions between professed values and values-in-action often have their origins in one's underlying beliefs or assumptions.

For example, the reason why you might not do the planning necessary to ensure that your children can take over the farm could stem from the fact that deep-down, you believe there really is no future in farming and that your children would probably have a better life off the farm. And so, while you might really want them to continue the farm, your belief is that it not in their best interest to do so. Your actions reflect your beliefs, not your values.

If you encounter a situation or issue in which your desired outcome does not match reality, examine the beliefs or assumptions that might be

influencing the situation. These may be your own or those of someone else in your family. Ask, Does this belief or assumption really support my (or our) goals or needs? If not, get creative and come up with an alternative belief or assumption that you can fully embrace and that will achieve what you want. A willingness to examine beliefs and assumptions can make a big difference in whether or not you actually achieve the quality of life you desire.

Quality of Life Objectives

Objectives are clear-cut, positive, and measurable actions that transform visions into reality. Setting and meeting specific objectives is another powerful tool for creating your desired quality of life. And, because objectives are measurable, they also serve an important monitoring function. By keeping track of your compliance with these objectives, you give yourself a concrete way of gauging the level of commitment you bring to your quality of life vision.

Some Examples

Quality of life objectives fall into two categories: the objectives of the family as a whole, and the personal objectives of each individual family member. Here are some examples of both:

- spend one whole Sunday a month together as a family
- read to my young children every day
- show our support for our children by attending all school concerts, programs, and home ball games
- talk one-on-one to each parent at least once a week
- devote a half-hour to prayer and reflection every morning
- take my wife out on a date at least once a month
- take a two week family vacation every year
- play with my younger brother at least three times a week
- help my husband with chores every Saturday morning
- straighten up the house everyday after school before Mom comes home from work
- participate in at least two major "career development" activities a year
- meet as a family once a month to address quality of life concerns

On photocopies of the Quality of Life Objectives worksheet provided with this chapter, list your objectives and keep track of your efforts to meet them.

A Supportive Environment

Obviously, the whole family must be committed to those objectives that apply to everyone, like spending one Sunday a month together. But it is also very important for family members to be supportive of each other's personal objectives.

While the person who sets a personal objective is ultimately responsible for its achievement, other family members should make sure their actions and attitudes do not create a negative environment, or any other obstacles, for that person. This means not judging, dismissing, laughing at, or putting down each other's objectives. And, it means offering willing cooperation when necessary, such as when creating schedules and plans.

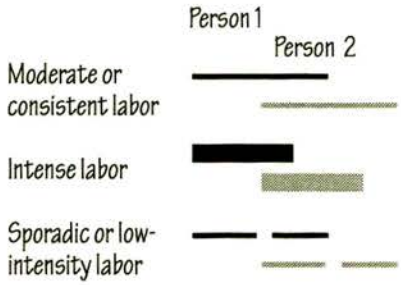
A Family Activities Calendar

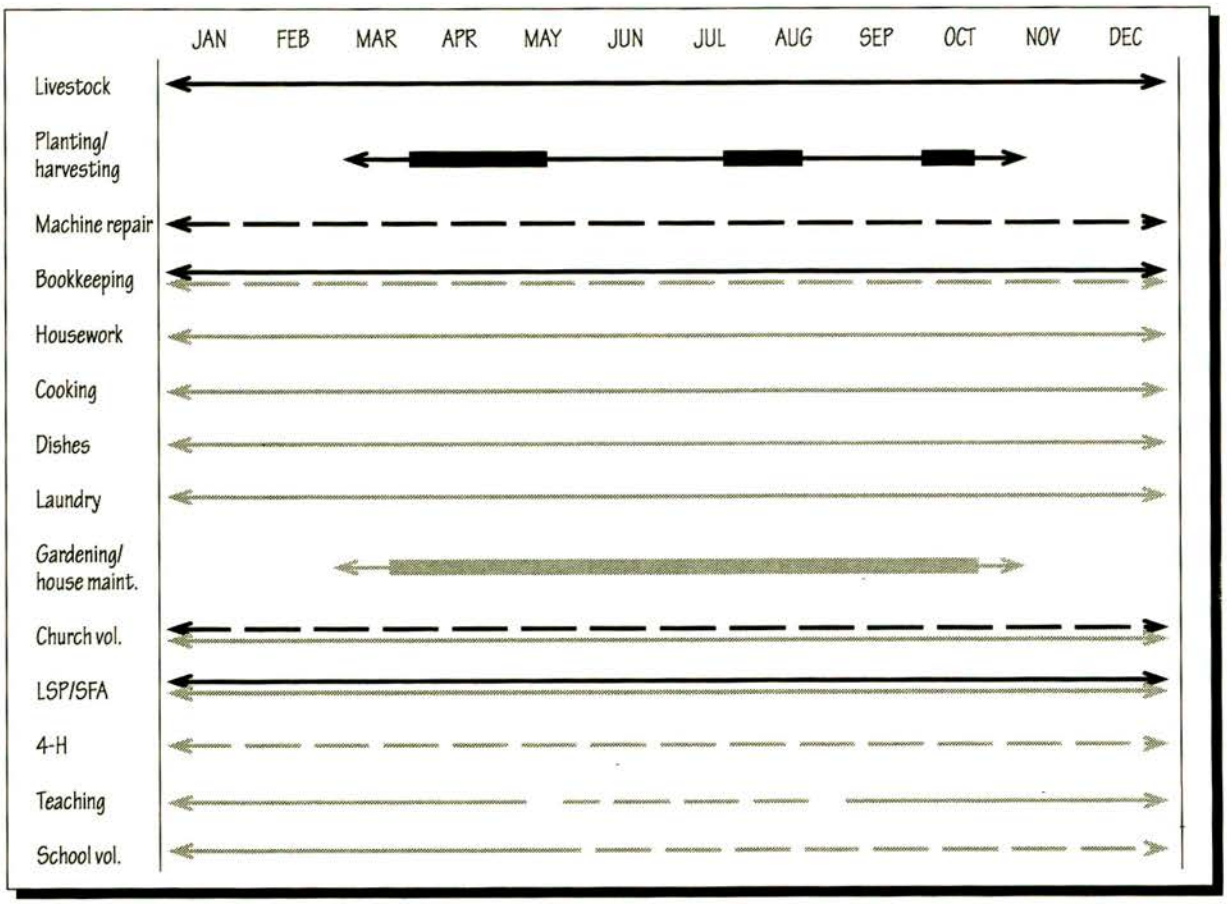
Another useful way for families to get at the question "Do our daily activities reflect our desired quality of life?" is to put together a "family activities calendar" that lays out all the major activities of each family member throughout the year. To do this exercise, see the instructions sheet provided at the end of this chapter.

How It Can Help

An activities calendar can help you make your desired quality of life a day-to-day reality by:

- providing everyone with a clear—and sometimes eye-opening—picture of what each family member does, when, and at what intensity level;
- revealing differences in workloads or activity levels between family members and serving as a springboard for renegotiating who does what and when;





- helping you spot stressful "crunch times" in advance and giving you an opportunity to come up with plans that could help lessen the stressfulness of these times;
- showing you whether or not you are actually allocating time to those things you claim are important to you; and
- helping you to more effectively make adjustments when unexpected occurrences such as accidents, illness, or opportunities come along.

How to Use It

The first time you do this exercise, plan on making two calendars. Your first calendar will show the current way family activities are distributed. More than likely, this will reveal some problem situations. If this happens, get creative and play around with things until you can come up with a calendar everyone feels good about.

Revise your family activities calendar annually, such as at the New Year or at the beginning of each school year. And, hang it in a location that everyone has easy access to it. You may even want to look at it together at the beginning of every month just to refresh your memory of upcoming activities or to make any necessary adjustments.

Additional Resources

Publications

In addition to the following publications, also refer to those listed in the introductory chapter, "Making the Most of Your *Tool Box.*" Most of the publications can be obtained through your local library or purchased from your local bookseller.

Rut Buster: A Visual Goal Setting Book, by Wayne and Connie Burleson. (Absarokee, MT: Sloping Acre Publishing Co., 1994.)

Offers a step by step process for identifying your basic values, desires, strengths, and weaknesses; developing a word picture of who you are and where you want to go; and dealing with the roadblocks that get in your way. This book can be obtained directly from the publisher at R.R. 1 Box 2780, Absarokee, MT 59001; 406-328-6808.

Living the Simple Life: A Guide to Scaling Down and Enjoying More, by Elaine St. James. (New York: Hyperion, 1996.)

The author uses short snippets from her life and the lives of others to present a number of strategies for focusing on activities that bring you the most satisfaction and enjoyment.

The Table Where Rich People Sit, by Baylor Byrd. (New York: Scribners, 1994.)

An illustrated book for all ages that tells the story of a young girl's discovery that her family is rich in things that matter most in life.

Your Money or Your Life: Transforming Your Relationship with Money and Achieving Financial Independence, by Joe Domingues and Vicki Robin. (Penguin Books, 1992.

A thought-provoking, practical book that outlines a nine-step program for transforming how one thinks about, earns, and spends money. Addresses questions like, "Does your job reflect your values?" and "Is your life whole? Do all the pieces—your job, your expenditures, your relationships, your values—fit together?"

The Cornerstones Model: Values-based Planning and Management, by Jerry Aaker and Jennifer Shumaker. (Little Rock, AR: Heifer Project International, 1996.)

Based on fifty-three years of livestock development experience in rural communities, this book combines visioning with planning and provides tools for a holistic, participatory approach to change.

Organizations

Quality of life considerations are an important part of Holistic Management, which is discussed in more detail in the introductory chapter, "Making the Most of Your *Tool Box.*" To learn more about Holistic Management, see to the references for the **Center for Holistic Management** and the **Land Stewardship Project** listed on page 13 of that chapter.

The **Center for Leadership Development** and **Kennedy Consulting, LLC** of Denver, CO provide a broad base of services geared toward helping family businesses ensure long-term sustainability, increased profitability, improved communication and relationships, leadership development, effective long-range business planning, and appropriate financial, estate, and succession planning. For more information, contact Don Green at Kennedy Consulting: 6890 S Tucson Way, Suite 200, Englewood, CO 80112. (303) 790-2416. Or, visit their web site at www.kcoe.com/kconsult.

Learning Strategies Corporation of Minneapolis, MN provides a variety of self-development tools that can enhance a person's efforts to achieve his or her life goals. For a catalog or more information, write to the Learning Strategies Corporation at 900 E Wayzata Blvd, Wayzata, MN 55391-1836; or call (612) 476-9200 or 800-735-8273.

Monitoring Quality of Life

Guided Discussion Questions

In your journal, write down your answers to the following questions and be prepared to share them with your family members. Feel free to skip those that do not apply to you, or simply rephrase them so that they do apply to you.

1. List three things that you really like about your life right now and why.

2. List three things about your life that you would like to change and why. What would need to happen in order for the changes to occur? Are you willing to do what it takes to bring about these changes?

3. Identify three skills or qualities that you have and briefly describe how these contribute to your family, farm, or community.

4. Pick out three skills or qualities you appreciate in your spouse, child, parent, grandparent, closest friend, or hired person. Explain why you value these in this person.

5. Describe what you would like to be doing five to ten years from now. Identify the changes that would be necessary to bring that life to reality.

6. Summarize the biggest change in your life or on your farm in the last three to five years. How did that change affect you? Your spouse? Your children? Your parents? Your siblings? Your friends? Your hired help? Your neighbors?

7. Describe at least one major change you know will occur in your life or on your farm in the near future. How do you feel about this change? What can you do now to help prepare for it?

8. Name the three people with whom you most frequently discuss life decisions or decisions affecting the farm. Briefly tell why you turn to these people.

9. List your favorite school, work, or farm activities and why you like to do them.

10. What do you most like to do away from school, from work, or from the farm? Specify how these activities add to your quality of life.

11. If you could change one thing about your farm, what would it be and why? Do you see this change as actually being possible? What would need to happen to make it so?

12. Answer the questions that apply to you:

    a. How do you feel about passing the farm on to your children or grandchildren? Why?

    b. How do you feel about the possibility of taking over the farm from your parents or grandparents? Why?

    c. If either of the above is something you desire, what needs to happen or change in order for you to achieve this goal? Address specific issues, such as money and estate planning needs; family relationships and communication patterns; the land base, its size, location, and ecological condition; preferred profit-producing enterprises and farming systems; and so forth.

13. Describe your community as you would like it be for yourself as an adult, or for your children or grandchildren. What services, opportunities, and people are needed to make it a good place to live?

14. Address any other quality of life issues of concern to you that are not covered by the above questions.

Monitoring Quality of Life

Quality of Life Objectives

Name _____ Month/Year _____

Record your quality of life objectives below and keep track of your actual completion of these objectives. When appropriate, note any reasons for differences between what you planned and what you actually did. List your objectives in order of frequency: daily, weekly, monthly, and yearly; or use a different record sheet for each of these categories. Use as many record sheets as you need for all of your objectives.

Objective: _____

Actual: _____

Difference: _____

Objective: _____

Actual: _____

Difference: _____

Objective: _____

Actual: _____

Difference: _____

Objective: _____

Actual: _____

Difference: _____

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Actual: _____

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Difference: _____

Objective: _____

Actual: _____

Difference: _____

Objective: _____

Actual: _____

Difference: _____

Objective: _____

Actual: _____

Difference: _____

Monitoring Quality of Life

Diagramming Your Values

Read through the following instructions before proceeding with the exercise. Once you have completed steps one and two, gather with your family members to share and discuss your diagrams.

1. List the things or ideas that are most important to you in your life (for example: leisure time, church activities, nature walks, motherhood, financial security, exploration, a clean house, and so forth):

2. In the space below or on a separate piece of paper, create a diagram using circles or other geometric shapes that visually describes the interrelationships between your values. Follow these guidelines as you create your diagram:

   a. Use different sized shapes to indicate the relative importance of each value; for example, enclose your most important values with the largest shapes.

   b. Arrange the shapes in a way that best shows how you see the interrelationships between all the different things you value. For example, overlapping circles might indicate a close interaction between two or more values; distance between circles might mean that the values have little to do with each other.

   c. Arrows or some similar device can also be used to indicate relationships between your values.

   d. Let go and let your imagination guide you!

Instructions for the Family Activities Calendar

This exercise requires the following materials:

- several large pieces of paper
- a black marker for general information and activities that involve everyone
- a different colored marker for each family member
- masking tape

1. In the upper right-hand corner, make a key indicating which color belongs to which person. Then, write out the twelve months of the year across the top of the paper in black. Be sure to start far enough to the right to leave space along the left hand side of the paper for the activities column.

2. On a separate sheet of paper, brainstorm a list of all the principal activities family members engage in throughout the year. Be specific and include all farm-related activities, recreational and personal activities, household chores, educational commitments, volunteering and community involvement activities, joint family activities, and so forth. Make sure everyone's activities are represented in this list before proceeding.

3. List all of the labor activities vertically on the left-hand side of the calendar with the black marker.

4. For each activity, fill in across the months of the year when the activity is performed using the color marker of the person who does it. If more than one person engages in a particular activity, you will have several lines in different colors for that activity. Or you may have a single line consisting of different colors if a different person does that activity at different times of the year.

   Also, classify the level of intensity for each activity using the following key:
   - thick line = heavy or intense activity level
   - light line = consistent or moderate activity level
   - broken line = low or sporadic activity level

5. Put the completed calendar on the wall or in a spot where everyone can see it. Concentrate on the patterns of the colors and lines. Discuss what you see:

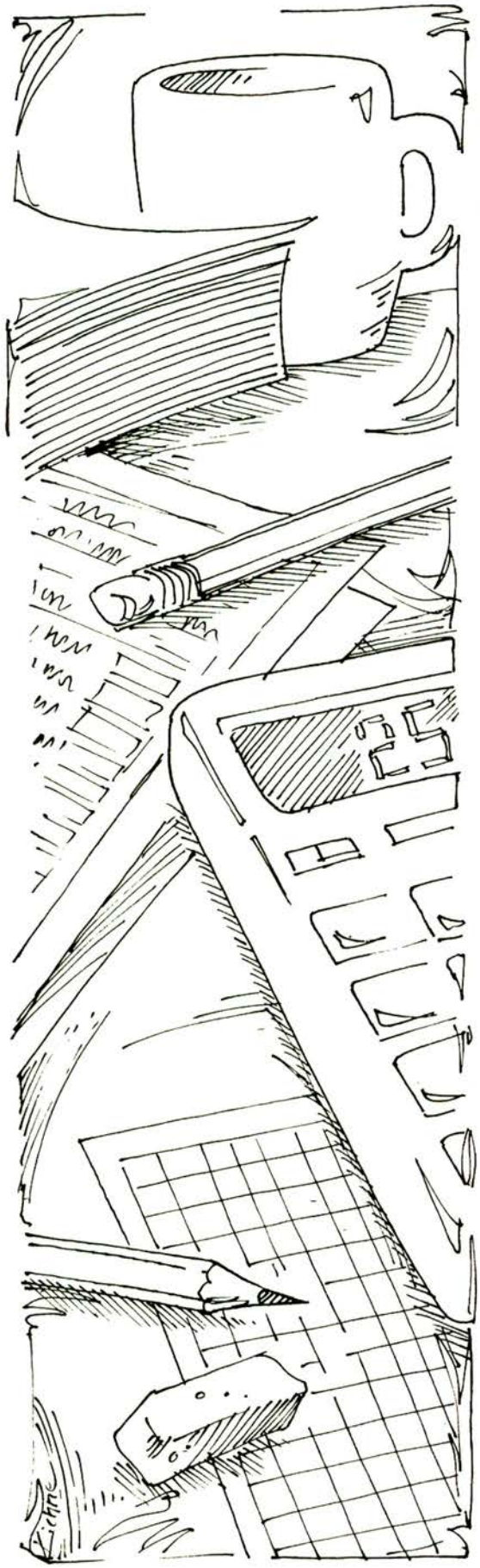
   - What differences does this calendar reveal in the way different family members mentally divide the year? For example, do some members think in terms of the school year while other think in terms of the growing season?

   - Does the calendar reveal any major discrepancies in terms of who does what or when? How do you feel about these discrepancies? What changes could be made to even things out more?

   - Do you spot any other problems, such as too many activities being bunched up at one time or major conflicts between the activities of several people? Again, work with each other to come up with an agreeable solution.

   - How does this big picture of how the family members allocate their time correspond to the shared quality of life vision you have created?

6. If necessary, create a second calendar that seems workable and with which everyone is comfortable.



Monitoring

Farm Sustainability with Financial Data

Determining the sustainability of your farm means looking beyond maximizing profits, the traditional measure used by agricultural economists. If maximizing profits is your only guide, you will miss the larger picture of quality of life, environment, and community. The materials presented in this chapter provide you with a way to see how well your farm supports this larger picture.

What Is It?

Monitoring farm sustainability with financial data involves the use of a simple worksheet and information from common financial statements to measure your farm's progress in four areas: 1.) reliance on government programs; 2.) use of purchased inputs; 3.) creation of local jobs; and 4.) balance between feed use and feed production.

Who Does It?

The worksheets are geared primarily for use by individual farmers or farm families.

When?

The worksheet should be completed once a year, as part of your annual financial planning process or after tax reports and financial statements are completed.

Time Required

Once the usual financial statements and tax reports are complete, filling out the worksheet should easily take less than an hour.

Materials and Cost

A master copy of the worksheet is provided with this chapter; your only cost will be to make photocopies of this master.

Some Background Information

CHAPTER CONTENTS

The following material was first published by the Land Stewardship Project as a report entitled *Monitoring Sustainable Agriculture with Conventional Financial Data* by Dick Levins, a professor and extension agricultural economist from the University of Minnesota and a member of the Monitoring Project team. The impetus for Dick's development of this material came from a discussion he had with the Monitoring Project farmers on what they mean by profit, how they measure profitability, and what planning methods have been most useful to them.

Here is Dick's recollection of this conversation:

> These farmers seemed as interested as any other group of farmers in making sure their operations were profitable. But as we talked, a picture of profit that went beyond dollar signs came into focus.
>
> Return on assets is a common guide to financial performance, but not for these farmers. Each of them agreed that farm income should be enough to cover debt payments and make some progress toward getting out of debt altogether. Bills should be paid, the need for off-farm income should be minimized, and a farmer should not be relying on inventory sales or depreciation to get by. Maximizing income took a back seat, however, to a delicate balancing act that includes quality of life, environment, and long-term goals for land and community. In this balancing act, making enough money was a better guide than making as much as possible.
>
> The farmers agreed that keeping track of certain expenses was an essential part of tracking profit. Accurate, honest figures were essential. Veterinary costs, feed costs, and custom hire costs came up often in our discussions. One of the farmers was using the computer program Quicken to track his expenses and, after one year, found the method not only useful but fun.
>
> The bigger questions of measuring profit were most often addressed in a more general way:
>
> - Was our family able to do what it wanted to do?
> - Was there enough money and time?
> - Did the debt level increase?
> - Were the bills being paid?
> - What about inventories, were they up, or down?
>
> If the answers to these questions were favorable, the farmers were inclined to consider the last year a profitable one. A farmer who was profitable would likely have a gut feeling that things were going in the right direction and that progress was being made. Some of this satisfaction might come from the bottom line of a conventional accounting statement, but some of it might not.

The contents of Dick Levins' report follow.

The New Indicators

I am proposing four indicators that, along with farm profits, can be used to evaluate the sustainability of farming operations. The indicators are:

1. reliance on government programs;
2. use of equipment, chemicals, and non-renewable energy;
3. creation of jobs; and
4. balance between feed use and feed production.

Why these indicators, and not some others? For one thing, these indicators lend themselves to being easily calculated from financial numbers farmers already have on hand. There are many other reasons, too, that are explained in this chapter.

Reliance on Government Programs

President Kennedy's farm advisors faced a huge problem—how could they control the cost for government farm programs? That was a generation ago, and every president since has struggled with the same problem, only on a grander scale. Kennedy's three billion dollar dilemma would have looked very good to Reagan's advisors and the 20 plus billion they were trying to justify each year in the mid-1980's! As this is being written, Clinton and a Republican Congress are squaring off over exactly the same problem.

An entire generation of farmers have come to see government subsidies as an essential part of many types of farming; however, a fully sustainable system of farming should not require this type of continual assistance. The first indicator in the system therefore measures the extent to which a farm is indebted to the taxpayers for its survival. This indicator can also be useful in helping the public see what kind of farming they are choosing to favor with special payments.

Use of Equipment, Chemicals and Non-renewable Energy

A quick look at almost any farm balance sheet will show you that chemicals, fertilizer and machinery are "assets." The chemicals and fertilizer usually show up as "current assets" and machinery is a big chunk of the "intermediate assets." In a recent year, the balance sheet for US agriculture as a whole showed these assets as having a value of slightly more than $85 billion.

The history of US agriculture in the twentieth century has generally been one of people being replaced by assets such as these. It has also, more recently, been one of environmental problems resulting from the use of these assets. So how do things that eliminate farming jobs and harm the environment come to be worth $85 billion?

The answer lies in another question: who are these assets serving? The type of farming that used these assets in 1991 paid $19 billion for petroleum based inputs, $6.9 billion for repair and maintenance, $6.8 billion in non-mortgage interest, and $17.3 billion in wearing out machinery and buildings. Non-farm, largely non-local, corporations have generously agreed to help farmers do their jobs in exchange for $50 billion per year. These may be expenses to farmers, but they are income to those who furnish the assets.

The level of expenses used by such "assets" is one indicator of how willing a farm is to share its income with non-farm corporations. Expenses accounted for by chemicals, commercial fertilizers, and gas guzzling equipment are also a measure of how a farm is interacting with the environment. When measuring sustainable agriculture, the rule here must be "the less, the better."

Creation of Jobs

Everyone has heard stories about how many people can be fed by the work of a single farmer. The down side of this is that economic activity at the farm level employs virtually no one.

Too strong a statement? According to a recent report, the average farmer in southeast Minnesota spent $252,942 during 1993. Of that money, less than $7,000 went for hired labor. A quarter million dollars of economic activity supported the operator's family and less, much less, than one other local family.

The average farmer spent over three times as much for interest than for hired labor. He or she spent over three times as much to lease land and equipment than for hired labor. He or she spent over three times as much on machinery and equipment purchases than for hired labor. He or she spent over three times as much for fuel and repairs than for hired labor. And he or she spent over three times as much for fertilizer and chemicals than for hired labor.

On the national level, the numbers are much bigger, but the story is much the same. Total production expenses for agriculture nation-wide were $141.3 billion in 1991. Hired labor, counting wages, benefits, and contract work, accounted for $12.6 billion, about nine percent of the total expenses. For comparison, interest claimed $13.5 billion. Equipment and machinery replacement cost $15.7 billion. Fertilizer, lime and pesticides expenses were $13.7 billion. Even the $7.9 billion bill for energy in the form of petroleum and electricity wasn't that much smaller than what non-operator labor was paid.

During the process of converting our farms from labor users to equipment and chemical users, millions of operators were "freed up to seek jobs elsewhere," as the economists like to say. There were 5.6 million farms in 1950 and only 2.1 million in 1991. Even with 3.5 million more operators on the land, farms in total spent 15 percent of their expenses on hired labor in 1950. That number is down to nine percent today.

This is no problem for economic theory. People, pesticides and plows are generic "factors of production." Each must submit to the same profitability test: marginal revenue must exceed marginal cost. Each must pay its own way, but only in terms of those things we choose to measure in dollars. Communities and environment, unfortunately, don't make the list.

What are we to make of such an agriculture? Is it one that is a marvel of efficiency in labor use? Or is it one that is a massive engine for generating rural unemployment? Which view you take has a lot to say about which economic indicators you use to measure a farm's performance.

Providing a living for a local family is something good, not something to be avoided. Whether the job is in the farmer's family or in someone else's family is not important as far as this indicator goes. The part of farm income that is directly available to local families is a number that should be maximized, not minimized, to the extent a farmer can remain consistent with his or her other goals.

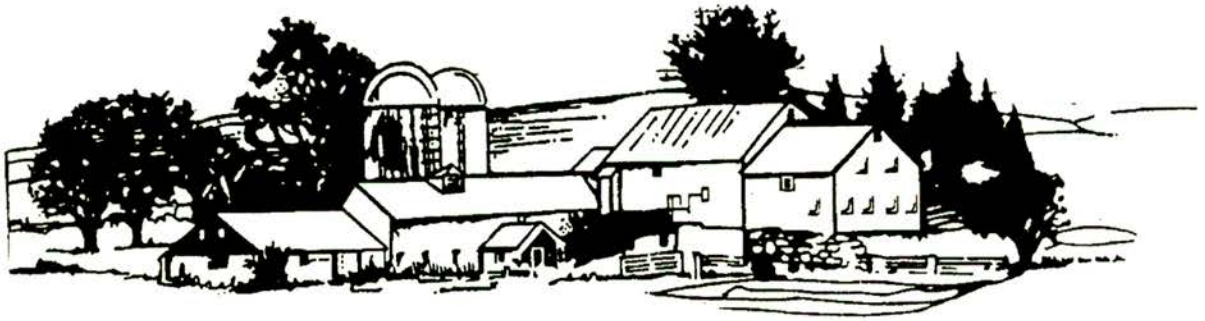
Balance between feed use and feed production

One of the biggest transformations in American agriculture has been that farmers, as a group, have decided to spend their lives waiting hand and foot on livestock. Farmers routinely grow feed, harvest it, bring it to animals who live indoors with absolutely nothing to do, pick up the manure, and carry it back to the fields so they can grow more feed.

Working like a dog (or more properly, like a cow or pig) is hardly satisfying, so farmers start looking for ways around it. Some buy 100-horsepower tractors to pull manure spreaders while that much horsepower, and more, is in the animals they are keeping on welfare. Others decide to "specialize" and grow only feed or only livestock. Then where to put manure becomes a major problem, and any chance for the animals participating in the production and harvesting of their feed is gone for good.

Pulling plows with mules is not the only way to put farm animals to work. Animals can break ground with their hooves. They can harvest feed by grazing. They can spread manure by walking on the fields where manure is needed to replenish nutrients and build up soil structure. All of this is possible, but only if the animals live where their feed is grown.

There is another problem, too, when feed production and use are out of balance. A farmer buying feed has little or nothing to say about how the land upon which that feed is grown is being treated. Conversely, a farmer selling feed has little or nothing to say about how the animals which consume it are treated.

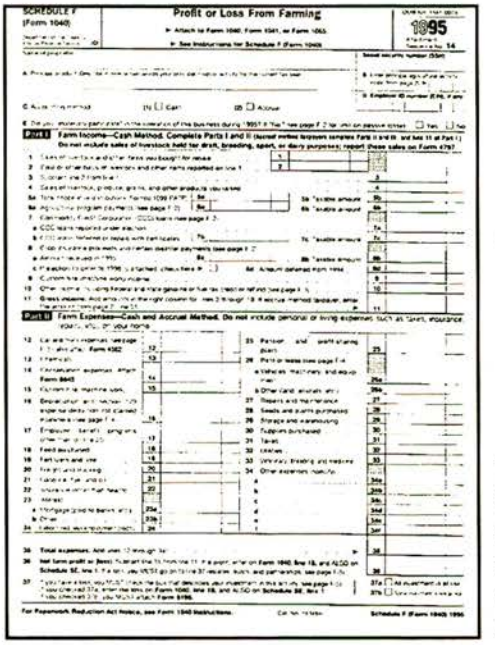


How to Calculate the Indicators

The worksheet at the end of this chapter can be used in a simple, straightforward way to calculate the indicators I am proposing for evaluating a farm's sustainability.

Sources of Numbers

The worksheet has been designed so that a farmer can do all the analysis from income and cost categories normally used on tax forms. This is not to say you should necessarily use the exact numbers on the tax forms, but at least the categories should be familiar.


SCHEDULE F (Form 1040) — Profit or Loss From Farming — 1995

The reasons you may not want to use the actual numbers on tax forms relate to the various purposes for which you are using the numbers. For example, over the years the government has helped many farmers pay for bigger and fancier equipment. The way it does this is through depreciation bonanzas of one sort or another. The more depreciation the government allows you to claim, the less you will have left to pay taxes on. But the high depreciation does not necessarily indicate how much your equipment and buildings are actually being used up in production during the year.

If you have a good set of farm records, they should certainly be used. Otherwise, work from your tax reports and be careful. To avoid the biggest pitfalls in working from tax records, check the following things before using them.

- Income should be for crops and livestock produced in the tax year. If you sold grain from last year, for example, you should adjust your numbers accordingly.
- Expenses should only be for the crops and livestock produced in the tax year. If you prepaid feed or supplies for next year, this is one of the adjustments you will need to make to get everything to match.
- Depreciation on machinery and buildings should be an accurate reflection of the degree to which those items were actually used up during the year.
- If you sold breeding livestock during the year, it will be on Form 4797 instead of on Schedule F. It is income, nonetheless, and it should be included in the Gross Income figure you use in the worksheet.
- If you decide to make any changes on your tax numbers, make sure you recalculate net income so it will be consistent with the changes you have made.

These adjustments should be easy enough to make, and then there is only a matter of copying some numbers onto a form, adding them up, and doing a little division here and there.

Worksheet Calculations

The first section of the worksheet determines what part of gross farm income is from government payments. There is only one calculation to make: divide Agricultural Program Payments by Gross Income.

The next group of numbers is a general indication of how your way of farming uses chemicals, machinery, and non-renewable energy. The expense categories listed here are Chemicals; Custom Hire (machine work); Depreciation on Equipment and Buildings; Fertilizers and Lime; Gasoline, Fuel and Oil; Rent or Lease Vehicles, Machinery, and Equipment; Repairs and Maintenance; and Utilities.

Add these numbers up and divide them by Gross Income. This will show the percent of your income that you are choosing to spend on this group of expenses. As a general rule, you would like to see this percentage be lower rather than higher.

The third section of the worksheet asks you to look at the money you spent to directly support families in your community by providing employment. This may be your family or it may be someone else's. There are four numbers in this section: Employee Benefit Programs; Hired Labor; Pension and Profit Sharing Plans; and Net Farm Profit (or loss). Divide the sum of these four numbers by Gross Income.

The final section of the worksheet is devoted to determining the balance between livestock and feed on your farm. The balance for your farm is calculated by first subtracting the dollar value of feed sold from the dollar value of feed purchased. This difference is then divided by Gross Income. A value of zero indicates a perfect balance. A grain farm would have a positive number close to 100 percent, indicating that almost all of the grain it produces is sold for feed used on other farms. A livestock operation that did not grow all its own feed would have a negative number. The closer that number comes to minus 100 percent, the less feed used on the farm would have been produced on the farm.

Remember, the feed-sold and feed-purchased numbers used in estimating the balance should be for a single year. If your numbers include sales or use from inventories, you will have to adjust them accordingly.

Using the Worksheet

So we have four indicators. One shows the degree to which you depend on the government for income, one shows the degree you depend on non-renewable energy and machinery, one shows the degree to which you provide jobs for local families (including your own), and one shows the balance of feed production and use on your farm.

No one of these numbers is intended to be used by itself any more than profitability should be used by itself. Each number is part of a bigger picture, and being "perfect" on any one of them might come at the expense of another looking much worse than you would like to see.

Four Examples of Using the Indicators

Four examples of how the indicators look for different types of farms in Minnesota are shown in this chapter. Each is based on actual farm records and is intended to show how differences in farms show up in the indicators.

Conventional Grain Farm

The first example is a Southwest Minnesota grain farm. The farm is 960 acres and, apart from the acres set aside for government programs, is all planted to a corn-soybean rotation. It is typical of many farms in the area in that about one-third of the land is owned and the other two-thirds are rented.

The gross income for the farm is $255,000. This includes an $18,000 check from commodity programs, so seven percent of this income comes from government programs.

The farm relies heavily on chemicals, fuel and machinery. Chemicals, depreciation, repairs and fertilizer are major contributors to the $99,200 spent on this category. The total spent here accounts for 38.9 percent of gross income.

The high machinery use makes for low labor use. Out of the quarter million dollar gross, only $7,100 goes for hired labor. The operator and family are, however, making a reasonably good living. Still, the total for this category of $44,600 is only 17.5 percent of gross income.

Finally, the farm is as out of balance as you can get. There are no animals on the farm and all of the feed is sold. Only the government payment keeps the balance indicator from being a "perfect" 100.

This example farm is almost a complete failure in terms of the financial indicators of sustainability. Equipment and chemical companies love it, but it generates virtually no jobs in the local economy. The operator may get rich—that depends on how much is paid for rent and interest—but few other local people share in the benefits. There is no chance for animals to work on the farm. And the farm ties up enough land to support at least three farms using different methods.

Monitoring Farm Sustainability with Financial Data

Conventional Grain Farm

Government Payments as Percent of Gross Income

Gross Income	255,000	
Agricultural Program Payments	18,000	
Ag Program Pmts / Gross Income (x 100) ==>		7%

Energy and Machinery as Percentage of Gross Income

Chemicals	28,500	
Custom Hire (machine work)	5,500	
Depreciation on Equipment and Buildings	25,000	
Fertilizers and Lime	13,500	
Gasoline, Fuel, and Oil	6,000	
Rent or Lease Vehicles, Mach. & Equipment	0	
Repairs and Maintenance	18,000	
Utilities	1,700	
Total	99,200	
Total / Gross Income (x 100) ==>		38.9%

Support for Local Families as Percentage of Gross Income

Employee Benefit Programs	0	
Labor Hired	7,100	
Pension and Profit Sharing Plans	0	
Net Farm Profit (or loss)	37,500	
Total	44,600	
Total / Gross Income (x 100) ==>		17.5%

Indicator of Feed Production and Use Balance

Gross Income from Crops Sold for Feed	237,000	
Feed Purchased	0	
Difference	237,000	
Difference / Gross Income (x 100) ==>		92.9%

Conventional Grain, Finishing Hogs

The second example is also a Minnesota grain farm, but this time there is an older finishing barn on the farm which is usually used to feed out about 1,000 feeder pigs each year.

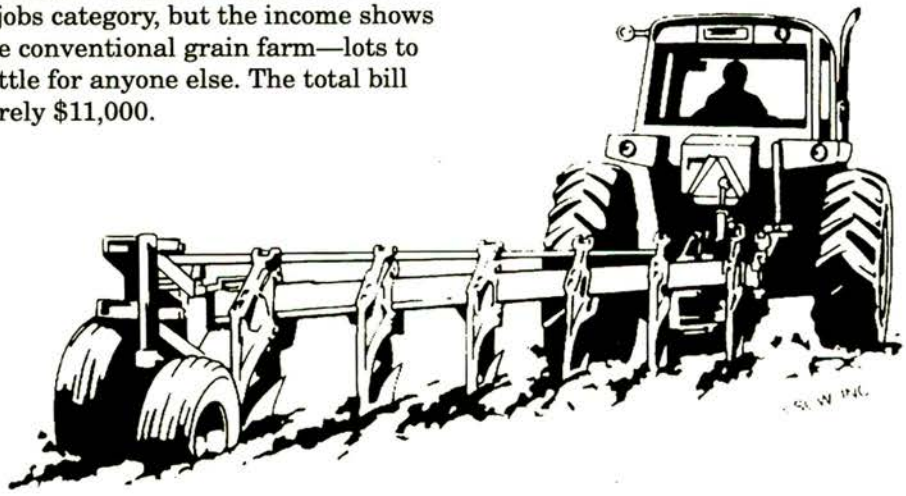
The farm's gross is up to $350,000 because of the added income from selling hogs. There is still lots of corn base, however, and this qualifies for a $15,000 commodity payment. The payment is 4.3 percent of gross income.

This farm is also heavily dependent upon equipment and non-renewable resources, and it has all of the usual expenses that go with grain farming. In addition, the hogs are raised in confinement and have no opportunity to provide useful work. Instead, feed and manure handling equipment add to the $114,355 total for this category. It comes to 32.7 percent of gross.

The operator of this farm is doing very well. Net farm income is $65,000 in a typical year. Almost 22 percent of gross goes to the jobs category, but the income shows the same split as the conventional grain farm—lots to the operator, very little for anyone else. The total bill for hired labor is barely $11,000.

Finally, the farm is substantially out of balance. After the hogs are fed, there is still $217,743 in feed grains to be sold to other farms. A relatively small amount of specialized feeds are also purchased, and the final balance indicator is 59.6 percent.

This farm shows that adding livestock alone does not always improve the financial indicators used here. It takes more equipment, not more people, to care for them in this case, and the problems of conventional grain farming are not addressed at all.



Monitoring Farm Sustainability with Financial Data

Conventional Grain, Finishing Hogs

Government Payments as Percent of Gross Income

Gross Income	350,000	
Agricultural Program Payments	15,000	
Ag Program Pmts / Gross Income (x 100) ==>		4.3%

Energy and Machinery as Percentage of Gross Income

Chemicals	25,307	
Custom Hire (machine work)	254	
Depreciation on Equipment and Buildings	25,388	
Fertilizers and Lime	33,629	
Gasoline, Fuel, and Oil	7,390	
Rent or Lease Vehicles, Mach. & Equipment	1,240	
Repairs and Maintenance	18,499	
Utilities	2,648	
Total	114,355	
Total / Gross Income (x 100) ==>		32.7%

Support for Local Families as Percentage of Gross Income

Employee Benefit Programs	0	
Labor Hired	11,291	
Pension and Profit Sharing Plans	0	
Net Farm Profit (or loss)	65,000	
Total	76,291	
Total / Gross Income (x 100) ==>		21.8%

Indicator of Feed Production and Use Balance

Gross Income from Crops Sold for Feed	127,743	
Feed Purchased	9,194	
Difference	208,594	
Difference / Gross Income (x 100) ==>		59.6%

A Conventional Dairy

The third example is a conventional Minnesota dairy milking 54 cows. The farm uses 225 acres to grow corn and hay. There are another 45 acres of conventional pasture and seventy or so acres of woodland.

The farm grosses $161,000 and gets a $3,000 check from the government for growing corn. Program payments are less than two percent of gross income.

The farm is not much different from a grain farm in that it is top-heavy with equipment. There is corn equipment, hay equipment, feed handling equipment, manure handling equipment—you name it. It costs a lot to own this much equipment, and just as much to keep it running. When you add in chemicals and fertilizer for the crops, the bill for the second category comes to $47,500, or 29.5 percent of gross.

The farm hires some part time help at harvest time and occasionally gets some relief from milking. The majority of the $59,400 in this category, however, goes to the husband and wife who each work very hard for the $49,500 they are clearing. They wonder if it is really worth both of them working full time just to keep things going.

This farm, too, is out of balance, but not as badly. A small amount of corn and hay gets sold each year, and, in spite of 225 crop acres and another 45 acres in pasture, there is still $17,000 in feed which must be paid for.

Perhaps it is no wonder that Minnesota is losing almost three dairy farms every day. In spite of the gruelling work put in by husband and wife, suppliers of equipment and non-renewable resources still make as much as they do. And while the grain farmer works six to eight weeks a year, these folks are working 52 weeks a year tending crops and waiting hand and foot on milk cows.

Monitoring Farm Sustainability with Financial Data

Conventional Dairy

Government Payments as Percent of Gross Income

Gross Income	161,000	
Agricultural Program Payments	3,000	
Ag Program Pmts / Gross Income (x 100) ==>		1.9%

Energy and Machinery as Percentage of Gross Income

Chemicals	2,100	
Custom Hire (machine work)	1,400	
Depreciation on Equipment and Buildings	17,000	
Fertilizers and Lime	3,400	
Gasoline, Fuel, and Oil	4,100	
Rent or Lease Vehicles, Mach. & Equipment	0	
Repairs and Maintenance	17,000	
Utilities	2,500	
Total	47,500	
Total / Gross Income (x 100) ==>		29.5%

Support for Local Families as Percentage of Gross Income

Employee Benefit Programs	0	
Labor Hired	9,900	
Pension and Profit Sharing Plans	0	
Net Farm Profit (or loss)	49,500	
Total	59,400	
Total / Gross Income (x 100) ==>		36.9%

Indicator of Feed Production and Use Balance

Gross Income from Crops Sold for Feed	2,900	
Feed Purchased	17,000	
Difference	-14,100	
Difference / Gross Income (x 100) ==>		-8.75%

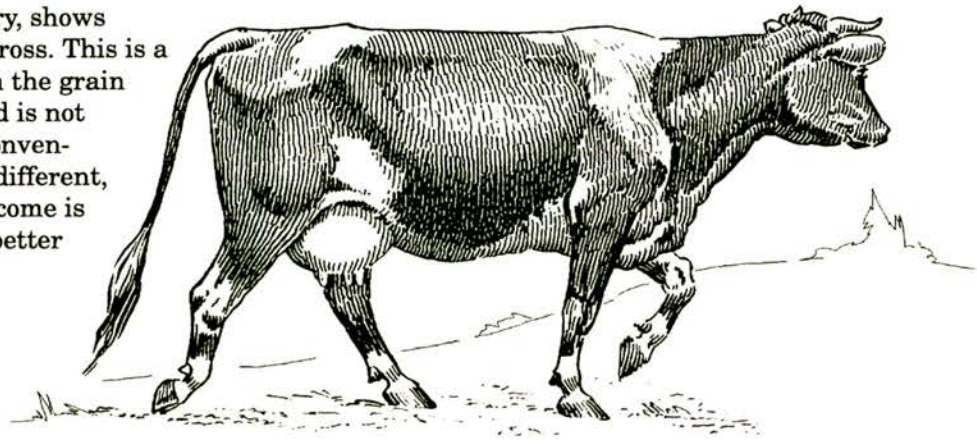
Grazing Dairy Cows

The fourth and final example is also a dairy. It has more cows than the dairy just described, has a lower gross income, and looks a whole lot better when seen with the new indicators. The big difference between this farm and the conventional dairy is that there is no corn grown on the farm. The farm's 250 acres are all in pasture which is carefully grazed for maximum production.

The farm grossed $149,318 in a recent year. Since there was no corn, the government saw no reason to help this operator at all. Perhaps the public will someday rethink its decision to single out the one farm which used no chemicals and no commercial fertilizer for such treatment!

The cows are not inside all day waiting to be fed and cleaned up after. They are out most of the year, spreading manure and harvesting feed. One result is that there is very little equipment on the farm. The total bill in this category, even counting custom hay harvesting and manure handling (you can only ask so much of cows in a Minnesota winter!), is $30,924, or 20.7 percent of gross. This is by far the lowest percentage for this category among the four example farms.

The third, or "jobs" category, shows $58,295, or 39 percent of gross. This is a far higher percentage than the grain operations have shown and is not much different than the conventional dairy. What is very different, however, is the way the income is split up. There is a much better balance between the operator and the hired help, and both get reasonable vacations and time with their families.



Finally, the farm is close to being in perfect balance. Some hay was sold, some feed was purchased, but the overall percent of gross was less than four percent.

This example shows that the answer to dairy financial problems does not necessarily lie in bigness. The problem to begin with is too much equipment, and buying more won't fix it. What works better in this example is creative management guided by thoughtful goals.

And compared to grain farming, there is no contest at all with these indicators. Grain farming, even with conventional livestock feeding, is heavy on equipment, light on jobs. Grazing dairy cows is the mirror image—light on equipment, heavy on jobs.

Monitoring Farm Sustainability with Financial Data

Grazing Dairy Cows

Government Payments as Percent of Gross Income

Gross Income	149,318	
Agricultural Program Payments	0	
Ag Program Pmts / Gross Income (x 100) ==>		0%

Energy and Machinery as Percentage of Gross Income

Chemicals	0	
Custom Hire (machine work)	93,560	
Depreciation on Equipment and Buildings	8,000	
Fertilizers and Lime	0	
Gasoline, Fuel, and Oil	2,039	
Rent or Lease Vehicles, Mach. & Equipment	1,019	
Repairs and Maintenance	6,424	
Utilities	4,086	
Total	30,924	
Total / Gross Income (x 100) ==>		20.7%

Support for Local Families as Percentage of Gross Income

Employee Benefit Programs	0	
Labor Hired	26,486	
Pension and Profit Sharing Plans	0	
Net Farm Profit (or loss)	31,809	
Total	58,295	
Total / Gross Income (x 100) ==>		39%

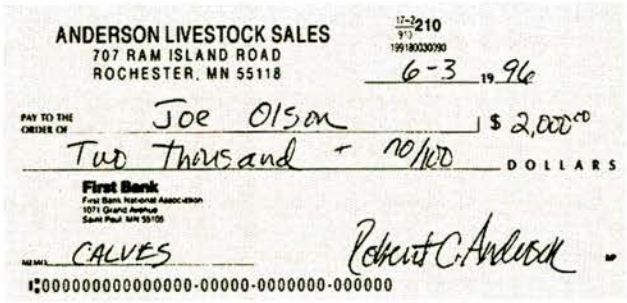
Indicator of Feed Production and Use Balance

Gross Income from Crops Sold for Feed	3,987	
Feed Purchased	9,678	
Difference	-5,691	
Difference / Gross Income (x 100) ==>		-3.8%

How Do Profits Fit In?

There is general agreement that farms should be profitable, but not nearly as much consensus on just what that means. Economists see things one way, and most everyone else sees things another way.

For most everyone, except economists, the word "profit" means something like "what's left after the bills are paid" or "what's left for the family." Some might even go so far as to include "and something has been set aside to replace equipment and breeding stock," but that is about as far as it goes. Making profits, rather than defining the word, is vastly more important to regular people.


ANDERSON LIVESTOCK SALES
707 RAM ISLAND ROAD
ROCHESTER, MN 55118

6-3 19 96

PAY TO THE ORDER OF Joe Olson $ 2,000.00

Two Thousand + 00/100 DOLLARS

First Bank

MEMO CALVES Robert C. Anderson

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Economists generally have more time on their hands and consequently have thought a great deal more about exactly what the word profit should mean. The economist's definition is based not on making enough to live on, or even on having enough to buy a Buick, but on seeing that each resource used in production is making more than it could if it were used some other way.

The way profits are defined makes a difference in how they are measured. It also affects how profits fit into an overall system for becoming more sustainable.

The Economist View of Profits

Some of the costs economists use in calculating profits are very real in the sense that a check must be written to pay them. Buying feeder livestock is an example. Other costs, however, are more hypothetical in the sense that they represent income that could be gained in some other use of farm resources. Both types of costs are subtracted from income to determine profits in the sense economists use the term.

Land is a good example of how the economist's definition might seem unusual. What was originally paid for land used in farming is irrelevant. So is the size of the mortgage payment. Instead, economists subtract the full value of whatever could be made by letting someone else use the land at the going rate.

The labor and management provided by a farm family are treated the same way by economists. They are charged against gross income at whatever could be made doing something else off the farm. If a person can make $55,000 working in town, it doesn't matter if that same person can make $50,000 per year farming. It would not be profitable to farm, no matter how good $50,000 might look at first glance. To farm would be to lose $5,000 per year.

The Regular Person's View of Profits

The way land, labor, management, and other farm resources are often treated by economists is not only unusual, it can be downright dangerous. As they say in the TV commercial, "Don't try this at home!" Imagine going into a tax audit with a story like this: "Sure I made $50,000, but actually I didn't make a dime because I could have made more doing something else, so I am not paying any taxes this year." About the best you could hope for would be that your jail time would be spent in a minimum security facility.

This is not to say that the IRS doesn't have the words "Profit and Loss from Farming" in big letters right on top of the Schedule F tax form, because they do. And, furthermore, it doesn't mean that a farmer who drives a nice car and regularly pays his or her bills is not commonly thought of as "profitable."

The general way in which IRS asks that farm profits be calculated works well enough for day-to-day purposes. Common expenses actually paid, along with some estimate of depreciation for equipment and breeding livestock, are subtracted from farm income. The remaining "profit" is what is left to support the farm family.

Enough versus Maximization

In this regular person's view of profits, whether a farm is profitable depends a bit on individual circumstances that economists don't consider. For example, a farmer could have long ago paid for land that has now become

much more valuable. The farmer might be easily paying his or her bills and living well, so in the regular person's sense, this farm is profitable. For economists, however, the land value makes all the difference in the world. This farmer may well be losing money by not selling out to developers and finding a job in town.

This points out the key difference between the economist and regular person's view of profits. The economist looks at making the maximum dollars possible, and the regular person looks at making "enough" dollars. The idea of "enough" is troubling to economists because it varies from person to person. The idea of "maximum" is troubling to most farmers because they see themselves as farmers, not as investors managing a portfolio of resources.

"Maximum" is a fine guiding principal if all that is being considered is profits. The only goal is making more. But in sustainable agriculture, there is always a balancing act among family, community, and environment that includes, but is not confined to, profits from farming. In this balancing act, the concepts of "enough" and "acceptable to me, if not everyone else" are simply more useful than maximization of profits or any other single goal.

The goal of making "enough" will not only vary from farm to farm, it will vary for the same farm as circumstances change. Farmers usually need off-farm income when they are getting started. Later on, things might turn more their way and what the farm is making becomes enough. And, as age brings wisdom, farmers might decide that having enough money has two sides: making more and needing less.

The important thing for sustainable agriculture is that "enough" at least leaves open the possibility of concentrating on other goals. "Maximization" will always have a reason to look only at profits.

Looking Ahead

The system shown in this report, like all financial analysis systems, is primarily one for looking back and seeing where you have been. It is useful for measuring your own progress and for making comparisons with other farms.

There are also many good tools for looking toward the future and seeing how you are going to move more toward "enough" while staying true to your other farming goals. Land Stewardship Project occasionally offers courses in Holistic Management throughout Minnesota, and many farmers have put HM planning tools to good use. Some conventional planning tools work well for these purposes, too, if only you are careful to keep all your goals, and not just profit, in mind.

Monitoring Farm Sustainability with Financial Data

Indicators Worksheet

Government Payments as Percent of Gross Income

Gross Income _____

Agricultural Program Payments _____

Ag Program Pmts / Gross Income (x 100) ==> _____

Energy and Machinery as Percentage of Gross Income

Chemicals _____

Custom Hire (machine work) _____

Depreciation on Equipment and Buildings _____

Fertilizers and Lime _____

Gasoline, Fuel, and Oil _____

Rent or Lease Vehicles, Mach. & Equipment _____

Repairs and Maintenance _____

Utilities _____

Total _____

Total / Gross Income (x 100) ==> _____

Support for Local Families as Percentage of Gross Income

Employee Benefit Programs _____

Labor Hired _____

Pension and Profit Sharing Plans _____

Net Farm Profit (or loss) _____

Total _____

Total / Gross Income (x 100) ==> _____

Indicator of Feed Production and Use Balance

Gross Income from Crops Sold for Feed _____

Feed Purchased _____

Difference _____

Difference / Gross Income (x 100) ==> _____

Monitoring

Birds

Birds can add color, song, and even joy to your farm. And, because birds respond to both short term and long term changes in habitat, they also serve as good "biodiversity barometers." Management decisions and practices that protect or restore a diversity of habitats not only can bring more birds to your farm, but also contribute to its sustainability. Monitoring bird movements and abundance can help you see the impact of management on biodiversity and ecosystem health.

What Is It?

This chapter describes a modified Point Count Method. The structured consistency of this method works well for tracking changes in bird presence and abundance due to changes in management.

Who Does It?

Any interested member of the farm family can learn to do bird counts. Working in pairs makes the process easier as one person observes and the other takes notes. You might also consider asking the help of someone with experience doing bird counts, perhaps a local bird club member or biologist.

When?

Bird breeding activity peaks between late May and early July. To take full advantage of the opportunity to observe migratory species on their nesting territories, do three counts spaced two weeks apart at each permanent sampling point, during calm weather.

Time Required

Plan on spending a minimum of ten minutes at each sampling point. The total time spent in the field depends on the number of sampling points and how long it takes to hike between them. Summarizing the results of your outing onto the record sheets at home requires a few more minutes.

Materials and Cost

A clipboard, a shoulder bag, pencils, binoculars, and a field guide can be obtained for about a hundred dollars. Higher quality binoculars will increase that figure. To record your observations, master copies of a Point Count Form and a Six-Year Record Sheet are included with the chapter. You will need to make photocopies from these masters.

CHAPTER CONTENTS

Getting Started

To make the most of your bird monitoring activities, spend some time considering why monitoring birds can be a helpful part of your farm management and what you want to learn from the process of monitoring birds.

Why Monitor Birds?

As you know, the sustainability of a farm depends on many factors, including sustaining the ecosystem base that supports the farm. Biodiversity is an important component of a sustainable, productive ecosystem base, and birds serve as good indicators of biodiversity.

Meadowlark

Birds are good "biodiversity barometers" because they reflect habitat quality and respond quickly to changes in habitat conditions. Different habitats tend to attract different communities of bird species. Thus, improvements in habitat diversity often translate into increases in the number of different bird species on a farm. If habitat quality and diversity is maintained over time, birds may also experience improved nesting success, which in turn can help long term population levels.

Conversely, population declines and losses in bird species over time can signal a loss of biodiversity and a weakening ecosystem, which may ultimately threaten the farm's long-term sustainability.

The biodiversity of any farm can be enhanced by implementing a management plan that creates or maintains the variety of habitats needed to support that diversity of life. (See Figure 1.) Options might include

- naturally landscaped areas around buildings;
- woodlands, groves, or brushy areas;
- grasslands, including pastures and hay fields;
- rest or reserve areas; and
- stream corridors, waterways, or wetlands.

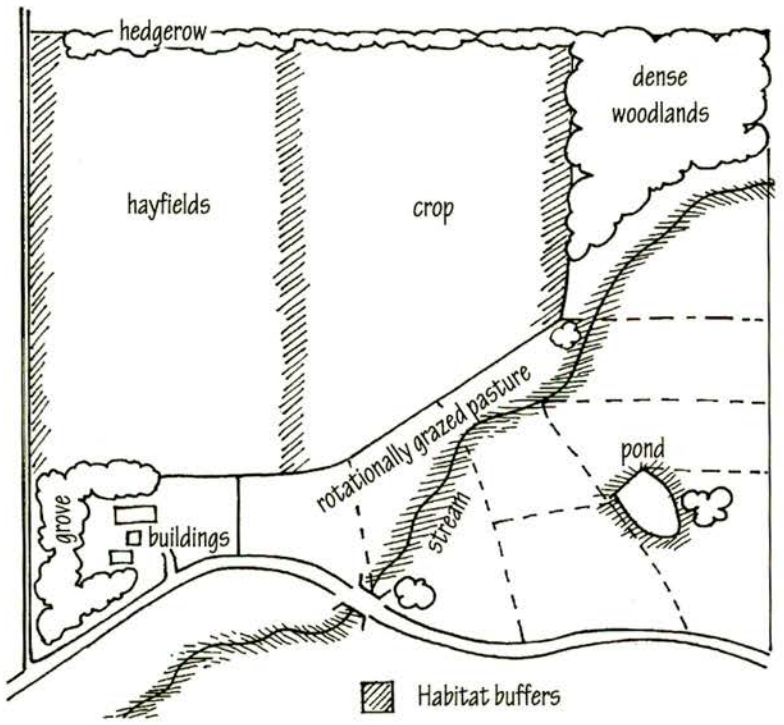


Figure 1: Possibilities for habitat diversity around the farm

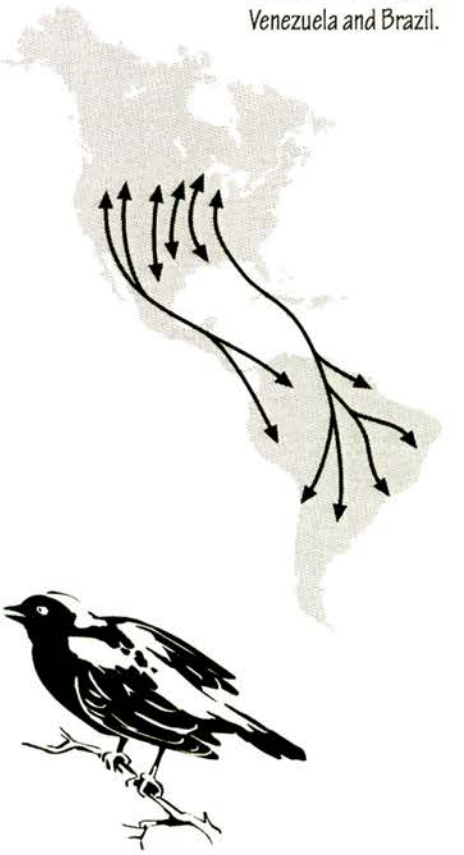
Develop a Monitoring Plan

Before heading out to the field, put together a clear and workable plan for monitoring birds. Use the following suggestions to help you with this process:

- Review the goals you and your family have set for your farm. Do they reflect an understanding of the importance of biodiversity and the need to sustain a healthy ecosystem?
- Summarize the main farming practices you use and rate them in terms of whether or not you think they enhance or discourage biodiversity on your farm.
- Do a quick assessment of the different habitat types already on your farm. Study the types of birds these habitats attract, as well as simple things you can do to start improving bird habitat. (See the "Additional Resources" section of this chapter for guidance.)
- Write down a few clear and workable objectives about what you want to learn from monitoring birds on your farm.

If the process of monitoring is new to you, be assured that you do not need to have everything figured out before hand. In fact, your first year of monitoring may simply be a way to familiarize yourself with birds, bird habitat, and the biodiversity conditions on your farm. Then, from this base of experience, you can begin to see different management possibilities. Most of all, be willing to learn from experience and enjoy yourself in the process.

The grassland birds winter as far away as Venezuela and Brazil.



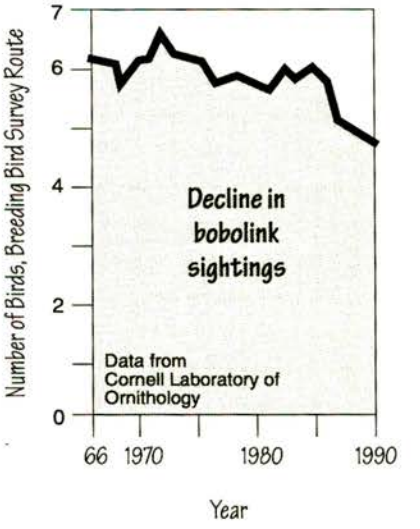
Grassland Birds

The need to protect or restore a diversity of habitats on farms is especially urgent for grassland nesting birds. Grassland birds have experienced steeper, more consistent, and more geographically widespread declines than any other group of North American migrant land birds. These declines are, in large part, due to the widespread increase during the last thirty to forty years of farming practices that destroy or severely alter grassland ecosystems.

In the Upper Midwest, a number of grassland nesting species have experienced population declines across all or in significant portions of the region:

- **several kinds of sparrows,** namely the grasshopper, the vesper, the savanna, and the field, which migrate to the southern United States or northern Mexico for the winter;
- **eastern and western meadowlarks,** which also winter in the southern United States and norther Mexico; and
- **dickcissels and bobolinks,** which pass all the way through Central America and winter from Venezuela to Brazil.

The bobolink is one of many grassland birds that have experienced declining populations.



Survival Strategies of Grassland Nesting Birds

One survival strategy of many grassland species is polygamy. If conditions are favorable and a male's territory is attractive, more than one female may choose to nest in the area. The male invests the most time and energy assisting with the brood of his first mate, but may also spend time caring for the young of a second, or even a third, mate.

Scattering is another strategy used by grassland birds to increase nesting success. A clutch usually consists of four to six eggs and after about ten to twelve days incubation, the young hatch and are out of the nest in less than two weeks. The young then scatter into cover and signal for the adults to bring food with insect-like chipping. This mobility helps young birds avoid predators, as well as nest disturbance or destruction by wild herbivores or domestic livestock. Also, most females will renest if they lose their eggs or hatchlings to predators.

A Focus of Monitoring Project Farmers

The fact that each of the farms participating in the Monitoring Project had hay fields and rotationally grazed pasture provided the Project farmers with a good opportunity to focus their bird monitoring activities on grassland nesting birds. In general, they wanted to know which farming practices could best help create a habitat that attracted these birds and enable them to nest successfully.

Working with the other Monitoring Project team members, the farmers identified several specific objectives:

- to document the presence (or absence) of grassland nesting birds on their farms,
- to determine whether or not the birds were nesting in their pastures and hayfields,
- to see how the birds responded to rest areas within their grazing system, and
- to determine the presence (or absence) of the birds on several nearby conventionally cropped farms.

After the first three seasons of using the Point Count Method described in this chapter, the farmers' findings were hopeful. The presence of the previously listed grassland species was confirmed on all six farms. Nesting success was verified at several locations, including designated rest areas. The counts conducted on the conventionally cropped farms confirmed the absence of these birds.

Consider Grassland Birds in Your Monitoring

If you have any grassland habitat on or near your farm, consider making grassland birds a focus in your bird monitoring activities. Grassland birds must become the concern of more farmers if their numbers are to improve. And, the open character of their habitat makes them easier to see (compared to woodland birds) and therefore easier to monitor. The relatively smaller number of species associated with grassland habitats also means fewer species to learn to identify.

Managing for Grassland Birds

During the first three years of the Monitoring Project, team farmers identified many of the bird species that respond to improved grassland nesting habitat in their pastures and hay fields.

When clipping a grazing paddock after the nesting season one farmer saw a meadowlark with six young flying up from the grass. His observation suggests that this grass-nesting bird had been able to raise young in a pasture being managed with rotational grazing. This finding is particularly significant because recent Breeding Bird Survey Routes conducted in southeast Minnesota have shown very low numbers of meadowlarks.

Management Intensive Grazing

Management intensive (or rotational) grazing involves dividing a pasture into smaller sections called *paddocks,* and then controlling when the animals enter a paddock to graze and how long they stay there. At the appropriate time, which depends on a variety of factors like grass growth rates and stock density, the animals are removed and rotated to a fresh paddock. Once the animals are removed from the paddock, they are not allowed back into it until the grasses have recovered from being grazed.

Not only does management intensive grazing allow farmers to manage for optimal grass production, it also enables them to create a grazing plan that can accommodate the needs of wildlife that depend on a grassland habitat.

Rest Areas

One strategy favorable to grassland nesting birds that Monitoring Project farmers worked into their grazing plans was to set aside one or more paddocks (or portions of paddocks) and leave these areas ungrazed during the nesting season. No animals were allowed to graze the rest areas from the beginning of the grazing season in mid to late April until at least the end of July. This allowed pasture vegetation to grow taller and more mature than vegetation in neighboring paddocks being grazed.

Based on two years experience and observation, these rest areas appear to help improve bird nesting success because they provide a place for birds to nest undisturbed. And, when birds attempting to nest in nearby paddocks are disturbed by livestock or machines, the rest area gives these birds the opportunity to relocate and renest. Monitoring Project farmers saw concentrations of bobolinks and dickcissels taking advantage of the cover provided by the rest areas. The farmers also saw side benefits in the rested paddocks: increased root growth (which improves soil structure and drought tolerance) and increased seed production (especially of clovers and other legumes.

Other Strategies

In addition to using rest areas, the Monitoring Project farmers looked for ways to avoid nesting disruptions caused by pasture clipping, grazing, and haying, but without dramatically affecting pasture and hay production.

One strategy was to reduce or delay pasture clipping to allow fledglings to achieve some level of mobility before the mower disrupts the nest. Another was to stop the practice of clipping altogether. One of the farmers with a beef herd did not clip any of his paddocks one season, without any noticeably negative affect on pasture or herd productivity. And, he was happy to observe a number of male dickcissels singing from perches on taller plants.

Although active nests were sometimes left intact following grazing by cattle, the results were not always as positive when it came to mechanical grass harvesting. "I cut hay on our other farm and I must have destroyed several bobolink nests," said one farmer, "the adults were all circling, screaming at me."

Monitoring Project farmers also experimented with several methods to reduce nesting disruption from hay making, including delaying the first cutting of hay as long as possible.

Flushing bars also help reduce loss of nesting ducks, songbirds, and other wildlife from mower blades. These devices, which flush wildlife before the mower blade gets them, have been around in one form or another for years. Several organizations have information on designs for lighter, more effective front-mounted flushing bars for pull-type mowers:

Ducks Unlimited Canada at 5015 49th St., Camrose, Alberta T4V N5, Canada. (403) 672-6786.

California Waterfowl Association at 4630 Northgate Blvd., Suite 150, Sacramento, CA 95834. (916) 648-1406.

The Point Count Method

This chapter teaches how to use a modified Point Count Method to monitor birds. With this method, you establish several fixed points from which you observe and count birds over time. While other less structured methods can be used to monitor birds, the Point Count Method brings a higher level of consistency to your monitoring activities. By avoiding even slight changes in location and by making sure that you are consistent in your timing from year to year, you can lend more validity to your observations.

Bluebird

A Useful Tool in All Habitats

The Point Count Method can be used to monitor birds in different habitats:

- **In grassland habitats:** This method works well for monitoring birds associated with the open spaces of grassland habitat, such as pastures, hay fields, unmowed or rested areas, and even larger grass waterways.

- **In wetland or stream habitats:** This method also works well for monitoring waterfowl, wading birds, and shorebirds associated with water-dominated habitat, including wetlands, streams, and even farm ponds. Counts done during migration and nesting seasons help track changing habitat conditions and the activities of different species throughout the year.

- **In wooded habitats:** The Point Count Method can also be used in wooded habitats, although it becomes slightly more difficult. Woodlands are home to more species of birds, which you will need to learn to identify, and they are harder to observe. This is especially true in larger, more dense woodlands where it is difficult to see except within a short radius. In this situation you will probably hear more birds than you see. This limited visibility reduces the usefulness of the method to the inexperienced birder. If, on the other hand, the main wooded area of your farm is a grove or shelterbelt, the method works fine as described.

- **At the boundaries between habitats:** The boundary between two habitat types, called *edges,* are also excellent places to conduct bird counts. Edge counts are particularly good for monitoring the diversity of birds on the farm because they capture species using both habitats plus those that are specifically attracted to edge conditions.

- **Around the farmyard:** Using a fixed point to count birds works very well around the farmyard, where you may also see a mixture of birds from different habitats.

How to Select Point Locations

The first step in the Point Count Method, then, is to select point locations that are representative of the various different habitat types on your farm. Points can be positioned in the middle of a field or paddock, or they can be located at the edge of a wooded area or a stream corridor. They can

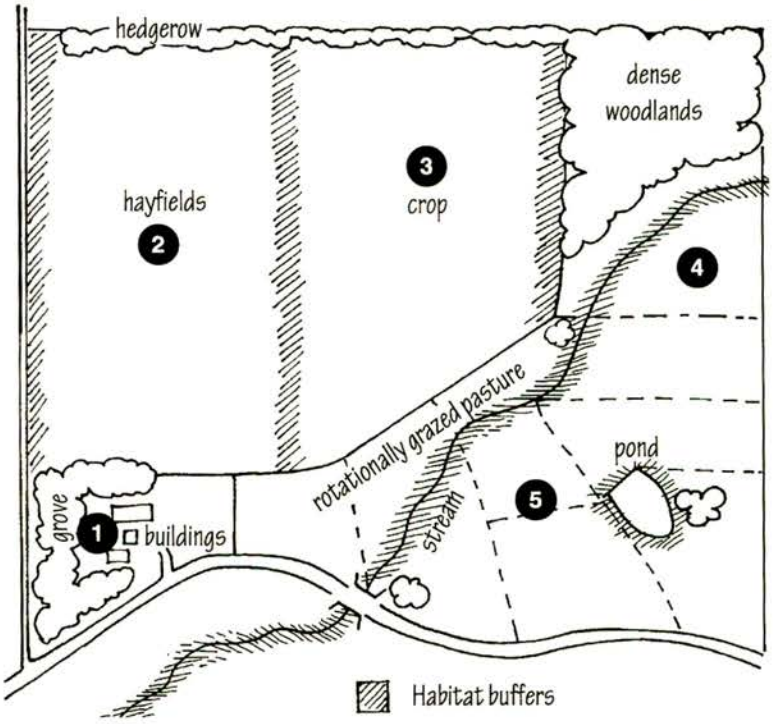


Figure 2: Decide on the best hiking route for your point counts and label your sites accordingly.

also be placed at a corner where different farming practices meet. The main thing to remember with the Point Count Method is this: **always stand at the same place when counting.**

To ensure this, use known distances from fence posts or other reference marks when selecting a point. Use photographs to help you pinpoint a location if fixed markers are not available or desired. If necessary, mark point locations with plastic flags; however, use them sparingly and discretely to avoid disturbing birds on their territories. Place markers a reasonable distance from the sampling point on the N-S or E-W axis, pace off the distance, and write it down.

Mark each point location on a copy of your farm map, then decide on the best hiking route and label your sites accordingly. (See Figure 2.) In a field notebook or journal, write down a detailed description of each point's location and your reasons for choosing it as a monitoring site. This information will be helpful for drawing conclusions from your observations and acts as a backup in case you lose your map.

When to Schedule Counts

Birds tend to be most visible and vocal during the breeding season, generally between late May and early July, making this the best time to conduct counts. By this time the early surge of migrant species has passed through and resident species have settled into their nests. Counts are also completed about the time territorial nesting behavior tapers off.

Dates for point counts	
Count 1 during:	May 25–June 10
Count 2 during:	June 11–25
Count 3 during:	June 26-July 10

Plan on doing three counts per year at each point, spaced at roughly two-week intervals. All counts should be done between 6:00 and 9:00 A.M., in calm weather. Also, plan on conducting counts for at least three consecutive years, six if possible. Ideally, systematic observation and record keeping becomes a regular, and life-long part of your farm management.

If you would feel more comfortable doing your first count with someone who has done them before, contact a local bird club member or a natural resource agency biologist for assistance. This is a great way to build confidence in using the procedure and to refine observation skills.

Binoculars: An Essential Tool

Investing in a good pair of binoculars is guaranteed to improve your birding skills and enjoyment.

Binoculars come in a wide variety of lens powers and field widths. Either a 7 x 35 or 7 x 50 (same power lens but wider field of view) model works well. Many birders consider 8 x 40 models to be ideal. Remember that the higher the lens power, the more you will notice shakiness. Compact binoculars can also be jittery.

Solid binoculars with sharp optics generally cost between $150 and $200. Serious birders might spend twice that or more for sharper optics and better durability. Cheaper models ($50-$100) will suffice for light use.

Always protect your binoculars from hard jolts and vibrations as these offset the prisms. Prism damage is hard on the eyes and cannot always be fixed.

And, while one person can conduct accurate bird counts, a team approach can be more effective and enjoyable because it enables one person to make observations while the other person takes notes. If you have trouble hearing high-pitched bird songs, you should team up with a sharp-eared partner.

How to Conduct Counts

On the morning of the count, load the following equipment into a cloth or leather shoulder bag, lined with a plastic bag to keep your things dry:

- enough photocopies of the Point Count Form for each point site, plus a few extra, attached to a clipboard
- sharpened pencils with erasers
- a birding field guide

Be sure to take a watch with you, as well as your binoculars. Also, consider bringing a snapshot camera and using photographs to capture site conditions and characteristics.

A master copy of the Point Count Form (the data sheet with the "bull's-eye and cross hairs") is provided at the end of the chapter, along with a Six-Year Record Sheet. Use these master copies to make photocopies.

At the Point Sites

At each point site, fill out the information at the top of the Point Count Form. Write neatly and in pencil; completely erase any changes or mistakes. The center of the cross hairs on the form represents where you are standing; the inside circle represents a distance of fifty yards out from center and the outside circle a hundred yards. Add reference marks for such things as trees, fences, and buildings.

Then, record all the birds you hear and see during a ten minute period. If working with a partner, keep conversation hushed and to a minimum. Record the bird activity on the form. For instance:

- Show flyovers by name and number with directional arrows.
- Note the location and identity of birds heard singing but not observed.
- Note females feeding young or acting broody.
- Show the relative locations of territorial males.
- Put a question mark (?) after any uncertain identifications.

Refer to the example on the opposite page. Follow the same procedure at each site. Six to eight points can be easily counted in two hours.

At Home

Upon returning home, transfer all of the count results onto the Six-Year Record Sheet. (See the example on the right.) Put this and the day's Point Count Forms into a notebook or file for safekeeping. Any migration

Monitoring Birds

Point Count Form

Date _____ Time _____

Point No. 5 Count No. 1 (2) 3 Year No. (1) 2 3 4 5 6

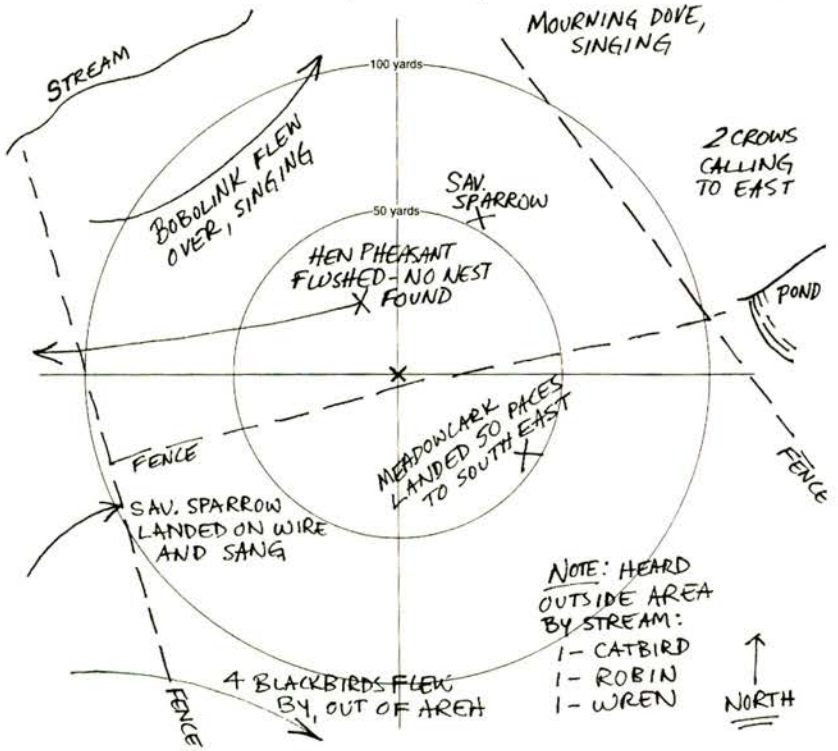
Location NEXT TO FENCE, PASTURE WEST OF POND

Observers J. OLSON, B. SMITH

Weather CLEAR, ABOUT 70°, S WIND 10 MPH

Habitat type REST PADDOCK, UNPASTURED SINCE '96

Vegetation notes MIXED GRASS & CLOVER, 18" TALL



Examples of a filled-out point count form and a six-year record sheet

Monitoring Birds

Six-Year Record Sheet

YEARS	YEAR 1: 1998				YEAR 2:	
COUNT NO.	1	2	3	TOTAL	1	2
MONTH/DAY	5/28	6/15				
Savanna Spar.	1	4				
Grasshop. Spar.	–	–				
Vesper Spar.	–	–				
Field Sparrow	–	–				
E. Meadowlark	2	1				
W. Meadowlark	–	–				
Bobolink	–	–				
Dickcissel	–	–				
Sedge Wren	–	1				
Bluebird	–	–				
Killdeer	2	2				
Blackbird	2	2				
Pheasant	–	1				
Seen or heard outside area:						
song spar.	2	–				
R.T. hawk	–	1				
Catbird	1	1				
Crow	1	2				
Wren	–	1				
Robin	–	1				

observations, unusual sightings, or other natural history notes can be recorded in your field notebook or journal.

Remember, your first season of conducting counts helps you establish a baseline of information. This baseline lets you compare observations made in future years and monitor how birds respond to changes in management. New points can be set up and counted as needed to monitor managed areas. If it makes sense to drop an area, do so. Also, feel free to revise your monitoring objectives as you become more experienced and as you make changes in your management.

Some Monitoring Cautions

The approach suggested in this chapter works well for monitoring birds in a farm setting and within the parameters of the farm family's goals. It is especially useful for defining a baseline of information and then documenting changes through time using a consistent method of observing.

Avoid Comparisons with Other Farms ✔

This monitoring tool is not, however, designed for making comparisons between different farms, as might be done within a scientific research study looking at regional trends. Even though the same count method might be used in a scientific study, the differences in skill, experience, and technique among the people doing the farm monitoring counts introduces too much variability to allow for meaningful comparisons between different farms or regions.

Savanna sparrow

You might also want to take this kind of variability into account when analyzing your results if the counts are not done by the same person or team, or during the same time period, from year to year. Remember too, that some species are more visible and others more secretive. This also may affect results and influence the way your records should be interpreted.

Keep Disturbance to a Minimum ✔

Human disturbance always introduces some bias into monitoring results, whether from farm activity or simply from the act of going out and observing. In fact, intensive searches may cause some females to abandon nests. Predators and nest parasites like cowbirds often are aware of and respond to human activity, making the birds you are investigating more vulnerable. For these reasons, always strive to keep disturbance to a minimum when conducting your bird counts.

Acknowledge the Big Picture ✔

Remember this caution as well when interpreting your results: migratory birds are also vulnerable to habitat loss in their wintering areas. Disappearance or declining numbers of species may reflect hemispheric trends and not necessarily what you are doing on your farm. Local management to improve nesting success may not be enough to overcome wider trends.

Sharing Information

As you become more comfortable with the process of monitoring and start observing connections between farming practices, habitat loss or gains, and bird counts, you may find that it becomes increasingly important to regularly share information with others doing similar activities. Connecting with others can be especially useful when exploring management strategies that promote biodiversity restoration.

Here are some possibilities you might pursue:

- Join the local chapter of a sustainable agriculture organization and attend field days.
- Connect with local schools or nature groups like the local chapter of the Audubon Society.
- Contact your state Department of Natural Resources or other natural resource agencies for ideas on what you can do to make your farm more bird friendly.
- Make use of emerging communication technologies like the Internet to check out the World Wide Web home pages of organizations, universities, and resource agencies.

Also, feel free to contact the Land Stewardship Project with feedback on your monitoring experiences.

Additional Resources

Tap into the vast resources available on birds to enhance your monitoring activities and to learn more about how to create and maintain bird habitat.

Many of the materials described below can be purchased from local bookstores, bird feeding supply stores, or the American Birding Association (see the ABA listing on page 14 of this chapter for address and phone information). Check with your local library as well to see what might be available through interlibrary loan.

Field Guides

A good field guide is a valuable tool for any level of bird monitoring.

Birders Guide to Minnesota, 3rd Edition, by Kim Eckert. (Plymouth, MN: Williams Publishing, Inc., 1994.)

A county-by-county guide to over 800 birding locations throughout the state, including an annotated list of Minnesota birds, selected identification hints and over 200 detailed maps. (If you live outside Minnesota, check with the ABA catalog for a birding guide for your state.)

Guide to Field Identification: Birds of North America, by C. S. Robbins, B. Bruun, and H. S. Zim. (New York: Golden Press, 1983.)

A thoroughly revised update to the first edition published in 1966. Contains full-color illustrations of birds in typical habitats. Text, sonagrams, and range maps appear on pages facing illustrations.

Field Guide to the Birds of North America, National Geographic Society, 2nd edition. (Washington, DC, 1987.)

A comprehensive guide that contains all North American breeding species and many vagrants, accidentals, and exotics. Its 220 color plates provide plumage variations for many species. Color range maps and descriptive information are located on the pages facing the relative plates. The text covers identification, breeding, habitat, and vocalizations.

Field Guide to Birds East of the Rockies, by Roger Tory Peterson. (Boston: Houghton Mifflin Co., 1980.)

Covers North America east of the one hundredth meridian. Includes 136 full-color plates for easy identification and 390 three-color range maps. The Peterson System of pinpointing key fieldmarks on the schematic illustrations is an invaluable aid to beginners.

The Birders Handbook: A Field Guide to the Natural History of North American Birds, by Paul R. Ehrlich, David S. Dobkin, and Darryl Wheye. (New York: Simon & Schuster, 1988.)

A unique handbook designed as a companion for field identification guides. Contains accounts of the natural history of all species known to breed regularly north of Mexico, as well as short essays detailing interesting topics related to each species.

Other useful guide-related items available from the American Birding Association include the ***ABA Checklist and Trip List*** to record your trip or life-long sightings, and the ***ABA Fieldcard,*** which contains all the regularly occurring species in an ABA Checklist Area.

Other Bird Books

The Minnesota Department of Natural Resources offers the following three books by Carrol Henderson; all are available from the DNR Bookstore at 612-228-9165:

Landscaping For Wildlife. (St. Paul, MN: State of Minnesota, Dep't. of Administration, Communications Media Division, 1987.)

Offers easy-to-follow, affordable landscape plans to enhance wildlife habitat in the Midwest climate.

Wild About Birds: The DNR Bird Feeding Guide. (St. Paul, MN: State of Minnesota, Dep't. of Administration, Communications Media Division, 1995.)

Provides techniques used by the author to double the number of species using his feeders. Includes woodshop basics for construction of 26 different feeders, tips on 44 types of food, plus detailed descriptions and photos of almost all 69 bird species east of the Rocky Mountains.

Woodworking For Wildlife: Homes for Birds and Mammals. (St. Paul, MN: State of Minnesota, Dep't. of Administration, Communications Media Division, 1992.)

Features numerous diagrams for building shelters for birds and mammals. Includes plans for the Peterson Bluebird house, bat houses, platforms for the great horned owl, wood duck nest boxes, and more. Offers information on 50 species of birds and mammals.

Bird Videos

The following two videos offer general birding instructions for the beginning birder. Other available videos cover more detailed information on specific species. Many birding videos are available through interlibrary loan or can be purchased from the American Birding Association. Or, check with a local birding group to see if they have any videos to borrow or rent.

How to Start Watching Birds, by Diane Porter. 90 minutes. (Fairfield, IA: Ideaform, 1994.)

Covers everything a beginning birder needs to know to start birding. Demonstrates how and why of bird observations and what significant details to look for when identifying a bird. Shows how to use a field guide and tells when and where to find birds. Tells about birding etiquette, binoculars, and various birding resources: organizations, books, magazines, and audio aids.

Techniques of Birding, by Arnold Small. 69 minutes. (South Laguna, CA: Nature Video, 1985.)

Offers instructions on birding techniques aimed at beginning birders. Covers field guides, binoculars and scopes, photography, "pishing," field identification techniques, and sport birding. Features 109 species.

Bird Song Resources

Bird song cassette tapes or compact discs are the best way to learn how to identify birds by their calls. With repeated listening and field experience, songs will stick in your memory. **A note of caution:** Do not play song tapes out in the field. Some species might abandon their nests because of it.

Birding By Ear: Guide to Bird Song Identification, by Richard K. Walton and Robert W. Lawson. 3 cassettes or CDs and 64-page booklet. (Boston: Houghton Mifflin Co., 1989.)

This system teaches various techniques that give you a method for learning the songs of 85 common species occurring in the Eastern and Central United States. These techniques can then be applied to learn the songs of birds not featured.

Field Guide to Bird Songs of Eastern and Central North America, edited by Roger Tory Peterson. 2 cassettes or 1 CD. (Boston: Houghton Mifflin Co., 1983.)

Keyed by page number to the Peterson's *Field Guide to Birds East of the Rockies* and features recorded songs and calls for over 250 species.

Guide to Bird Sounds. 2 cassettes or 1 CD. (Ithica, NY: Cornell Laboratory of Ornithology, 1985.)

Keyed by page number to the National Geographic Society's *Field Guide to the Birds of North America,* both editions. Calls, songs, trills, and other sounds are recorded for 179 species.

Know Your Bird Sounds, Vol. 1, by Lang Elliot. 65 minute cassette. (Minocqua, WI: NorthSound Music Group, 1991.)

Features the songs, calls, screeches, and alarm calls of 35 common species. Becoming familiar with these will help you pick out and identify birds with unfamiliar songs calls.

Bird Song Master, by Gary A. Schumacher. Version 2.2, Mac or PC. (Columbus, OH: Micro Wizard, 1996)

A computer software program that, along with a CD-ROM drive, gives you many ways to manipulate the bird songs contained on the CD versions of the Peterson's *Field Guide to Bird Songs* (Eastern and Western) and the National Geographic Society's *Guide to Bird Sounds.*

Organizations and Programs

American Birding Association (ABA) promotes recreational birding, contributes to the development of bird identification and population study, and fosters public appreciation of birds and their vital role in the environment. It publishes a bimonthly journal *Birding,* the lively monthly newsletter *Winging It,* and the quarterly newsletter *A Birds-Eye View* for young birders.

Contact the ABA at P.O. Box 6599, Colorado Springs, CO 80934. (719) 634-7736. To order books or other items offered by the ABA, call (800) 634-7736 (USA and Canada) or fax to (800) 590-2473 (USA & Canada); e-mail: abasales@abasales.com. Discounts on some items are available for ABA members.

National Audubon Society/Minnesota Audubon Council (MAC) has thirteen chapters throughout Minnesota with members skilled at bird identification. To connect with an Audubon birder in your area call or write the Minnesota Audubon Council at 26 East Exchange Street, Suite 207, St. Paul, MN 55101. (612) 225-1830.

Partners in Flight is a cooperative effort of federal government agencies, states and provinces, private corporations, and non-governmental conservation organizations, to maintain populations of forest and grassland neotropical migratory birds in the America's. They publish a ***Citizen's Guide to Migratory Bird Conservation,*** (1995) which offers ways in which citizens can be active partners in the endeavor to protect or restore the habitats of these birds. To obtain this guide and information on other Partners in Flight materials, contact the National Fish and Wildlife Foundation, 1120 Connecticut Ave. NW, Suite 900, Washington, DC 20036. (202)-857-0166.

Monitoring Birds

Point Count Form

Date _____ Time _____

Point No. _____ Count No. 1 2 3 Year No. 1 2 3 4 5 6

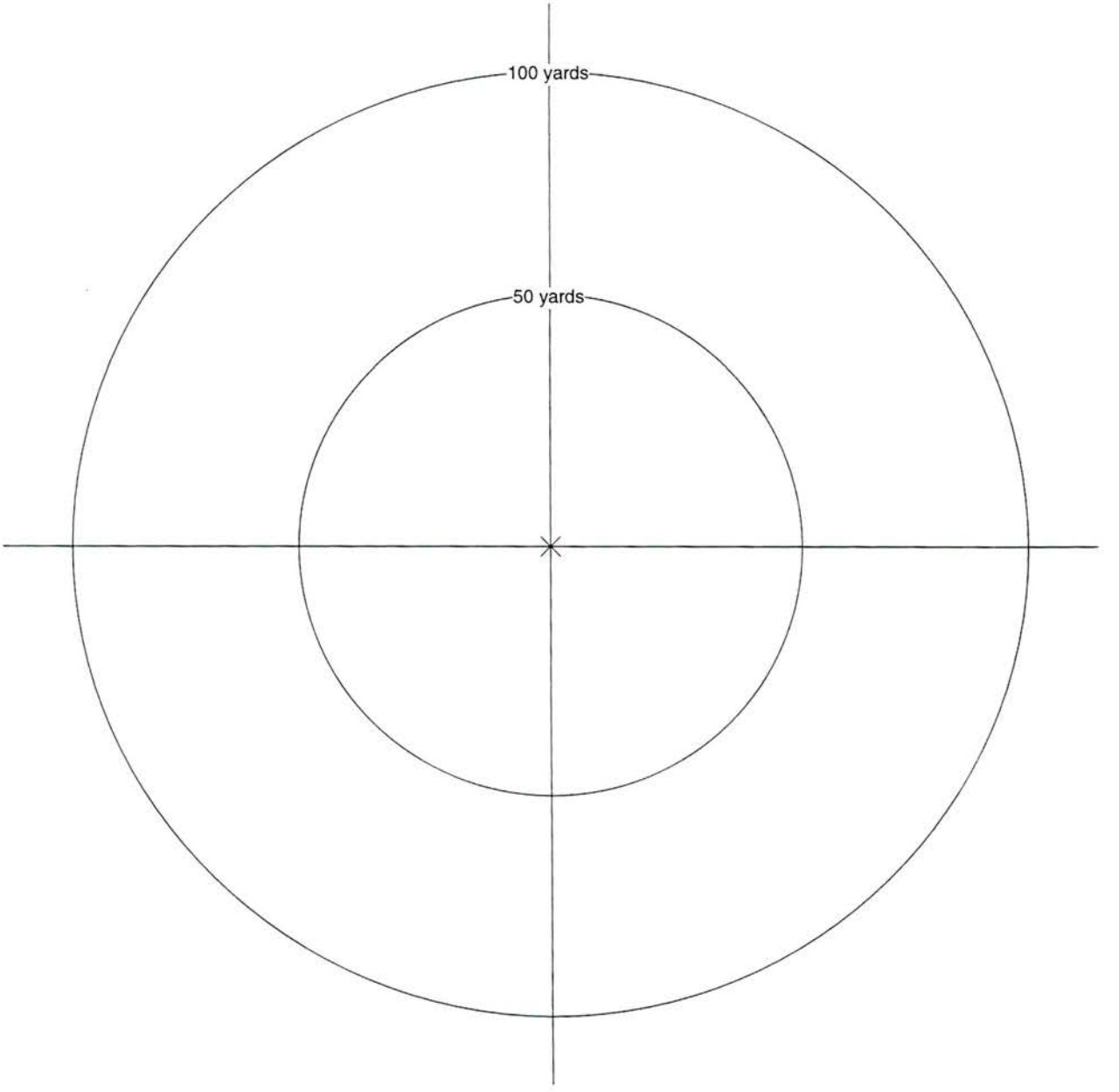
Location _____

Observers _____

Weather _____

Habitat type _____

Vegetation notes _____



Monitoring Birds

Six-Year Record Sheet

Location _____ Point No. _____

YEARS	YEAR 1:				YEAR 2:				YEAR 3:				YEAR 4:				YEAR 5:				YEAR 6:			
COUNT NO.	1	2	3	TOTAL	1	2	3	TOTAL	1	2	3	TOTAL	1	2	3	TOTAL	1	2	3	TOTAL	1	2	3	TOTAL
MONTH/DAY																								

Monitoring

Frogs and Toads

Management practices that enhance the environmental health of your farm are also capable of producing an abundance of frog and toad species. Because of their sensitivity to changes in water quality and land use practices, monitoring frog and toad populations can help you assess the environmental impact of your management practices.

What Is It?

Monitoring frogs and toads involves learning the calls of the different species and then listening for them three times a year at one or more points on your farm. A free audio cassette tape from which to learn the calls is provided.

Who Does It?

Any interested member of the family can learn the frog and toad calls and do the listening counts. Working with others can add to the effectiveness and enjoyment of your monitoring activities.

When?

Listening counts should be done once, at twilight or later, during each of the three count periods: early spring, late spring, and summer.

Time Required

A listening route with three sites might take an hour, depending on the length of the route. The actual time spent listening is five or ten minutes. Preparation time needed to learn the calls will vary from person to person.

Materials

At home, you will need an audio cassette player to learn the calls. On the counts, you will need a pencil and clipboard, a flashlight, the Frog and Toad Identification Guide, and photocopies of the Frog and Toad Record Sheet. The guide and a master copy of the record sheet are provided.

Getting Started

CHAPTER CONTENTS

In recent years, the worldwide decline of amphibians has drawn the attention of citizens and scientists alike. In the midwestern United States, frog and toad populations have dropped dramatically over the last several decades due to extensive loss of wetland habitat and increased degradation of water quality. This sensitivity to changes in land use and water quality makes amphibians good indicators of environmental health. And, while the larger picture may be rather bleak, frogs and toads can quickly respond to changes in local habitat conditions.

Enhancing Environmental Health

Management practices that enhance the overall environmental health of your farm are also capable of producing an abundance of frog and toad species.

Biodiversity plays a vital role in sustaining the environmental health of a farm. Ensuring biodiversity requires management decisions that promote a diversity of habitats on the farm, some of which can provide habitat needed by frogs and toads. These include streams, wetlands, permanent and seasonal ponds, grasslands, and woodlands. Practices that promote good water quality also help increase the abundance of these animals. Even improvements in soil structure help species like the American Toad, which burrows below the frost line to overwinter in upland sites away from water.

Why I Monitor Frogs and Toads

Monitoring Project farmer Ralph Lentz explains why he monitors frogs and toads on his farm near Lake City, Minnesota:

> The frogs get singing on our place a little earlier in the spring than in most other places. This is probably because of the spring-fed pond and relatively warm water temperatures. What I hope to observe as I improve vegetative cover and water quality through rotational grazing that includes areas of extended rest is an increase in the abundance of frogs and toads. I think I am already seeing this, but I will be paying closer attention as time goes on. Paying attention to frogs and toads and other stuff causes me to see things I was not looking for and helps me better define my management in terms of soil health, water quality, diversity, and choices for future generations.

Steps before Monitoring

Before heading out to monitor for frogs and toads on your farm, consider doing the following suggestions:

- Review the goals you and your family have set for your farm. Do they reflect an understanding of the importance of biodiversity in sustaining a healthy environment?
- Summarize the main farming practices you use and rate them in terms of whether or not they enhance or harm the environmental health of your farm.
- Write down a few clear and workable objectives about what you want to learn from monitoring frogs and toads on your farm.

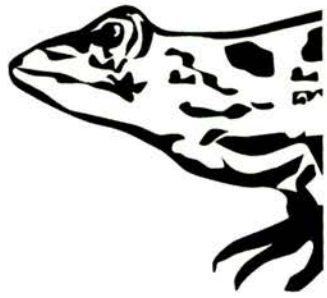
Follow up your monitoring activities by investigating ways to improve the health of your farm's natural resources.

Some Monitoring Cautions

While frogs and toads can quickly respond to improvements in local habitat conditions, they do not travel great distances. If your farm currently has no frogs or toads or is missing some species, colonization could take some time. Certain species may not appear if your farm is not within their historic territory.

Conditions such as long-term drought or sources of water quality degradation beyond your direct control can also delay or diminish the response to improved habitat conditions on your farm. In other words, be cautious of how you interpret the information gathered from monitoring frogs and toads on your farm, especially in the short-term.

Frog and Toad Monitoring Tools



Leopard frog

The main tool used to monitor frogs and toads involves conducting listening counts three times a year: early spring, late spring, and summer. This method has proven to be an effective and simple way to monitor frogs and toads for both lay and professional observers.

Prep Work

Prior to doing the listening counts, you will need to do some preparation work.

Learn the Calls

Several weeks before doing your first count, begin listening to the audio cassette tape "Frogs and Toads Found in Minnesota," included with the *Tool Box,* to learn the identifying calls. Also, review the descriptions of the calls given on the Frog and Toad Identification Guide included with this chapter.

Listen and review as often as you need to in order to feel comfortable about your ability to identify the different species this way. Try listening to the tape at times when you might normally listen to the radio, such as driving to town or doing the dishes. Just remember that repeated listenings is a more effective learning strategy than "crash studying."

Select Listening Sites

Do a quick assessment of the different habitat types on your farm and identify those that might provide good frog and toad habitat. From among these, select at least one as a listening site. If you establish several listening sites, make sure they are far enough apart so that the calls from one site are not confused with calls from another site. You could also establish

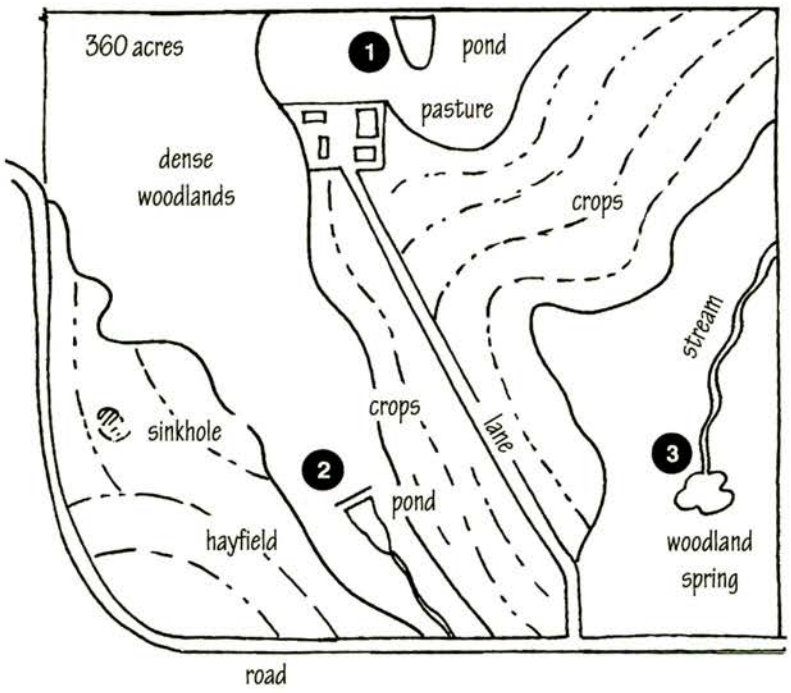


Figure 1: Establish multiple listening sites far enough apart so that calls from one site are not confused with calls from another site.

a monitoring route that includes a couple of off-farm listening points within your neighborhood.

Mark your listening points and monitoring route on a farm map. Also, write down a general decription of each location in your journal as well as your main reasons for choosing the site. (See Figure 1.)

All sites should be relatively free of noises, such as heavy traffic, that might interfere with your ability to hear the animals or cause them to remain silent. Plan on familiarizing yourself with your site(s) and your route during daylight hours so that when you go out at dark you will cause as little disturbance as possible.

Plan Ahead

Refer to the chart at the left and mark your calendar with a reminder to conduct one count during each of three count periods. The best time to do counts is after dusk on a calm night.

Count Period	Range of Dates	Minimum Water Temperature
1. Early spring	April 15–30	50°F
2. Late spring	May 20–June 5	60°F
3. Summer	June 15–30	70°F

Because not every night is good for monitoring frogs and toads, be prepared to seize the opportunity when it comes. Make sure you have a clipboard, pencils, and the Frog and Toad Identification Guide handy; your flashlight has good batteries; and you have enough photocopies of the Frog and Toad Record Sheet on hand. You will need one record sheet per year for each site. Use the master copy only to make photocopies.

Open Your Ears

On the night of the count, gather your monitoring materials and head out to your site(s) after dusk. Be sure to have a watch with you to keep track of time.

Approach each site quietly and sit for a few minutes to let the animals adjust to your presence, then start your timed listening. Listen for five or ten minutes (be consistent from site to site and year to year) and record your observations on the Frog and Toad Record Sheet. (See Figure 2.)

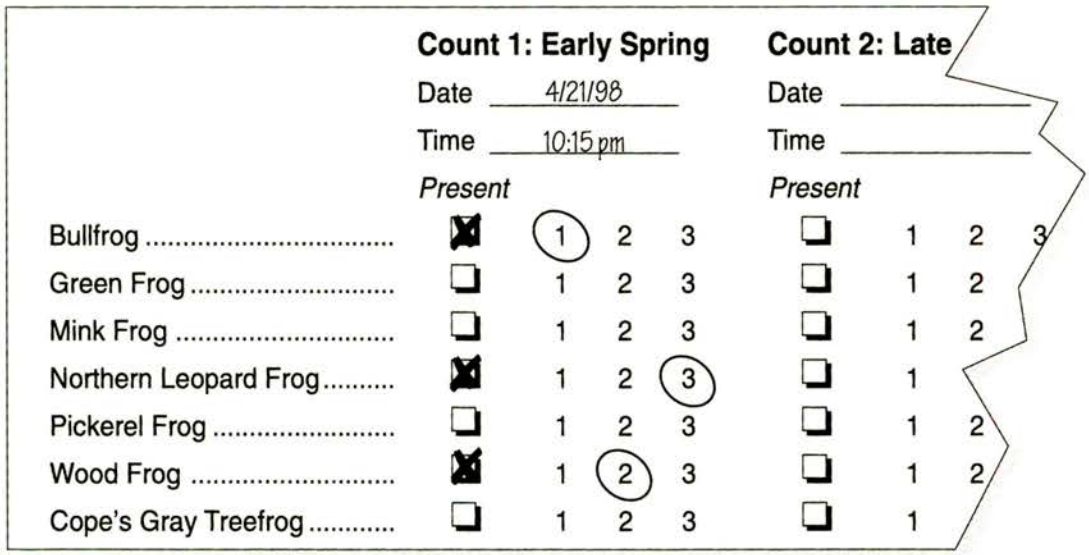
Check the "Present" box if you hear a particular species. Then circle the number (1, 2, or 3) that best describes the level of abundance you are hearing for that species:

1 = individuals of a species can be counted; there is silence between the calls heard

2 = calls of individuals can be distinguished, but there is some overlapping of the species' calls

3 = a full chorus of the species can be heard; calls are constant, continuous, and overlapping

Use the space at the bottom of the record sheet for notes about weather conditions and any other interesting observations made during each count period. Or, record this information in a field notebook or journal.



	Count 1: Early Spring				Count 2: Late			
	Date 4/21/98				Date _____			
	Time 10:15 pm				Time _____			
	Present				*Present*			
Bullfrog	☒	(1)	2	3	☐	1	2	3
Green Frog	☐	1	2	3	☐	1	2	
Mink Frog	☐	1	2	3	☐	1	2	
Northern Leopard Frog	☒	1	2	(3)	☐	1		
Pickerel Frog	☐	1	2	3	☐	1	2	
Wood Frog	☒	1	(2)	3	☐	1	2	
Cope's Gray Treefrog	☐	1	2	3	☐	1		

Figure 2: Filling out the Record Sheet

Open Your Eyes

In addition to opening your ears through listening counts, you can also monitor for the presence of frogs and toads on your farm by simply opening your eyes.

When you walk across a pasture or along a stream bank watch the ground to see if any frogs or toads leap away from you. Look for frogs and toads when working around the farmyard and in orchards and garden areas. If you hear tree frogs in your yard, try to get a glimpse of them. Record your sightings on a separate copy of the Frog and Toad Record Sheet labeled "Sightings," or keep track of them in a field notebook.

Monitoring frogs and toads can do more than help you assess the environmental impact of your management decisions. It can also help strengthen—or awaken—your awareness of the world in which you live. And, it can serve as an opportunity to connect with family members in a fun way that adds to the quality of your life.

Additional Resources

Books

The following books can be obtained through your local library or purchased through your local bookseller.

Amphibians and Reptiles Native to Minnesota, by Barney Oldfield and John J. Moriarty. (Minneapolis: University of Minnesota Press. 1994.)

A guide to the forty-eight species of amphibians and reptiles native to Minnesota for the amateur herpetologist, specialist, and curious observer. Describes identifying characteristics and preferred habitat with excellent photos and maps. Outlines techniques for observing, and gives timely discussion of their conservation needs.

Field Herpetology: Methods for the Study of Amphibians and Reptiles in Minnesota, by Daryl R. Karns. (Minneapolis: Bell Museum of Natural History. 1986.)

A practical, "how-to" guide for the field study of amphibians and reptiles in Minnesota. A useful companion to other field guides and highly recommended for weekend naturalists, school teachers, and other amateur herpetologists.

Minnesota's Endangered Flora and Fauna, edited by Barbara Coffin and Lee Pfannmuller. (Minneapolis: University of Minnesota Press. 1988.)

A comprehensive reference covering some three hundred species, ranging from mosses and lichens to jumping spiders and bald eagles. Gives brief descriptions of the natural history, including present and historic range maps, of each species that was listed as endangered, threatened, or special concern at the time of printing. Although the state list was revised in 1996, the book still gives the general audience good background information on many of Minnesota's rare life forms.

Natural History of Amphibians and Reptiles of Wisconsin, by Richard C. Vogt. (Milwaukee: Milwaukee Public Museum. 1981.)

An excellent field guide and a natural history treatise on Wisconsin's herpetofauna, designed to aid both species identification and appreciation. The dichotomous key in the front of the book enables the reader to narrow down choices for further diagnostic identification.

Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes, by George K. Reid. (New York: Golden Press. 1987.)

An inexpensive, informative, and well-illustrated guide to the plants and animal that live in or near ponds, lakes, streams, and wetlands. A highly recommended resource.

Organizations and Programs

Minnesota Frog Watch was formed due to concern over the loss and deformities of Minnesota's amphibians. The program is part of the Center for Global Environmental Education at Hamline University in St. Paul, MN. Minnesota Frog Watch develops educational materials and activities guides, an on-line project, and activities related to the study of toads and frogs. It coordinates volunteer participation in the Minnesota Frog and Toad Survey, which is part of the North American Amphibian Monitoring Program. And, it takes reports on sightings of deformed frogs, toads, and salamanders. For more information, contact Minnesota Frog Watch at Hamline University, 1536 Hewitt Avenue, St. Paul, MN 55104; (612) 523-2812 or (800) 888-2182.

Information on frogs and toads of Minnesota can also be obtained from the **Nongame Wildlife Program** of the **Minnesota Department of Natural Resources.** Program staff may also be able to offer assistance in conducting listening counts on your farm. Contact the Nongame Wildlife Program, Minnesota Department of Minnesota, Section Wildlife, 500 Lafayette Road, St. Paul, MN 55155-4007. Or, call the Minnesota DNR general information number at (612) 296-6157.

Web Sites

The following web sites offer a wide variety of both local and world-wide information concerning frogs and toads:

Declining Amphibian Population Task Force:
www.acs-info.open.ac.uk/info/newsletters/FROGLOG.html

Minnesota Frog Watch/1000 Friends of Frogs:
www.cgee.hamline.edu/frogs

Minnesota Department of Natural Resources:
www.dnr.state.mn.us

Minnesotat Herpetological Society:
www.onrampinc.net/mhs/

North American Amphibian Monitoring Program:
www.im.nbs.gov/amphibs.html

Society for the Study of Amphibians and Reptiles:
www.falcon.cc.ukans.edu/~gpisani/SSAR.html

Monitoring Frogs and Toads

Frog and Toad Record Sheet

Year _____

Location _____

Check "Present" if you hear a particular species. Then circle the number that best describes the level of abundance you are hearing for that species:

1 = individuals of a species can be counted; there is silence between the calls heard

2 = calls of individuals can be distinguished, but there is some overlapping of the species' calls

3 = a full chorus of the species can be heard; calls are constant, continuous, and overlapping

	Count 1: Early Spring				**Count 2: Late Spring**				**Count 3: Summer**			
	Date _____				Date _____				Date _____			
	Time _____				Time _____				Time _____			
	Present				*Present*				*Present*			
Bullfrog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Green Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Mink Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Northern Leopard Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Pickerel Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Wood Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Cope's Gray Treefrog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Eastern Gray Treefrog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Northern Cricket Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
Spring Peeper	❑	1	2	3	❑	1	2	3	❑	1	2	3
Western Chorus Frog	❑	1	2	3	❑	1	2	3	❑	1	2	3
American Toad	❑	1	2	3	❑	1	2	3	❑	1	2	3
Canadian Toad	❑	1	2	3	❑	1	2	3	❑	1	2	3
Great Plains Toad	❑	1	2	3	❑	1	2	3	❑	1	2	3

Count 1 notes:

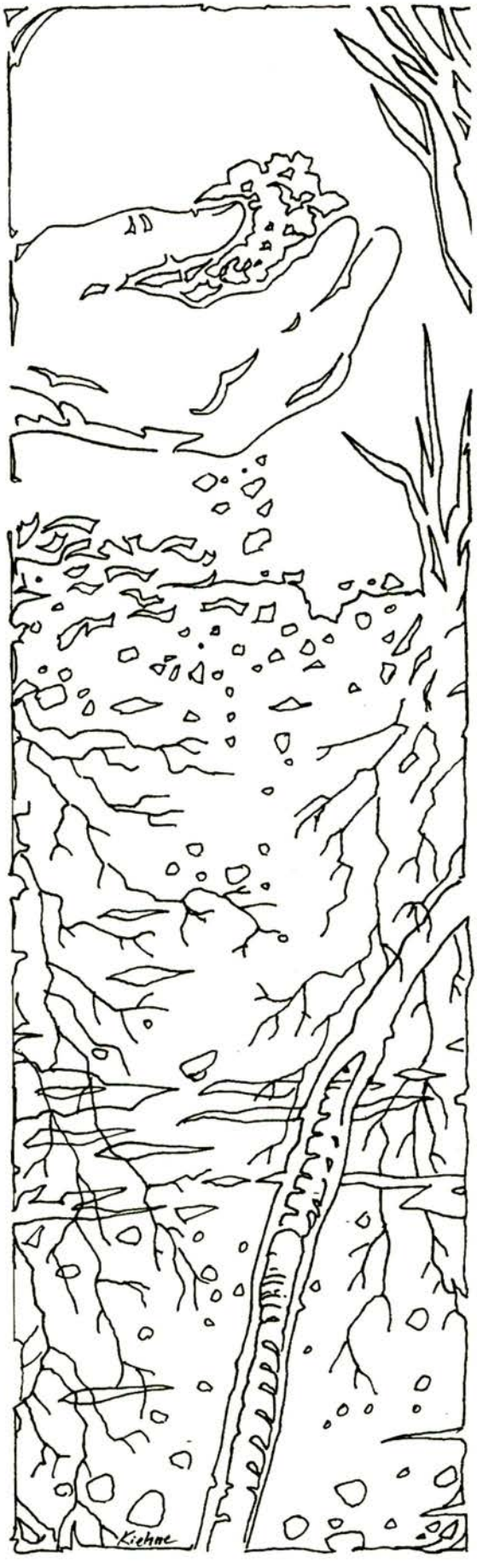
Count 2 notes:

Count 3 notes:

Monitoring Frogs and Toads

Frog and Toad Identification Guide

Species	Calls	Identifying Marks
Bullfrog	Deep bass notes that sound like a foghorn, or the roar of a distant bull but with a more musical quality. They occasionally sing in chorus.	Brown and large; 3 1/2–8 inches.
Green Frog	Vigorous call with considerable carrying power. Resembles the twang of a loose banjo string and is usually given as a single note.	Mottled brown w/ yellowish-green background; 2 3/8–3 1/2 inches.
Mink Frog	Sounds like a creaking porch swing or glider.	Green w/ dark mottling on back. Bright green "smile" on sides of head. 2–2 3/4 inches.
Northern Leopard Frog	A long, deep snore similar to the sound of rubbing your thumb against an inflated balloon. Often interspersed with a chuckling sound.	Two rows of spots on back; 2–3 1/2 inches.
Pickerel Frog	Soft snore that is more regular and has less carrying power than that of the leopard frog. No chuckling.	Two rows of spots on back w/ a yellow edge on the belly; 1 3/4–3 1/4 inches.
Wood Frog	A hoarse, low-pitched croaking. The subtle quacking sound has little carrying power.	Appears to have a mask on the face; 2–2 3/4 inches.
Cope's Gray Treefrog	Similar to the eastern gray treefrog; but shorter, faster, and harsher.	Green or grey. When grey, large dark blotches on back; Inside thighs yellow; 1 1/4–2 inches.
Eastern Gray Treefrog	A loud, resonant trill; somewhat birdlike in sound. Slower, longer, and more melodic than the Cope's gray treefrog. Individual voices may vary.	Gray, w/ dark, black-bordered blotches; 1 1/4–2 inches.
Northern Cricket Frog	Strong resemblance to the chirping of a cricket, or like the sound of two steely marbles striking each other. Begins slowly, continuing more rapidly for 30 to 40 seconds.	Non-climbing treefrog; grey, brown, or tan; dark triangle between the eyes; 5/8–1 1/2 inches.
Spring Peeper	High, ascending peep that can be heard for a 1/4 mile. A trill call similar to the jingling of sleigh bells.	Tan or peach "X" on back; 3/4–1 1/4 inches.
Western Chorus/ Boreal Chorus Frog	Ascending, musical, high-pitched call lasting 1 to 2 seconds; does not carry. Sound similar to running a fingernail across the teeth of a high-quality, fine-toothed comb.	Tan w/ brown stripes; 3/4–1 1/4 inches.
American Toad	Drawn-out, high-pitched musical trill lasting up to 30 seconds. Individual voices carry a slightly different pitch.	Mottled green, brown, or tan; 2–3 1/2 inches.
Canadian Toad	Clear trill similar to the American toad, but deeper, slower, and lasting only about 5 seconds.	Brown w/ variable patterns of white and black; large bump between eyes; 2–3 1/2 inches.
Great Plains Toad	Loud, harsh, metallic rattle often lasting 20 seconds or more.	Large dark patches w/ light back borders; 2–3 1/2 inches.



Monitoring

Soil

Healthy soil, one of earth's most precious resources, is vital to a farm's long-term productivity and profitability; to environmental integrity; and to plant, animal, and human health. Monitoring the effects of management practices on your soil can help you to build and sustain this vital resource.

What is It?

Soil monitoring techniques can be used to assess the current status of soil resources; track changes in soil health due to management practices; and investigate specific soil health problems, such as compaction.

Who Does It?

A farm's soil should be monitored by the person most directly impacting it, the farmer. Working with a partner—such as a spouse, son or daughter, or neighbor—can make your monitoring more thorough and enjoyable. Professionals who can help include an independent soil/crop consultant, or staff from the Natural Resources Conservation Service (NRCS) or Cooperative Extension Service.

When?

Monitor your soil several times during the crop year: for example, a half-day to a day in the spring, a couple of hours in mid-season, and then again following harvest. Also, be consistent from year to year, such as always before field work in the spring or during the first two weeks of July.

Time Required

A few hours, two or three times a season, allows for adequate monitoring of soil health. Investigating specific problems may require additional time.

Materials

Useful materials include a clipboard, a shovel, an aerial photograph of your farm, soil survey maps, a soil probe, and a soil sampling tube. You will also need photocopies of the Soil Assessment Record Sheet and the Soil Test Record Sheet; a master copy of each is provided. Some incidental materials will be needed for specific monitoring tools.

Costs

Many of the above items are readily available—or can be made—on most farms. What is not can be purchased for less than a hundred dollars. Also consider the cost of laboratory soil analysis and consultant fees when planning your soil monitoring strategy.

Getting Started

CHAPTER CONTENTS

This chapter of *The Monitoring Tool Box* provides a basic framework from which you can observe, manage, and appreciate your farm's soil resources. It offers some background information on key soil properties and processes, but does not claim to explain all the complex interactions that make soil the wonderful resource it is.

"Monitoring Soil" also describes a number of simple and inexpensive techniques with which to monitor your soil. Feel free to supplement this chapter with ideas, information, and tools of your own.

The Ideal Soil

As you plan your soil monitoring activities, consider the following description of the ideal soil and how to manage for it from the 1957 Yearbook of Agriculture, *Soil:*

> *[The ideal arable soil has] a deep rooting zone, easily penetrated by air, water, and roots. It holds water between rains, but allows the excess to pass through it. It has a balanced supply of nutrients. It neither washes away during rains nor blows away with high winds. The combination of practices to use depends on what is necessary to develop and maintain a soil as nearly as possible to the ideal on a sustained long-time basis. They vary widely among the many kinds of soil.*
>
> *Successful farmers choose the practices for their fields according to two primary considerations: What practices do I need to come near the ideal? How will the costs and returns fit into my farm budget?*
>
> — Charles E. Kellogg

Ask yourself, "What perspective on soil is most in line with our family's goals for the farm and our management plan? Does it reflect the ideas expressed in this quote, or does it reflect a different view of soil?" In other words, be clear about what you are trying to achieve for the farm as a whole and how healthy soil fits into the mix.

Part of this clarity involves understanding the "playing hand" nature and past farming practices have dealt you. The tools offered in this chapter can help you assess your farm's soil with regard to its

- **general characteristics** (landscape details and history, soil types, soil profile, soil texture);
- **physical fitness** (soil structure, surface conditions, water dynamics);
- **fertility** (nutrient levels, organic matter content, cation exchange capacity, pH);
- **biological activity** (residue decomposition, soil organisms); as well as
- **crop health** (appearance and stress resistance).

The baseline of information gathered from your first year's monitoring can help you learn how best to build upon your soil's strengths and work within its limits. The same tools can then be used to monitor progress toward your long-term goals for your soil and for the farm.

Develop a Monitoring Plan

Thoughtfully review this chapter in light of your goals for your farm and your current management practices. Then ask yourself, "What do I want to learn from monitoring my farm's soil?" From this basis, identify some clear objectives and build a monitoring plan around these objectives, plugging in the tools that seem most likely to help you answer your questions. For example:

Objective: I'd like to know how my tillage practices affect the health of my soil.

Plan: Monitor soil structure and look for signs of compaction and erosion. Also, examine growth patterns of crop roots.

Objective: Does my soil sustain a complex community of beneficial soil organisms?

Plan: Monitor residue decomposition and conduct earthworm counts.

Develop a monitoring plan that is both informative and manageable, and write it down in your journal or field notebook. Keeping things manageable is especially applicable to the first year of soil monitoring while you are still familiarizing yourself with the process. Let your monitoring skills and your plan evolve with experience.

Choose Your Monitoring Sites

To select the specific sites you want to monitor over a period of years, consider variations among fields, differences in management practices and soil types, as well as unique or problem areas. From among your options, select five to ten soil monitoring sites by using the following methods:

Managing for the Ideal Soil

For Mike and Jennifer Rupprecht of Lewiston, Minnesota, leaving their farm's soil resources in better condition than when they started farming is of prime importance. In addition to the social and spiritual value of land stewardship, they fully recognize its direct value to them. They know that how they care for their soil resources greatly affects their ability to meet their other goals for the farm, like paying off the home place and making a good living for the family.

The Rupprechts became involved with the Monitoring Project, in part, seeking specific indicators they could monitor to determine progress toward their goal of managing for the ideal soil. They were also interested in having long-term soils research conducted on their farm so that others could confirm or refute their own observations.

The Rupprechts' farm consists of row crops, hayfields, and rotationally-grazed pasture. To sustain the production and profitability of these components of their farm, the Rupprechts have identified some very clear soil management objectives, including

- increasing organic matter content and cation exchange capacity over time,
- setting target levels for soil nutrients,
- avoiding fertilizers that may be harmful to soil organisms,
- increasing water infiltration and eliminating erosion, and
- minimizing compaction.

Besides providing measurable indicators of progress toward good soil stewardship, these objectives also make that goal more real and more relevant to daily life on the farm. By using the tools offered in this chapter, you too can learn how to measure your progress toward managing for the ideal soil.

A Starting Plan

The following outlines a simple soil monitoring plan that can be used to familiarize yourself with the monitoring process. It can be easily modified and expanded as your comfort, confidence, and interest grows. At one or two monitoring sites, use the following tools:

In the Spring

- ✓ Test the stability of your soil aggregates. (See page 9)
- ✓ Dig for earthworms. (See page 18)

In the Summer

At the end of June or beginning of July

- ✓ Test for compaction using a soil probe. (See page 10)
- ✓ Check the decomposition of last year's crop residue. (See page 17)
- ✓ Do a root inspection. (See page 19)

In the Fall

- ✓ Conduct a perc test. (See page 13)
- ✓ Look for nightcrawler middens. (See page 18)

Every Three to Five Years

- ✓ Have a soil test done to track organic matter, cation exchange capacity, and nutrient levels. (See pages 15 to 16)

The Specific Site Method

If you identify specific areas you want to monitor, clearly mark these sites on your farm map and label them either with a number or a letter. (See "Sketch a Farm Map" on page 5.) Go out to these locations and write down in your journal any information that will help you to find this location again.

For example, say you select a ten acre area in your north 80 because the crops tend to be poorer there. Make a note such as this:

> *Site A: SW corner north 80, approximately 10 acres. Extends east about 16 wooden fence posts from the SW corner, then north a quarter mile and then back to the west fenceline. Soil obviously lighter in color than surrounding areas.*

You can also note any other facts you know about this site, such as its farming history—both under your stewardship and before.

The Transect Method

Monitoring sites can also be selected along a *transect*, a long continuous strip across a field with monitoring locations spaced at even intervals. (See Figure 1.)

Select a logical starting point and mark it on your map. Next, pick out some feature at the other end of the field, such as a tall tree along a fenceline, and mark it as well. Give this transect a label, such as "Transect 1."

Make your way straight across the field toward the far point. As you go, make notes about every fifty or a hundred paces about soil type, slope, or soil color. For each stop, mark your location on your map and label the site with a number or letter. Record a more detailed description of each site in your journal.

Depending on your farm's layout and size, you may want to mark out several transects. Over the years, keep your eyes open for other areas that might also need to be monitored, such as an area that is not responding well to your management changes, and add these to your list of monitoring locations.

Record Keeping Aids

Along with the various soil monitoring tools, this chapter also includes a **Field Guide** to help you interpret your soil monitoring observations, a **Soil Assessment Record Sheet** on which to keep track of them, and a **Soil Test Record Sheet** on which to summarize the results of laboratory soil analysis. For each year of monitoring, you will need a photocopy of

both record sheets for each monitoring site. The master copies of these record sheets from which to make photocopies are provided. Keeping good records of your soil monitoring activities will help you to see trends and changes over time.

Size Up Your Soil Resources

Before proceeding to the specifics of soil monitoring, take some time to size up the general characteristics of your current soil resources using any or all of the following tools.

Sketch a Farm Map

Put together a map of your farm detailing as much information as possible as it relates to your soil resources. (See Figure 1.)

On a piece of graph paper, trace or sketch out a true-to-scale map of your farm. An aerial photograph of your farm can be a helpful guide; check with your local NRCS office to see if an aerial photograph of your farm is available. On your map, include notable features such as:

- fencelines/boundaries
- treelines/woods
- specific fields
- farmstead location
- field driveways
- lanes
- paddock divisions
- livestock yards
- waterways
- contour lines/strips
- ponds/creeks
- wetlands
- tile lines
- springs/wells
- hills/knolls
- low spots/draws
- sink holes

Walk your farm, if necessary, to check for accuracy and to fill in any missing details. Draw up a map for each of your land parcels if they are not contiguous.

Either on the map itself, or in your journal, note any pertinent information such as farm/field size (in acres), the cropping history of fields, their management history (such as areas that historically have had manure applied), and so forth. Make several photocopies of your map(s) when you finish, keeping the original as a master copy.

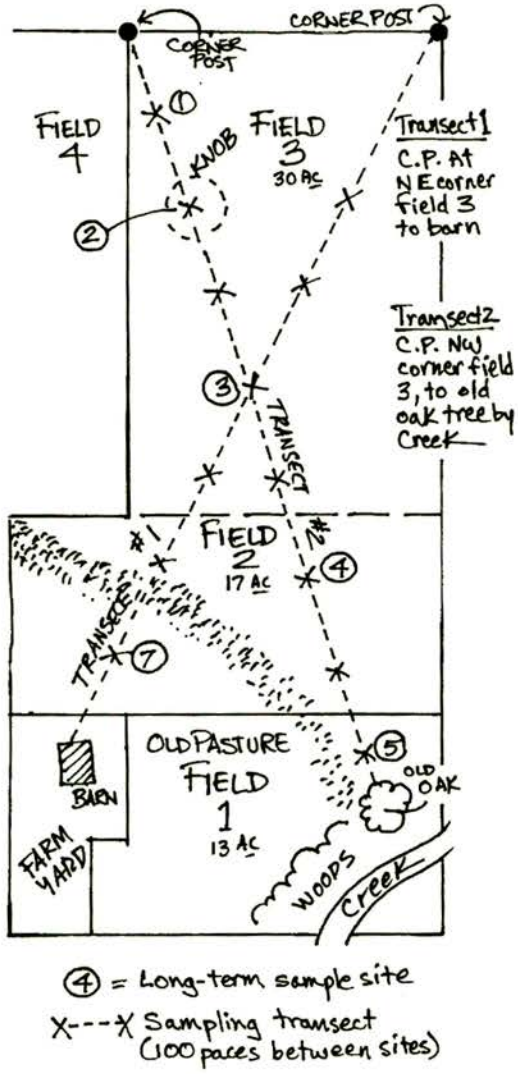


Figure 1: A sketch map is one way to outline a big-picture view of your soil resources.

Get Up Close and Personal

Another way to size up your farm's soil is to get "up close and personal" with it. At each of your monitoring locations, dig into the soil and answer questions like these:

- What color is your soil? How dark or light?
- How easily can you dig into the soil with your hand or shovel?

- What does it feel like in your hand? Sticky? Gritty? Smooth?
- How well does it crumble in your hand?
- How does your soil feel when you walk on it? Hard and packed down? Soft and spongy? Somewhere in between?
- What else do your senses tell you about your soil?

For each location, record this information in your journal. Monitor for this information periodically—such as after a rain, after a long dry period, at different times of the year, or from year to year—and note changes and similarities.

This approach allows you to develop a more subjective "feel" for your soil. Such knowledge, when combined with information gathered from other observation methods, can give you a fuller picture of the well-being of your soil.

Research Your Farm's Soil Types and History

Much information can be gleaned from your county's soil survey, which should be available from your local NRSC office or library. Research this excellent source to find out your farm's main soil types, their locations, and the crop suitability ratings for each soil type. The soil survey also relates general landscape characteristics like slope and aspect, soil forming factors such as whether the area was prairie or forest, the type of bedrock or parent material, climate, and the management history of the soil in your region.

Also, look for other references that might help you understand the history of your soil, as well as its inherent limits and potential. These resources include geological histories such as *Minnesota Underfoot,* and ecological histories like *Minnesota's Natural Heritage: An Ecological Perspective.* Summarize this type of information in your journal or as notes on your map.

Examine the Soil Profile

To complement your soil survey research, actually examine the soil profile at your monitoring sites.

The Soil Profile

A soil's *profile* consists of successive layers of soil and soil-building material running vertically from the surface to the bedrock, or *parent material.* These layers are called *horizons* and are classified according to their color, texture, consistency, structure, pH, boundary characteristics, and continuity. The parent material from which a soil type is formed tends to influence its overall properties:

- **Limestone bedrock:** Soils are typically clays and clay loams with high inherent pH.

- **Sandstone bedrock:** Soils are usually coarse-textured, tend to be more acidic, and have lower nutrient reserves.
- **Shale bedrock:** Soils are typically clays, shallow, and impermeable to water.
- **Glacial till and outwash:** Soils reflect the properties of the parent material carried by the glaciers and the manner in which the material was deposited. They can range from sandy or gravelly to fine, loamy soils.
- **Loess:** Loess soils are wind-blown deposits of fine silt materials and are among the world's most productive soils because of their silty loam texture.

Dig In

If at all possible, find a soil surveyor who will come out and walk your farm with you. In addition to his or her extensive knowledge of soil types and their corresponding profiles, a soil surveyor may also have an extra-long soil sampling tube that allows you to examine the soil profile without having to dig a big hole.

If you do need to use a shovel, dig into the soil as deep as you can. Then examine the walls of the hole and look for different color layers of soil. The top layer, or the *topsoil,* is usually darker than the *subsoil* layer below it.

Measure the depth of the top layer, note the color and record both pieces of information on the Soil Assessment Record Sheet. Do the same for any other distinct layers you can see due to color differences, such as a transition layer between

A Lesson in Soil History

In 1994, just as the Monitoring Project was getting started, Mike Rupprecht invited George Poch, retired Soil Conservation Service (now NRCS) soil surveyor, to his farm. George had conducted soil surveys in southeastern Minnesota for nearly thirty years, and Mike wanted George's help in learning the story of his farm's soil.

On a high spot at the eastern edge of the farmstead, George plunged his personally designed sixty-inch soil sampler into the ground. He pulled out a fifteen-inch core that showed the dark brown topsoil to be about eleven inches deep followed by the light brown subsoil. Taking a pinch of the topsoil between his fingers and rubbing, George identified the soil type as a silt loam.

After removing the first core from the sampler, George probed the hole again and brought up the next fifteen inches of soil, which looked exactly like the bottom four inches of the previous core. George identified the soil in this location as a classic example of Mt. Carroll silt loam, a productive, well-drained soil developed from wind-blown loess.

Walking east about fifty yards, George ran his probe into the ground again and pulled out another fifteen-inch core that was dark brown the entire length. A quick run through with his fingers emptied the probe. Upon sinking the probe again, the dark brown quickly gave way to a light brown in the second core indicating a sixteen-inch layer of topsoil. Although similar in characteristics and management response to the Mt. Carroll soil, this soil would technically be classified as a Port Byron silt loam.

Further probing across the farm revealed predominantly Mt. Carroll silt loam with a few patches of Port Byron mixed in. As they walked, George talked about the geological history of the area—what layers of rock would be found below the soil, how the wind-blown loess was carried in from glaciated areas to the west, and how previous farm management (over the last one hundred or so years) had changed the soil and the landscape.

This last topic piqued Mike's curiosity so they headed into a draw to take a core sample. The probe went down forty-eight inches before they found a change in color. But, instead of finding lighter color subsoil at that depth, the already dark soil became almost black. This black soil was the original soil in that draw when it was first farmed—meaning that all of the soil above it was topsoil eroded off higher ground. For Mike, this was a powerful lesson about the importance of taking good care of his soil resources.

the topsoil and the subsoil. Use your county soil survey as a reference, especially if you are unable to dig down to the parent material. (For a cross-section of a soil profile, see "The Soil Universe," on page 16a.)

Figure 2: Assessing soil texture with the ribbon method

Assess Soil Texture

While examining the soil profile, also check the *soil texture* of each layer. The term soil texture refers specifically to the relative amounts of mineral particles in the soil. But soil is not only made up of sand, silt, clay, and rock fragments, but also organic matter, water, and air. An ideal soil texture is 50 percent solids, 25 percent water, and 25 percent air. Either of the following two methods can be used to assess soil texture.

The Ribbon Method

The ribbon method is a "hands-on" way to determine soil texture. Put a rounded tablespoon of soil in the palm of one hand (about half a handful). Spray a little distilled water onto the soil and knead it. Repeat this process until the soil forms a nice ball in your palm.

Ribbon Method

No ball: ..... sand

Ball but no ribbon: ..... loamy sand

	Feels very gritty	Feels very smooth	Feels both gritty and smooth
1 inch ribbon:	sandy loam	silty loam	loam
1-2 inch ribbon:	sandy clay loam	silty clay loam	clay loam
2 inch or more ribbon:	sandy clay	silty clay	clay

Then gently squeeze the soil between your thumb and index finger to form a ribbon that extends over the top of your index finger. Continue to form a ribbon until it breaks. (See Figure 2.) Note how long the ribbon was when it broke and whether it feels gritty or smooth. Compare your findings with the ribbon method chart at left to determine the texture rating. Record this information on the Soil Assessment Record Sheet for each site.

The Quart Jar Method

The quart jar method of assessing soil texture allows you to see the relative amounts of mineral and organic particles within a given soil.

With a permanent marker, make a line approximately one-third of the way from the bottom of a clean, empty quart jar and another line at the two-thirds point. Collect some soil from the top six to eight inches of your soil profile or other depth of interest. Fill the jar with soil to the first line and add distilled water up to the second line. Add a little automatic dishwasher detergent to the water to help disperse the soil particles.

Shake the jar vigorously for about thirty seconds. Let it sit for about five minutes. Again, shake the jar vigorously for about thirty seconds. Place the jar on a hard, level surface and let it sit until the water is mostly clear—at least two hours; overnight is better. The largest particles (sand)

will settle first and form the bottom layer, followed by silt and clay. Organic matter fragments, being much less dense, often float. (See Figure 3.)

When all of the soil has settled out of suspension, look at the soil in the bottom of the jar. With a ruler, estimate the percentage of each constituent, and refer to the quart jar chart below to determine the soil texture. Record this information on the Soil Assessment Record Sheet for each site.

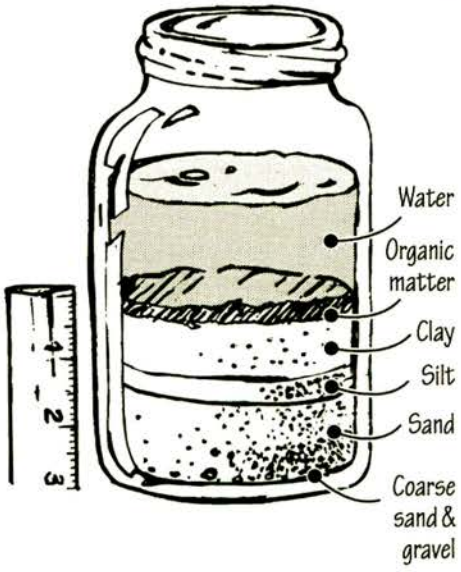


Figure 3: Using the quart jar method to assess soil texture

Quart Jar Method

Particle Distribution	Soil Texture
good mixture (40% sand, 40% silt, 20% clay)	loam
greater than 50% sand	sand or sandy loam
greater than 50% silt	silt or silty loam
greater than 20% clay	clay loam
greater than 40% clay	clay

Physical Fitness

Stresses like drought, heavy rainfall, tillage, and traffic all affect the physical fitness of your soil. To minimize the effects of such stresses, soil needs to be in good physical condition. In soil language, it needs to have good *tilth*. Soil with good tilth is easy to work, makes a good seedbed, is well aerated, and is easily penetrated by roots and water. Soil in poor physical condition is more susceptible to erosion, crusting, compaction, and extremes in soil moisture.

Soil Structure

The proper growing environment for plants depends on good soil structure. *Soil structure* refers to the way individual soil particles group into larger clusters or *aggregates*. In the best soil structure, particle groups are loose and crumbly; a handful of soil easily crumbles into a bunch of small, granular aggregates. Soil with poor structure can be cloddy with big chunks of soil or is dusty and powdery.

Test for Aggregate Stability

A good tool for evaluating the structural condition of your soil involves testing for *aggregate stability,* the ability of soil aggregates to withstand breakdown by water. A soil's aggregate stability is a good indicator of how well it can resist crusting and erosion.

Use a shovel to dig out a six- to eight-inch sample of topsoil and gently mix a handful or two in a bag. Pick out two or three pea-size soil aggregates and place them in the bottom of a small glass jar. Gently add just enough water to cover the soil aggregates halfway and let them soak for

Aggregate Stability Test

	Aggregate Response	Stability in water	Interpretation
1	breaks down by wetting	none	very susceptible to crusting and erosion
2	breaks down with gentle swirling, water turns cloudy	low	susceptible to crusting and erosion
3	breaks down with gentle swirling, water stays clear	fair	somewhat stable, susceptible to erosion and crusting from bare surface or excess tillage
4	no breakdown with gentle swirling	good	very stable; sign of good structure-protecting practices

about a minute. Use the aggregate stability chart at left to interpret your results. Repeat the test several times at each site and record the results on the Soil Assessment Record Sheet.

Common Symptoms of Poor Soil Structure

Soil Compaction

Soil compaction is the most widespread form of poor soil structure in the Midwest. *Soil compaction* involves compressing the pore spaces between soil particles, resulting in poor aeration, slower water infiltration and drainage, and poor root penetration. The leading cause of compaction is working the soil when it is too wet; heavy axle loads also cause compaction. Soils with poor structure or low organic matter are especially susceptible. (See Figure 4.)

One type of compaction, called the *hardpan*, is usually found at the depth of primary tillage, between six and twelve inches. The breakdown in structure results from repeated use of a tillage tool, such as a plow or disk, at the same depth. Hardpans cause shallow root growth, which makes plants more vulnerable to drought and other stresses.

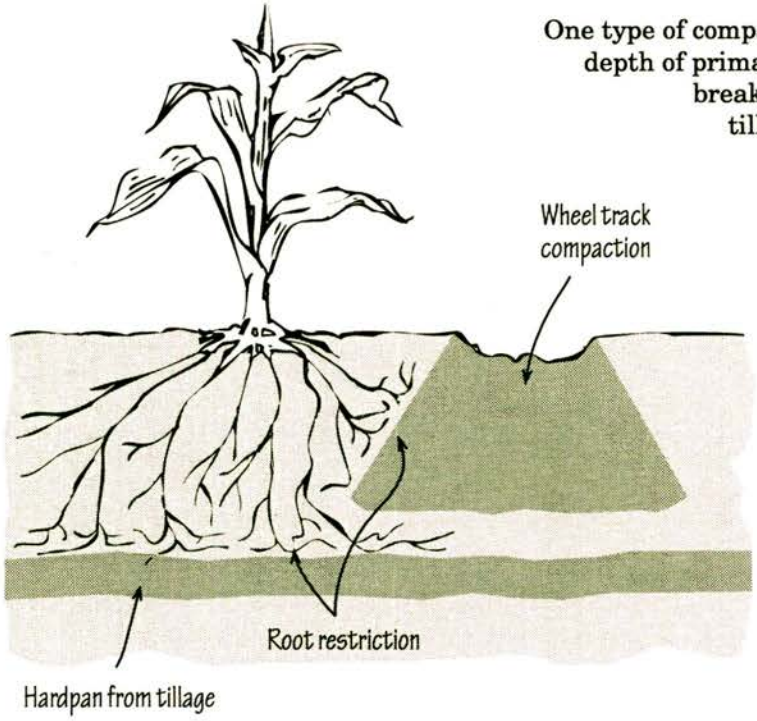


Figure 4: Common examples of soil compaction

Check for compaction: Observation of fields and crops is the simplest way to check for compaction. For instance, if you see water standing in the wheel tracks across a field, compaction is likely. If your crops show symptoms of drought even though you have had plenty of rain, a compacted layer or hardpan may be the reason.

A *soil probe,* a solid metal rod with a point at one end and a handle at the other, is also a valuable, easy-to-use tool for checking for compaction. Use this tool several days after a soaking rain when the soil is moist but not muddy. Testing when the soil is too dry could lead to false interpretations because a dry soil is harder to penetrate. Slowly press the probe into the ground until you feel resistance or

compaction. Refer to the measurement marks on your probe to note the depth of the compaction. Use the Field Guide to rate the level of compaction and record this rating on the Soil Assessment Record Sheet. (See "How to Make Your Own Soil Probe" at right.)

If you suspect a compaction problem based on observations and the use of a soil probe, use a shovel to dig a hole twelve to fifteen inches deep. Make note of any dense soil layers or restricted root growth and record this information in your journal or on the record sheet.

Erosion

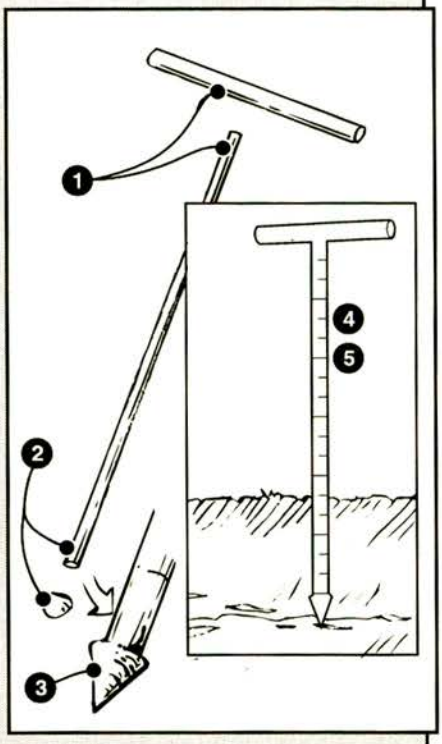
Erosion, from either wind or water, is another common symptom of poor soil management. Erosion directly reduces long-term productivity because it carries away the very topsoil that provides the best growing environment for plants. Whereas compaction or a hardpan can be alleviated through management, erosion requires the formation of new topsoil, which can take hundreds of years.

Check for erosion: The obvious way to track water-caused erosion is to observe your fields during or after a downpour. Check for signs such as the following:

- Is water running in your fields? Is it forming channels?
- Do you see any washouts in field terraces, along fencelines, creeks, waterways or tile outlets?
- Do you find any deposits of soil and debris?
- How muddy or cloudy is the water running in your creek, waterways or ditches?
- How silty is the bottom of your creek after the water level and flow speed return to normal?

Obvious signs of wind erosion include dirty snow, soil drifts in road ditches, and dusty air on windy days. Record the appropriate rating from the Field Guide on the Soil Assessment Record Sheet, as well as any pertinent observations.

How to Make Your Own Soil Probe



When Mike Rupprecht wanted to check for soil compaction in his grazing paddocks where animal impact had been high, he first borrowed a soil penetrometer, a pointed metal stick with a pressure gauge that measures how much force is required to push it through the soil. Not liking the "feel" of the penetrometer, Mike decided to make his own soil probe. It took him thirty minutes to make from two dollars worth of materials. Mike regularly uses his soil probe to "look" below the soil surface.

Follow these steps to make your own soil probe:

1. Weld a nine inch section of three-quarter inch pipe to one end of a thirty-six inch by half-inch diameter steel rod.
2. Add a five-eighth inch ball of weld to the other end of the rod.
3. Grind the ball of weld into a cone-shaped point.
4. Use a hacksaw to make notch marks every two inches along one side of the rod.
5. Every six inches, make a mark all the way around the rod.

Surface Conditions

The surface conditions of your fields also impact the physical fitness of your soil. A soil surface covered by growing plants or crop residues is much less susceptible to breakdown in soil structure and erosion by wind and water. For instance:

- A good plant canopy, such as in a field of solid-seeded soybeans, softens the impact of raindrops on the soil surface and lessens the threat of damaging soil structure.
- Including intensively managed pastures and other sod-based crops in a rotation provides dense surface cover while building soil structure and increasing infiltration.
- Grass waterways and filter strips stabilize soil, slow runoff, and trap sediment in concentrated flow areas and at field edges.
- A "trashy" surface, covered with crop residue, protects against wind erosion while slowing overland water flow, increases infiltration, and reduces water erosion.
- Cover crops between cash crops can effectively protect the soil surface from erosion.

Ideally, the soil surface is protected by some form of surface cover for as much of the year as possible.

Estimate Surface Cover

The following two methods can be used to estimate surface cover.

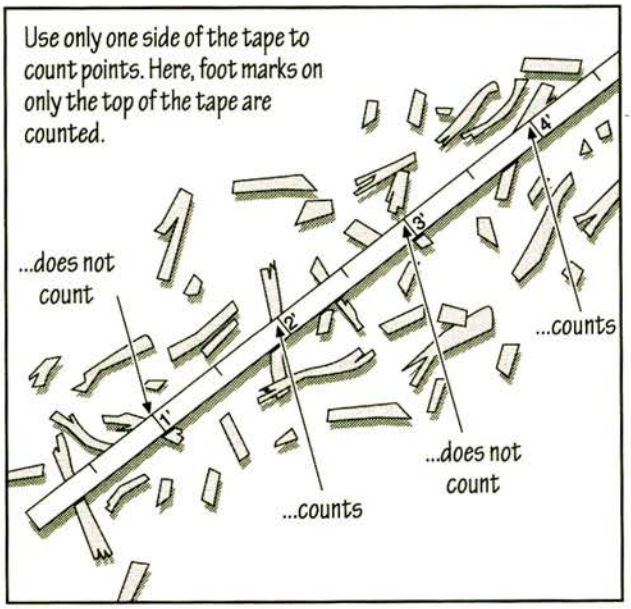


Figure 5: When estimating surface residue, count only the pieces of residue that are directly under a mark.

For residue cover: To estimate residue cover in a row-cropped field, you will need a 100-foot measuring tape. Within the general perimeter of your monitoring site, anchor the beginning of the tape and then stretch out the tape **diagonally across** the crop rows until you come to the end of the tape. Anchor this end as well. (A tape laid perpendicular or parallel to the crop rows will not give an accurate estimate of residue cover.)

Starting with the 1-foot mark, look straight down at the tape and count each foot mark that is **directly over** a piece of residue. (See Figure 5.) Disregard any piece of residue that is smaller than one-quarter of an inch because it is not big enough to dissipate the energy of a rain drop in an intense storm. Used a note pad and pencil to help you keep track as you count. When you have examined the full length of the tape, add up your count marks to determine the percent of residue cover for the site. For example, 32 pieces of residue counted means 32 percent residue cover.

For a pasture or hayfield: To estimate the percent of the soil surface covered in a pasture or hayfield, you will need a yardstick. At each monitoring site, randomly toss the yardstick. Wherever it lands, lay the yardstick flat on the ground and count each half-inch mark that intersects

with **bare ground.** Divide that number by 72 to get an approximate percent of bare ground. Obtain the percent of surface cover by subtracting the percent of bare ground from 100. Say, for example, you count 29 half-inch marks that intersect with bare ground. The percent of bare ground is approximately 40 (72 ÷ 29), meaning 60 percent of the surface is covered (100 - 40).

For greater accuracy, repeat this procedure two or more times within the monitoring site and average the results. You might even want to take a photograph directly over the yardstick at one or more count locations. Keep track of your notes of the results for each location photographed and write this information on the back of the photograph. This may help to train your eyes to recognize different surface cover percentages.

To interpret the results: To interpret the results from either of the above methods for estimating surface cover, consult the Field Guide. For each monitoring site, record the appropriate rating on the Soil Assessment Record Sheet.

What constitutes good surface cover varies depending on whether or not the field is in a sod-based crop, is row-cropped, or is in a fallow period. For instance, a row-crop field with 30 percent residue cover is considered to be in "conservation mode." In a pasture or hay field, only 30 percent surface cover would be woefully inadequate.

Check for Surface Crusting

One consequence of limited or no surface cover is *surface crusting.* The pounding action of raindrops breaks down the structure of the exposed surface soil, causing a thin crust to form that has little or no structure. Very low levels of organic matter and excessive tillage greatly contribute to crust formation.

A surface crust decreases the amount of water that soaks in, creating more runoff and erosion. Besides contributing to erosion, a surface crust also decreases the amount of air than can reach soil microbes and plant roots. And, severe surface crusting decreases seedling emergence and leads to poor stand density in both row crops and pastures. (See Figure 6.)

To test for a surface crust, take a pencil or pocketknife and stick it into the soil surface at a low angle. Gently lift the end of the pencil or knife blade upward. If you find an obvious crust, note its thickness and how easily it breaks up. Consult the Field Guide and record your rating on the Soil Assessment Record Sheet.

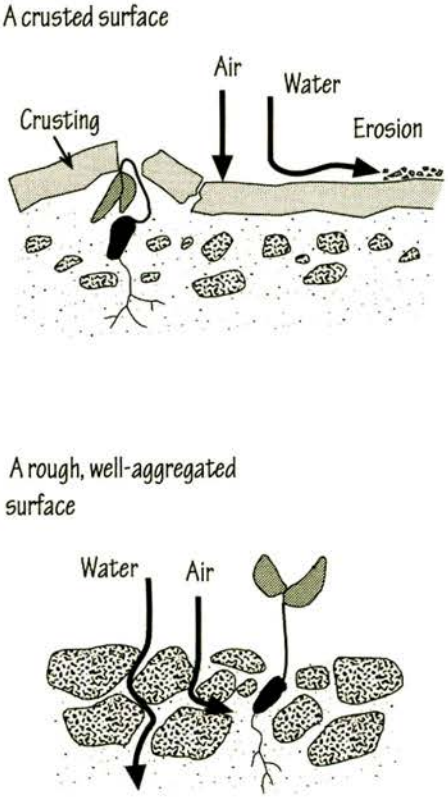


Figure 6: Surface conditions impact seedling emergence and air and water dynamics

Water Dynamics

The physical fitness of soil also depends on the soil's ability to soak up water, to retain the water needed in the root zone by plants, and to allow excess water to move out of the root zone so that good aeration is maintained.

Infiltration

Water *infiltration* refers to the percolation of water through the soil surface. Infiltration is helped by surface residues, worm holes and root

channels, good soil structure, and a rough soil surface. Surface crusts and compaction slow infiltration and lead to ponding, runoff, and erosion.

One way to check water infiltration is to visit your fields during a heavy rain to see if the water is soaking in or running off. If surface cover is adequate, or the surface is well-aggregated and rough (no crusting), the water should soak in with minimal erosion. (See Figure 6.) A drier way to check the rate of water percolation into the soil is to do a perc test using a coffee can.

Coffee can perc test

The perc test does not give you the exact rate of your soil's rainfall infiltration, but does give you a relative percolation rate in year-to-year comparisons. The best time to do the perc test is in the fall, when the soil has had the longest time to settle after any tillage. To do this test, you will need the following equipment:

- a two pound coffee can
- a small flat plastic lid
- an empty plastic soda bottle (16 or 20 oz. size)
- a ruler and a permanent marker
- a jug with enough water for the number of perc tests being conducted in one outing

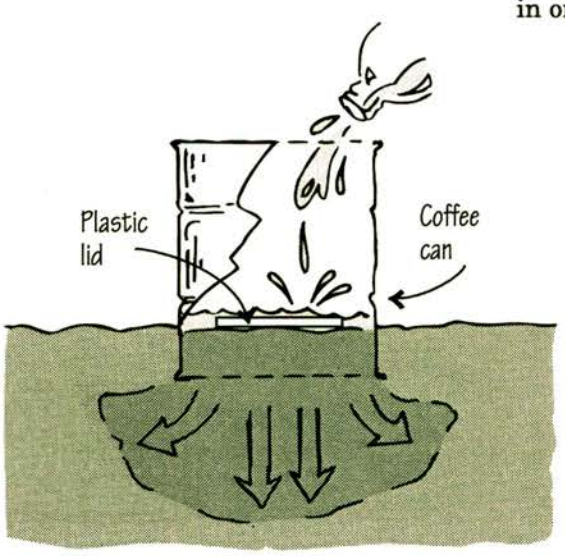


Figure 7: Use the coffee can perc test to check water infiltration.

Before cutting out the bottom of the coffee can, stick a ruler inside of the can. Measuring up from the bottom, make a visible, permanent line at each of the first three inch marks. Pour enough water into the can to reach the one inch mark, then transfer that water to the plastic bottle. Mark the water line on the bottle to ensure that you always use the equivalent of one "coffee-can" inch of water every time you do the perc test. Cut out the bottom of the coffee can when you finish measuring and marking.

At your monitoring site, push the can into the soil to a depth of two to three inches, using the lines as a guide. (If the soil is hard, lay a short board across the top of the can and pound it with a hand sledge or hammer to push down the can.) Gently firm the soil around the inside edge of the ring to reduce water flow along the edge and place the plastic lid on top of the soil inside the can.

Fill the soda bottle with water up to the line and pour the water onto the plastic lid to protect the surface structure of the soil. (See Figure 7.) The first inch of water wets the soil and eliminates any variation in soil moisture conditions from site to site and year to year.

Repeat the previous step and note how long it takes the soil to absorb the second inch of water. Compare your results with the assessment criteria given on the Field Guide and record your rating on the Soil Assessment Record Sheet.

When you pull out the coffee can, turn it over and look at the soil core from the bottom. Check for wormholes, root channels, and other *macropores* and rate your findings for these as well. Macropores are large, continuous tunnels through the soil created by worms, roots, or other large soil organisms like beetles. They greatly improve water entry into the soil, as well as root growth.

Water Retention

Soil's ability to retain water in a form available to plants is another important characteristic of its physical fitness. Soils with high organic matter content or some clay hold more water than sandy or silty soils. Loamy soils tend to hold the most plant available water. Soils with poor water retention become obvious during extended dry periods. These soils may benefit from farming practices that increase organic matter, such as using green manure and cover crops. Organic matter builds better soil structure and can hold many times its weight in water, so even small increases in organic matter content tend to increase water retention. Consult the Field Guide to rate your soil's water retention ability and record this information on the Soil Assessment Record Sheet.

Good Drainage

Good *drainage,* the movement of excess water out of the root zone, is also an important soil property for good plant growth. In soil with poor drainage, excess water remains in the root zone and reduces the space for air; this leads to poor root growth and nutrient uptake. Good drainage allows the soil to warm up earlier in spring. More and more soils with good natural drainage are becoming waterlogged or over-saturated because of compaction and poor soil structure. Again, refer to the Field Guide to rate soil drainage and record this information on the Soil Assessment Record Sheet.

Elements of the Soil Universe

Soil profile consists of the successive layers of soil and soil-building material running vertically from the surface to the parent material.

Horizons, the vertical layers of soil from the surface down to the parent material, are classified according to their color, texture, consistency, structure, pH, boundary characteristics, and continuity.

Parent material, the material from which the soil was formed, influences the overall properties of the soil.

Soil structure, the way individual soil particles group into larger clusters, determines the growing environment for plants.

Compaction, the breakdown of soil structure and the compression of pore spaces, results in poor aeration, slower infiltration and drainage, and difficult root penetration.

Hardpan, a type of compaction usually found at the depth of primary tillage, causes shallow root growth and makes plants more vulnerable to drought and other stresses.

Surface cover softens raindrop impact, protects soil structure, and promotes infiltration.

Surface crusts lead to runoff and erosion, limit aeration, and hamper seedling emergence.

Infiltration of water through the soil surface is helped by surface cover, good soil structure, a rough soil surface; and is hindered by surface crusts and compaction.

Water retention refers to the soil's ability to retain water in a form available to plants. Loamy soils tend to have more plant-available water than clay or sandy soils.

Drainage, the movement of excess water out of the root zone, promotes good aeration, root growth, and nutrient uptake.

Organic matter yields key plant nutrients and promotes stable soil structure, good aeration, and water infiltration and retention.

Cation exchange capacity (CEC) is a measure of the soil's ability to store positively-charged nutrients like calcium, potassium, and magnesium. The CEC of any soil can be increased by increasing organic matter content.

Biological activity is concentrated in the top few inches of soil were microorganisms can get food, air, and water. This creates the "fence-post effect."

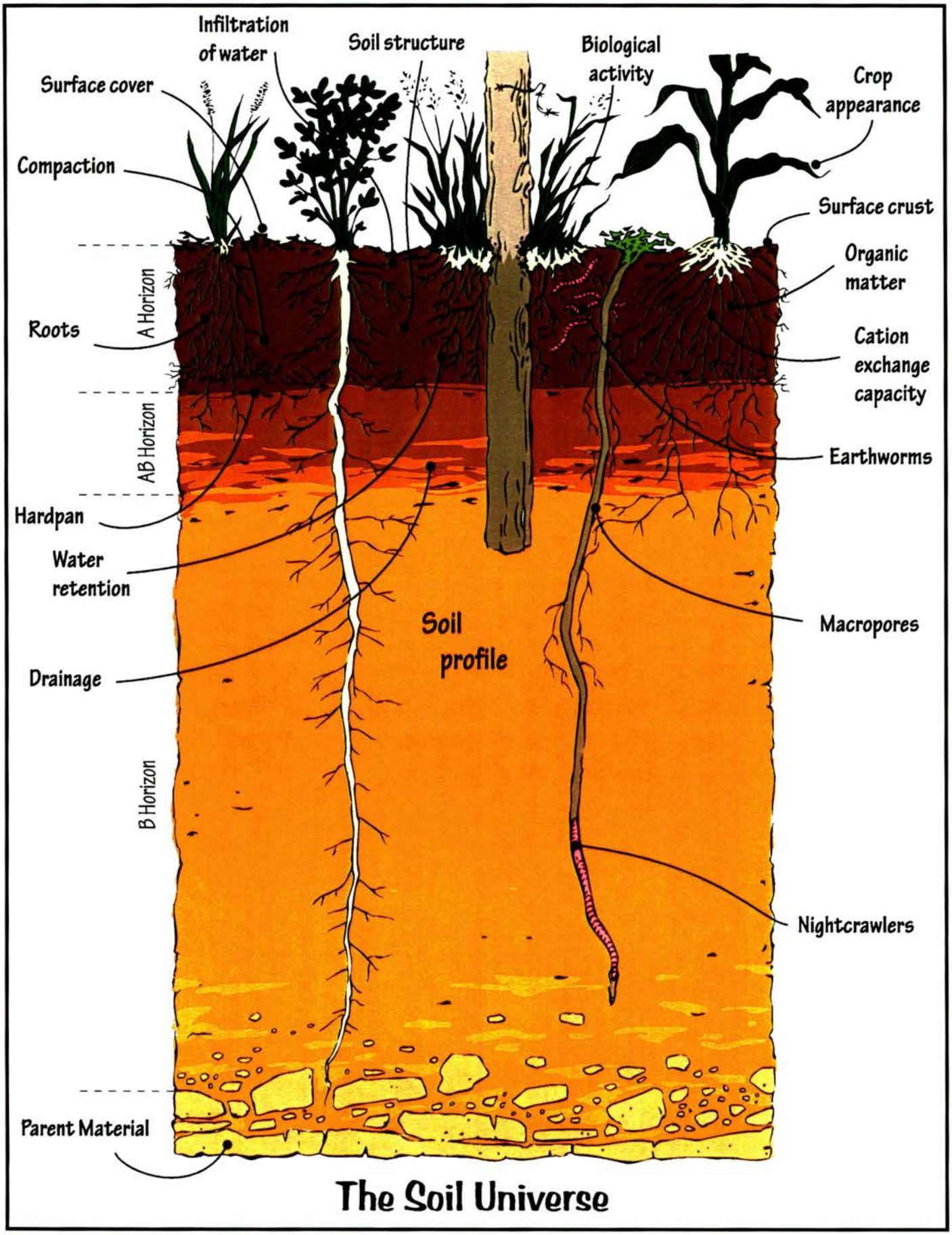
Earthworms convert organic matter into nutrient-rich castings, and create channels for air and water flow and for root growth.

Nightcrawlers are deep-burrowing earthworms that live in single, pencil-sized tunnels. They come to the surface to collect plant material for food, which they store over their burrow hole.

Macropores are large, continuous channels through the soil created by roots, worms, and other large soil organisms like beetles. As conduits for air and water movement, they facilitate aeration, infiltration, and root growth.

Crop appearance, growth characteristics, and resistance to stresses (extreme moisture conditions, pests, and disease) provide a quick appraisal of soil health.

Roots can reveal soil problems such as compaction, poor aeration, toxic conditions, and nutrient imbalances.



The Soil Universe

Soil Fertility

Healthy soil supplies plants with a well-balanced diet of *macronutrients* (nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur) and *micronutrients* (boron, copper, iron, manganese, molybdenum, and zinc). Healthy soil also cycles nutrients more efficiently, meaning it requires fewer inputs and loses fewer nutrients to erosion and leaching. Many people also believe that a well-balanced, fertile soil plays a key role in the nutritional health of livestock and people.

Testing for Soil Nutrients

A laboratory soil test offers the best and most thorough way to monitor your soil's nutrient levels. Contact an independent soil consultant or your County Extension Service to link up with a soil testing laboratory.

Work with a Professional

An independent consultant can help you work out a testing plan, take the samples for you, and help you decipher the management implications of your results. If you choose to take soil samples yourself, ask the laboratory you are working with to send you sampling instructions. You still may want to seek professional assistance for help in interpreting the soil test results. Look for someone with whom you feel comfortable and who is willing to help you reach your soil management and farm goals.

Develop a Testing Plan

Base the frequency of your soil testing program on your goals, crop rotation, soil types, and financial resources. Some farmers like to test every year; those on a two year crop rotation may test every other year. Others prefer to only test for nitrate nitrogen every year and for more stable nutrients (P, K, and most micronutrients) every three to five years. In sandy soils, boron and sulfur may need to be tested annually. Ideally, all monitoring sites should be tested during the first year of monitoring to establish a baseline of information.

Use the Soil Test Record Sheet to summarize the results of your laboratory analysis for each monitoring site. The grid can be used to map out the site location. In the "Notes" section of the record sheet, record any pertinent information, such as your fertility program for that site or your notes on how much credit to take for other sources of nitrogen like hay, cover crops, manure, and organic matter. This section can also be a place to record any plant tissue analysis done to test for nutrient deficiencies in crops.

What Else a Soil Test Can Tell You

Soil test results can tell you more than just your soil's nutrient levels; they can also report your soil's organic matter content, cation exchange capacity, and pH.

Organic Matter Content

In addition to being critical to a soil's structure and water-holding capacity, organic matter also plays an important role in soil fertility. Through the process of decomposition, dead plants and animals are converted into soil organic matter. Organic matter is the source of readily available plant nutrients, particularly nitrogen, phosphorus, and sulfur. Organic matter also increases cation exchange capacity.

Soil organic matter content depends on a number of factors, including climate and soil type. For example, in a cool, temperate region a sandy loam soil type might have 2-4 percent organic matter compared to 4-6 percent in a silt loam soil type. In a warmer climate, these numbers will be lower. Increasing organic matter content even 0.1 percent per year can benefit soil health significantly. Inversely, even a drop of 0.1 percent per year can signal a decline in soil health—even if the percent of organic matter content is high.

Changes in organic matter content should be tracked over several years to be confident of the trends because laboratory results are not precise enough to reliably detect annual changes as small as 0.1 percent. If you need to increase your soil's organic matter content, research the many different ways to achieve this and decide which makes the most sense for your farm.

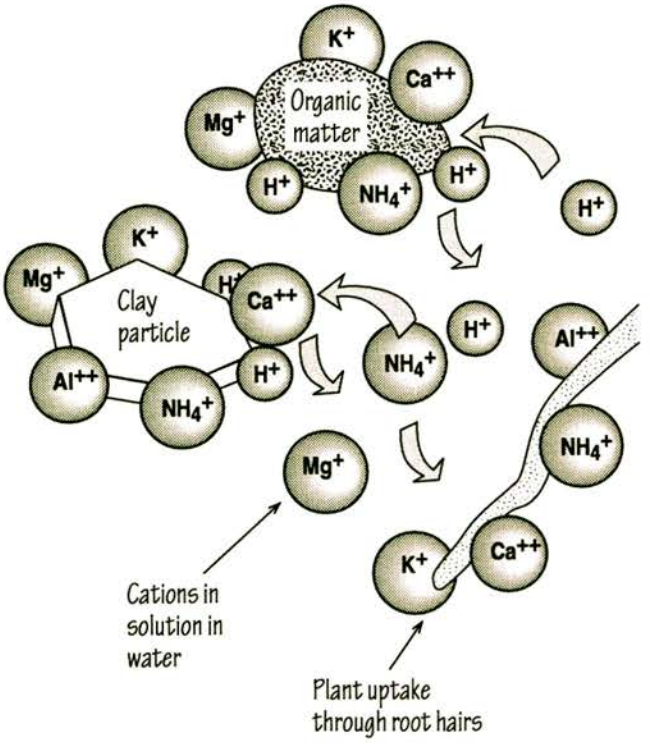


Figure 8: Cation exchange capacity

Cation Exchange Capacity

Cation exchange capacity (CEC) is a measure of how many positively charged nutrient ions (like calcium, potassium, and magnesium) your soil is able to store and supply to plants. For instance, a soil with a CEC of 15 can store many more nutrients than a soil with a CEC of 5. (See Figure 8.)

Cation exchange capacity depends on your soil's clay content, which you cannot change, and the organic matter content, which you can alter. The CEC of sand and silt particles are both low, but clay has a high CEC. *Humus*, the stable form of soil organic matter, also has a high CEC and is very important for storing nutrients in soils with little clay. An increase of about 0.5 percent organic matter will generally increase CEC by about one unit.

Soil pH

The term *pH* expresses the amount of soil acidity or alkalinity on a scale from 0 to 14. Most soils range from 4.5 to 8.5; a pH of 7 is considered neutral. Very few plants will tolerate very acid soils, those testing 4 to 5; nor do many plant thrive in too alkaline soils, anything over 7.8. Information on the optimal pH range for most crops is available from your local agronomist.

Low availability of nutrients usually result from too high or too low of a pH. For example, adding lime to a low pH soil can significantly increase the availability of other soil nutrients. A pH reading should not be used by itself, however, to determine your soil's nutrient needs.

Transfer the results of your laboratory analysis test to the Soil Test Record Sheet and record any other pertinent information. Also, review the criteria in the Field Guide and rate each of these soil fertility categories on the Soil Assessment Record Sheet.

Biological Life in the Soil

In addition to supplying plants with a good balance of available nutrients, a healthy soil also sustains a complex community of *beneficial soil organisms.* The main job of beneficial soil organisms is to convert dead plant and animal remains into soil organic matter, which improves a soil's physical fitness and nutrient supply. Larger organisms like earthworms, also help build good soil structure and aid water infiltration.

The Fence Post Effect

Except for deep-burrowing nightcrawlers, biological activity is concentrated in the top few inches of soil. Here large soil organisms like earthworms, beetles and nematodes, and *microorganisms* like bacteria, fungi, and algae have access to food (in the form of organic matter), air, and water. This high level of biological activity is readily apparent in the *fence post effect:* the first signs of rot on a wooden fence post often appear just below the soil surface. (See Figure 9.)

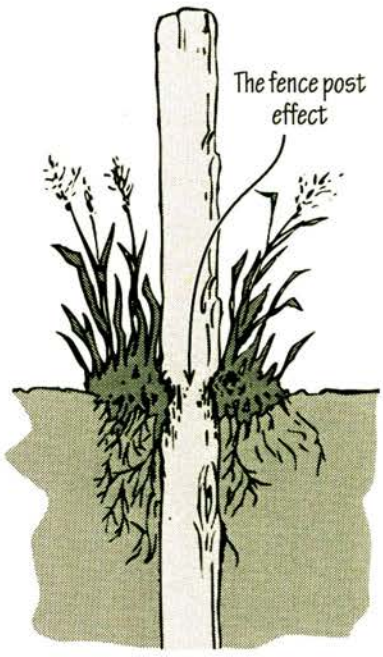


Figure 9: Biological activity is concentrated in the top few inches of soil.

Beneficial soil organisms respond quickly to management and can be a good indicator of soil health. Ensuring a high level of biological activity means avoiding those practices that tend to have a detrimental effect on beneficial soil organisms. These include low levels of plant residue and organic matter; poor aeration and drainage; certain chemical pesticides (especially insecticides); and tillage practices that leave a high percentage of bare soil, excessively break down soil structure, or bury residue too deep. Many farmers claim that anhydrous ammonia inhibits the activity of soil organisms, especially earthworms.

Residue Decomposition

An easy, but informative way to track your soil's biological activity is to look at the previous year's cowpies or buried residue. If there is little evidence of last year's organic additions, you have biologically active soil. If, on the other hand, you find a lot of undecomposed cowpies and buried residues, then your biological barometer is low. If you dig up corn stalks from three years ago, your soil has very little biological activity. Rate biological activity and residue decomposition using the Field Guide and record the ratings on the Soil Assessment Record Sheet.

Earthworms: Super Soil Builders

Earthworms are worth their weight in gold when it comes to soil building. They mix soil; cycle nutrients; provide pathways for air, water, and roots; and their nutrient-rich castings help stabilize soil. The most common types of earthworms are *angle worms,* also called gray worms because of

their grayish color, and *redworms* or red wrigglers. These earthworms reside in the top few inches of soil. Another common type is the *nightcrawler,* a large, deep-burrowing earthworm that comes to the soil surface at night for food.

Earthworms are most active during cool, wet periods in the spring and fall. They typically become inactive during periods of extreme heat, cold, or dryness. You are not likely to find many in July or August unless you check under thick mulch.

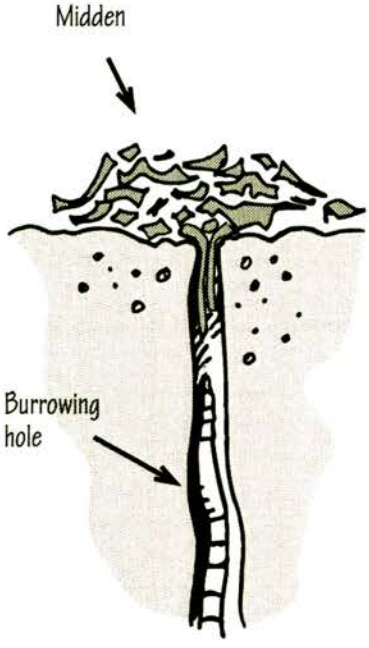


Figure 10: Evidence of nightcrawler presence

Dig for Worms

Take a shovel to the field a few days after a soaking rain in early May. Turn a shovelful of soil onto a garbage bag or sheet of plastic and use your hand to dig around for worms. Many healthy soils will have a worm or two in every handful (more than fifteen in the whole shovelful). If the soil is not a healthy environment for earthworms you may find only a few or none at all. Repeat this exercise three to five times per site. Record the numbers and make notes about what kind of worms you find in the "Notes" section of the Soil Assessment Record Sheet. Mark the appropriate rating for that category based on the criteria in the Field Guide.

Check for Nightcrawlers

Look for signs of adult nightcrawlers on the soil surface. You should find both burrowing holes and *middens,* or "tents" of plant residue, over the top of their permanent burrow. These tents, which measure about one to three inches across, are the nightcrawler's food supply. If it is a midden, you may even see several leaves or stems pulled down into the hole. (See Figure 10.)

Make a note of how many burrowing holes and middens you find in a two square foot area. Ten or more indicate that your soil management is benefitting from these valuable soil organisms. If you find fewer than five, investigate what management factors might be creating an unfavorable environment. Mark the appropriate rating on the Soil Assessment Record Sheet based on the criteria in the Field Guide.

Monitor Cowpies

Cowpies are a favorite food of worms, so this is an ideal place to look for them as well. Use your boot or a stick to turn over the cowpie. Make note of any evidence of earthworm activity, such as castings or burrow holes. In particular, keep track of how fast cowpies decompose. While microorganisms are contributing to this process, most likely earthworms are at work as well.

Crop Health

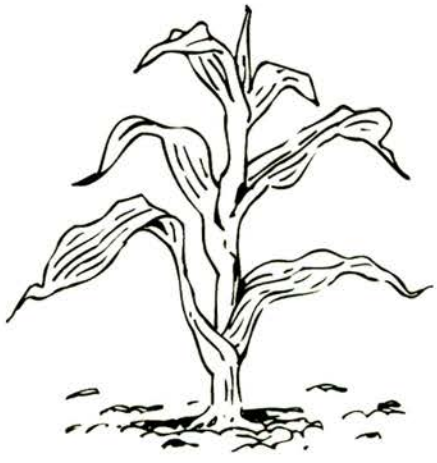
Monitoring the health of your crops offers you a very visible way to monitor your soil. In fact, problems with crop health often are your first indication that something is not right with your soil.

Use caution, however, when using crops to monitor soil. Many times the same symptoms expressed by a plant or crop can mean a number of different things, depending on the situation at hand. If your crops show any signs of weakness or stress in the following categories, make use of some of the other tools offered in this chapter and investigate the situation further. An independent crop consultant or the local County Extension personnel can also be a good resource in this regard.

Crop Appearance and Stress Resistance

Periodically walk your fields during the growing season to assess your crop's appearance and stress resistance. The crop health indicators listed below are also summarized on the Field Guide. Rate each category on the Soil Assessment Record Sheet and jot down more detailed information in your journal or in the notes section of the record sheet.

Overall appearance: Scan your field to get an overall impression of the crop's appearance and to spot any problem areas.



Roots: Crop productivity begins with good roots. Dig or pull up a plant and study its roots. Roots in healthy soil should be deep, fully developed with lots of root hairs and fleshy white when scraped. Plants with poorly developed roots are easily pulled out and more susceptible to being blown over by strong winds. Poor root systems tend to bunch or run horizontally instead of vertically down into the soil, and are often discolored or dying. Poorly developed roots can be a sign of a hardpan, poor aeration, toxic conditions, disease or pests, or nutrient imbalance.

Leaves: Healthy plants tend to have lush, full, green leaves. Leaves that are small, narrow, light green or yellow, discolored, or scorched may be showing a nutrient deficiency or imbalance. These same symptoms could also be an indication of poor aeration due to compaction.

Stems: Healthy stems are thick, strong, tall and straight. Short, spindly stems that are easily blown over, or lodged, are a sign that something is out of balance.

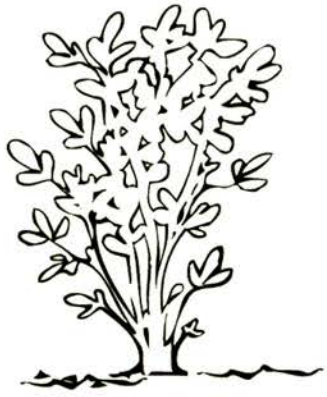
Stand density: Walk your fields several times throughout the season to determine *stand density,* the number of plants in a given area. Pay particular attention to germination rates and seedling emergence, and the percent of bare ground. If weather conditions cannot explain stand density problems caused by poor germination or emergence, then examine your soil conditions. Wet spots and knolls with little or no topsoil are obviously susceptible to poor stand density and indicate weaknesses in your soil resource.

Growth and maturity rates: Barring extreme weather conditions or delays in planting, healthy crops should grow well and mature fully

within their standard "days to maturity" rating. If planting was on time and weather conditions are good, but your crops are lagging behind or mature later than they should, poor soil conditions may be the culprit.

Resistance to pests or disease: Crops grown in healthy soils will show fewer serious pest or disease problems, especially during extreme environmental stress such as drought. If weather conditions are good, but your crops are suffering from disease or are being attacked by pests, the crops may be stressed by poor soil conditions.

Response to moisture conditions: The benefits to crops from good, physically fit soil show up dramatically during growing seasons with extreme moisture conditions. Good drainage can lessen the negative impact of too much water during a wet year. In drought conditions, soils with good organic matter levels can hold more moisture in the plant's root zone.



Weeds: The weeds in your fields may be trying to tell you something about how you are managing your soil. Many weeds thrive under specific soil conditions. For example, foxtail, velvetleaf, bindweed and ragweed all compete well in compacted or tight soils. Quackgrass and lambsquarter may mean excessive fertility. Curly dock could be a sign of an acid soil, with low calcium.

Nutrient Deficiency Symptoms

Observing your crops can also be used to monitor soil nutrient deficiencies. The Field Guide summarizes some common symptoms of nutrient deficiencies that show up in plants. Review the summary, then refer to it when you do a crop appearance and health assessment.

Remember, however, that deficiency symptoms that show up in plants do not necessarily mean that the soil is deficient in that particular nutrient. Other factors could be contributing to the situation. Rather than jump to an immediate conclusion, let these symptoms prompt you to investigate all the possible causes. You may also want to have a plant tissue analysis done on a sample from the affected area. Check with an independent crop consultant or your County Extension Service for more information about this test.

From Monitoring to Management

The soil monitoring tools offered in this chapter can help you see the connections between your management practices, the health of your soil, and the long-term viability of your farm. Use this process as a springboard for creativity and generating new ideas so that you can create a soil management plan that brings together "the combination of practices" that "develop and maintain a soil as nearly as possible to the ideal on a sustained long-time basis."

Additional Resources

Publications

Most, if not all, of the following resources can be obtained through inter-library loan. Some can be purchased through your local bookseller.

Best Management Practices: Nutrient Management. (Toronto & Ottawa, Ont.: Ontario Ministry of Agriculture, Food and Rural Affairs, and Agriculture and Agri-Food Canada, 1994.)

A good overview on testing for soil nutrients and interpreting test results. Details the benefits of soil testing and how to collect and handle the samples. Provides brief overviews of soil nitrate-nitrogen testing, manure testing and plant-tissue analysis. Also contains a well-illustrated section on nutrient deficiencies.

Best Management Practices: Soil Management. (See previous citation.)

Seventy pages of bulleted text, well-conceived photos, and stimulating graphics. Provides a comprehensive list of topics on soil and soil health, but the depth of coverage is limited by the bullet format.

Building Soils for Better Crops: Organic Matter Management, by Fred Magdoff. (Lincoln, NE: University of Nebraska Press, 1992.)

Offers an excellent balance of theoretical and practical soil management information. Describes the basic nutrient cycles and their interaction with organic matter dynamics. Reviews the effect of different management alternatives on soil organic matter, biological activity and other soil properties with an eye toward creating healthier soils.

Soil Survey of [Your County and State]

Possibly the single most useful resource in understanding your soils. Each county's soil survey contain maps of the prominent soil types for all land within the county. Simply locate the map(s) for your farm. Your county's soil survey is available through the local Natural Resources Conservation Service (NRCS) office. Your local library may also have a copy.

Methodologies for Screening Soil-Improving Legumes, by Marianne Sarrantonio. (Kutztown, PA: Rodale Institute, 1991.)

A detailed source for soil monitoring in response to management changes. Offers several hands-on tests for characterizing soil and monitoring soil changes over time.

Minnesota Underfoot: A Field Guide to the State's Outstanding Geologic Features, by Constance J. Sansome. (Bloomington, MN: Voyageur Press, 1983.)

Easy to use, easy to understand field guide with detailed maps, directions, and descriptions of fifty-six of Minnesota's most outstanding geological features.

Minnesota's Natural Heritage: An Ecological Perspective, by John R. Tester. (Minneapolis: University of Minnesota Press, 1995.)

Beautifully composed explanation of how ecosystems are structured, how they work and how they respond to natural and human influences. Covers Minnesota's main ecosystems: deciduous forest, northern coniferous forest, tallgrass prairie, wetlands, lakes, and streams and rivers.

Permaculture: A Practical Guide for a Sustainable Future, by Bill Mollison. (Washington, DC: Island Press, 1990.)

A comprehensive, thought-provoking guide for working with nature to design and maintain permanent, agriculturally productive ecosystems that mirror the diversity, stability and resilience of natural ecosystems.

Sustainable Soil Management by Appropriate Technology Transfer for Rural Areas (ATTRA). (Fayetteville, AR, 1996.)

An informative package of materials about alternative methods for understanding, assessing, and managing soil. For a free copy call ATTRA at 800-346-9140.

The Soul of the Soil: A Guide to Ecological Soil Management, by Grace Gershuny and Joseph Smilie. (Davis, CA: Agaccess, 1996.)

Stresses the need for a holistic understanding of soil and soil processes. Emphasizes the biological nature of soil and covers basic principles of soil function as well as management strategies that enhance the life of the soil in search of overall soil quality. Includes a chapter on "Observing and Evaluating Your Soil."

United States Department of Agriculture Yearbook

An annual publication put out by the USDA. Each year focuses on a different topic related to agriculture. Of special interest to soil: ***Soils and Men*** (Yearbook of Agriculture 1938) and ***Soil*** (Yearbook of Agriculture 1957).

Both contain thought-provoking historical perspective, technical information, management suggestions, and policy discussion, as well as several chapters detailing the fundamentals of soil science including soil formation processes, soil chemistry, physical properties of soils, soil biology and soil-water relations. Both are out of print but should be available through interlibrary loan and can sometimes be found at library and yard sales.

Wisconsin Soil Health Scorecard, by The Wisconsin Soil Health Program of the University of Wisconsin Center for Integrated Agricultural Systems. (Madison, WI: University of Wisconsin Press, 1996.)

A short booklet farmers can use to assess and monitor soil health by scoring 43 soil health properties using mostly sensory-based or descriptive indicators.

People

Cooperative Extension Service: Your state's Cooperative Extension Service is set up to share information on soil management specific to your region and/or crops. Many states have regional or state specialists who work in the area of soil management and who welcome farmers' questions. If they cannot answer your questions themselves, they can point you in the right direction to find an answer.

Farmer Organizations: Farmer organizations such as the Minnesota Sustainable Farming Association, the Practical Farmers of Iowa, the Innovative Farmers of Ohio, and the Nebraska Sustainable Agriculture Society allow farmers to network with and learn from each other.

Independent Soil or Crop Consultants: One of the most effective ways to be a good soil manager is to work with an independent soil/crop consultant who you can trust to provide unbiased soil management advice that is sensitive to your goals.

Natural Resources Conservation Service (NRCS): NRCS staff are trained to help identify management practices that will help improve nutrient use efficiency, decrease runoff and soil erosion, and improve soil quality.

Monitoring Soil

Soil Assessment Record Sheet

Date _____

Monitoring location and description _____

Weather conditions _____

Crop/tillage history (current plus previous two years) _____

Soil Profile

Topsoil: Layer 1 Depth from _____ inches to _____ inches Color _____ Texture _____

Subsoil Layer 2 from _____ inches to _____ inches Color _____ Texture _____

Layer 3 from _____ inches to _____ inches Color _____ Texture _____

Parent Material (depth to and type) _____

Soil Health Assessment

Assess your soil's health by rating the following characteristics:

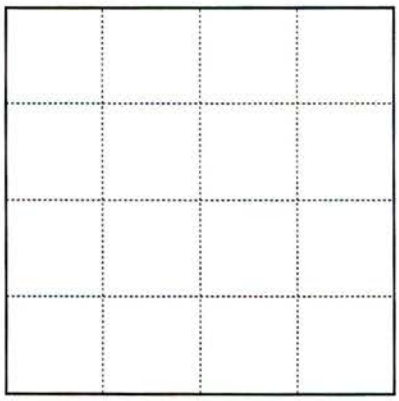
	Good	Fair	Poor	Notes
Physical				
Soil Structure				
Aggregate Stability				
Feel				
Tillage Ease				
Aeration				
Compaction				
Hardpan				
Erosion				
Surface Cover				
Surface Crusting				
Infiltration				
Macropores				
Water Retention				
Drainage				
Fertility				
Nutrient Balance				
Organic Matter				
Cation Exchange Capacity				
pH				
Biological				
Activity/Decomposition				
Earthworms				
Nightcrawlers				
Crop Health				
Overall Appearance				
Roots				
Leaves				
Stems				
Stand Density				
Growth and Maturity				
Resistance to Pests or Disease				
Response to Moisture Conditions				
Weeds				

Monitoring Soil

Soil Test Record Sheet

Date _____

Monitoring location and description _____



Notes

Macronutrients

Nitrogen _____

Phosphorus _____

(available) _____

Potassium _____

(% base saturation K) _____

Calcium _____

(% base saturation Ca) _____

Magnesium _____

(% base saturation Mg) _____

Sulfur _____

Micronutrients

Iron _____

Boron _____

Manganese _____

Zinc _____

Copper _____

Molybdenum _____

Organic Matter Content _____

Cation Exchange Capacity _____

pH _____

Monitoring Soil

Field Guide

Soil Health Assessment Criteria

Physical

■ Soil Structure

Good—crumbly, granular
Fair—lumpy or blocky
Poor—cloddy with big chunks; or dusty and powdery

■ Aggregate Stability

Good—aggregates do not break down with gentle swirling
Fair—aggregates break down with gentle swirling; water remains clear
Poor—breaks down by wetting or gentle swirling; water becomes cloudy

■ Feel

Good—loose and spongy; springs back after being squeezed
Fair—smooth or grainy; compresses when squeezed
Poor—mucky, greasy, or sticky

■ Tillage Ease

Good—mellow, falls apart, flows off tillage tool; able to till in higher gear
Fair—difficult to work, requires extra passes
Poor—tillage tool rides on surface, scours hard; soil never works down

■ Aeration

Good—open, porous, "breathes"
Fair—dense with few pores
Poor—tight, closed

■ Compaction

Good—no compaction; loose soil resists packing, easy to till
Fair—some compaction and packing, slight hardpan
Poor—high compaction; soil tight, difficult to till; water ponding

■ Hardpan

Good—no hardpan; deep root growth; little resistance to a soil probe
Fair—thin hardpan; some restriction of vertical root growth; requires more pressure to insert probe
Poor—thick hardpan; impenetrable by roots or soil probe

■ Erosion

Good—little or no erosion by wind or water
Fair—some erosion in moderate to heavy rain; some signs of sheet or channel erosion; some blowing of topsoil
Poor—severe erosion by wind or water; gullies or wash-outs form; large amount of topsoil moved or lost

■ Surface Cover

Good—dense plant spacing or plant canopy; no or minimal tillage leaves a "trashy" or heavily mulched surface
Fair—some bare ground visible between plants; moderate canopy; some form of tillage used, leaving a portion of residue cover
Poor—predominantly bare surface or sparse plant spacing; tillage leaves little or no surface residue

■ Surface Crusting

Good—no crust; surface rough, porous, easily dug by hand
Fair—thin crust; surface smooth with few holes
Poor—thick crust, cracks and curls when dry; hard, compacted surface

■ Infiltration

Good—water soaks in immediately; no ponding or runoff even during heavy rain; soil is spongy
Fair—water soaks in slowly; some ponding and runoff during heavy rain
Poor—little or no water soaks in; ponding and runoff even during moderate rain

■ Macropores

Good—five or more within the diameter of the coffee can
Fair—between two and five within the diameter of the coffee can
Poor—two or less within the diameter of the coffee can

■ Water Retention

Good—soil holds moisture well and makes water easily available to plants
Fair—soil drought-prone during dry stretches
Poor—soil drought-prone under normal weather conditions

■ Drainage

Good—excess water moves quickly through the soil and out of the root zone
Fair—excess water drains out out of the root zone slowly, but eventually
Poor—excess water unable to move out of the root zone causing waterlogging or oversaturation

Fertility

■ Nutrient Balance

Good—soil test indicates a balanced supply of both macro and micronutrients; no excesses or deficiencies
Fair—soil test indicates a slight excess or deficiency of one or more plant-essential nutrients
Poor—soil test indicates a severe excess or deficiency of one or more plant-essential nutrients

■ Organic Matter

(depends on soil texture and climate)

Good—content above 4 percent
Fair—content between 3-4 percent
Poor—content at 2 percent or less

■ Cation Exchange Capacity

(depends on soil texture)

Good—CEC over 15
Fair—CEC between 10-15
Poor—CEC under 10

■ pH

Good—between 6.5-7
Fair—slightly below or above the 6.5-7 range
Poor—significantly below or above the 6.5-7 range

Biological

■ Activity/Decomposition

Good—high level of activity; rapid rotting of previous year's plant growth or crop residue; manure quickly consumed
Fair—moderate level of activity; slow or partial rotting of old plant growth, crop residue, or manure
Poor—low level of activity; little or no rotting of old plant growth, crop residue, or manure

■ Earthworms

Good—more than fifteen worms in a shovelful of soil
Fair—between five and fifteen worms per shovelful of soil
Poor—fewer than five per shovelful of soil

■ Nightcrawlers

Good—more than ten in a two square foot area
Fair—between five and ten in a two square foot area
Poor—less than five in a two square foot area

Crop Health

■ Overall Appearance

Good—crop looks uniformly well, no signs of nutrient deficiency
Fair—crop looks well except for small areas here and there with only slight signs of deficiency
Poor—large areas of crop do not look well; widespread or advanced signs of deficiency

■ Roots

Good—deep, fully developed with many root hairs; fleshy white when scraped; plants hard to pull out, no lodging
Fair—shallow growth, more horizontal than vertical; few root hairs; slight effort needed to pull out plants; some lodging in strong wind
Poor—severely stunted or balled growth; roots brown, diseased, or dried up; plants pull out easily; widespread lodging

■ Leaves

Good—lush, full growth; uniform green color; no signs of nutrient deficiency
Fair—growth and color slightly off; early signs of nutrient deficiency
Poor—stunted, thin growth; discolored; showing signs of severe or advanced deficiency

■ Stems

Good—thick and strong, tall and straight
Fair—showing some signs of stunting or weakness
Poor—spindly and weak, short and crooked

■ Stand Density

Good—uniform germination, seedling emergence, plant growth, and/or stand
Fair—spotty unevenness in ger-mination, seedling emergence, plant growth, and/or stand
Poor—extensive unevenness in germination, seedling emergence, plant growth, and/or stand

■ Growth and Maturity

(depends on weather)

Good—crops grow well and easily mature within their standard "days to maturity" rating
Fair—crop growth lags somewhat; maturation slightly late
Poor—crop growth slow and weak; maturation significantly longer than the standard "days to maturity" rating; seed underdeveloped

■ Resistance to Pests or Disease

Good—high resistance to pest or disease problems even under stressful weather conditions
Fair—spotty or occasional pest or disease problems, made worse by stressful weather conditions
Poor—widespread pest or disease problems in normal weather conditions; crop failure in stressful weather conditions

■ Response to Moisture Conditions

Good—crops healthy even in extreme moisture conditions (either significantly above or below normal)
Fair—crops show some signs of stress (poor growth, pests, disease) in extreme moisture conditions
Poor—severe signs of stress in extreme moisture conditions

■ Weeds

Good—few or no weed problems
Fair—spotty problems with one or more weeds
Poor—widespread problems with one or more weeds

Symptoms of Nutrient Deficiency

Caution: Many nutrient deficiency symptoms are similar to symptoms of other plant stresses such as poor aeration or drainage, compaction, drought, or herbicide damage. Be sure to investigate all possible causes for the symptoms.

Nitrogen (N):
- stunted growth, spindly stems, small leaves; poor tillering in grasses
- entire leaf chlorotic (yellow or lacking green pigment); lower leaves show discoloration first, turning yellow and falling off before upper leaves lose intense green color; entire branches may die
- *too much N (toxicity):* very dark, uniform green; stems break or lodge in windy conditions; more susceptible to pest outbreaks

Phosphorus (P):
- growth slow, maturity retarded
- poor root and seed formation; poor tillering in grasses
- older leaves, veins, and stems turn dark green or purple

Potassium (K):
- edges and tips of leaves turn yellow or brown, with scorching, curling, or spotting (corn leaves streaked with yellow or yellowish green between veins); older leaves show symptoms first
- poorly developed root systems; easily water-stressed; susceptible to lodging

Calcium (Ca):
- young leaves and growing tips deformed and chlorotic; leaves eventually die off at the edges
- impaired root growth, some turn black or die
- diseased or discolored fruit (e.g., upper leaves of tomato plants turn yellow, tomato fruit develops blossom end rot)

Magnesium (Mg):
- chlorosis in older leaves, especially between the veins beginning at the tips and moving inward; severe cases may turn completely yellow or reddish purple
- in grasses, base of leaf shows small green spots against a pale yellow background; later leaves more chlorotic and striped with scorching at tips

Sulfur (S):
- chlorosis tends to first occur in younger leaves; difficult to distinguish from N deficiency except through plant tissue analysis
- in alfalfa, top leaves turn light green or light yellow first; eventually all leaves turn yellow

Iron (Fe):
- most prevalent in young leaves; first signs are pale leaves with dark green veins; eventually the entire leaf becomes chlorotic
- grasses develop alternate green and white stripes the entire length of the leaf

Boron (B):
- abnormal or retarded growth of shoot tip, eventually dying off; this encourages dwarfing and bushiness—youngest leaves often misshapen, wrinkled, thicker, and darkish blue-green
- discolored fruits, roots, and tubers, flecked with brown spots; "blackheart disease" in root crops
- tomato stems blacken at tips, young leaves on main stem yellow and die

Manganese (Mn):
- chlorosis between green veins of younger leaves; resembles Mg deficiency; shedding of leaves seen in advanced deficiency
- some grasses develop brown, black, or grayish spots next to veins (hence disease names like "gray speck," "white streak," "dry spot," or "marsh spot")

Zinc (Zn):
- leaves chlorotic between veins, or mottled with scattered dead spots
- spaces between leaf nodes shorter than normal
- grasses develop rusty brown flecks on leaves; in corn, white striping develops along the midrib of youngest leaves

Copper (Cu):
- leaves at the tips of stems wilt, a condition called "withertip"
- cereal grains become bushy with white twisted lead tips

Molybdenum (Mo):
- only a problem in soils with a pH reading less than 5.0; liming is sufficient to overcome deficiencies

Monitoring

Streams

Streams are an integral part of nature's water cycle and a vital source of fresh water. Streams act as arteries for the movement of materials through the landscape. And so, a stream can reveal not only the condition of fresh water, but also the condition of the environment through which it runs.

What Is It?

By observing the physical, biological, and chemical changes in and along a stream, you can become familiar with the natural processes that keep a stream ecosystem healthy, and recognize how land use practices affect these processes.

Who Does It?

Stream monitoring can easily be done by one person, but it can be a fun activity for families or with neighbors. Plus, working with others gives you a venue for sharing the things you observe. Community partnerships—such as with your local school, agricultural groups, or an agency biologist—can expand your understanding beyond what is happening on the portion of stream that flows through your farm to what is happening at the watershed level.

When?

Physical conditions are most easily monitored during July or August when stream flow is lower. Interesting things can also be learned from examining the stream after a big storm and during each of the four seasons. Different insects emerge at different times throughout the summer and could be sampled several times, such as late May, early July, and mid-August. The main thing is to be consistent from year to year.

Time Required

As little as a few hours a year is sufficient to identify stream organisms and collect information about the stability of streambanks and the condition of the streambed. However, the more time you put into your monitoring program, the more you can learn. Allow yourself the time needed to achieve your objectives and to have fun.

Materials and Cost

Basic supplies such as a plastic tape measure, a yardstick, simple net, and a field notebook might cost less than twenty-five dollars. A pair of inexpensive hip waders will come in handy as well. Reference books and water chemistry equipment needed for a more comprehensive program can be more costly. If intensive monitoring interests you, contact a group already doing stream monitoring to share resources.

Getting Started

CHAPTER CONTENTS

Water is an integral part of the earth's ecosystem and is essential to all life. As an ecosystem building block, water moves in a cycle: from clouds as rain or snow, through soil, over land, through lakes and wetlands, and down streams and rivers to the sea where it evaporates and condenses back to the clouds. (See Figure 1.) Because water cycles continuously over and through the land, all human and natural activity on the land affects water quality.

Why Focus on Streams?

As arteries for the movement of materials through the landscape, streams provide a way of assessing how different land use practices affect water quality. Furthermore, streams reveal key information about the condition of the environment of which they are a part.

This chapter of *The Monitoring Tool Box* also focuses on streams because several of the farmers connected with the Monitoring Project were interested in monitoring the impact of management intensive grazing on their streams. Together with other Monitoring Project team members, the farmers identified the following questions:

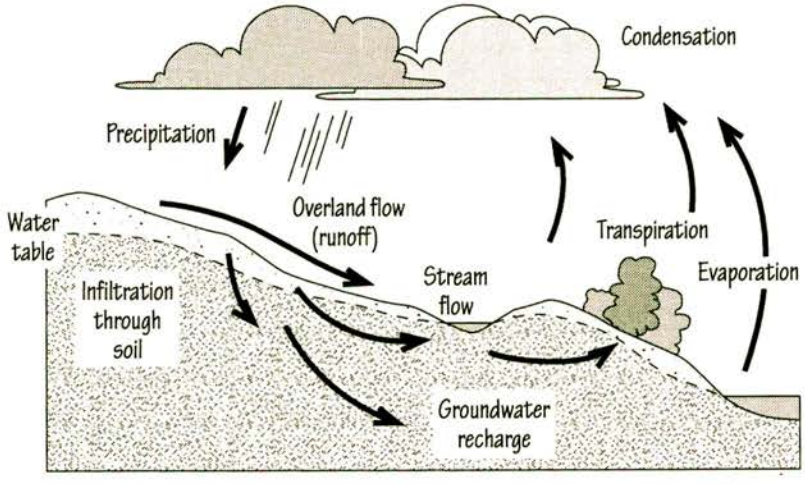


Figure 1: The water cycle

- How do different farming practices—row cropping, continuous grazing, management intensive grazing—affect the amount of soil, fertilizers, and pesticides entering adjacent streams?
- How do land use practices impact the shape of streambanks?
- How do land use practices affect the physical habitats of streams, especially the stream bed?
- How do land use practices affect aquatic animals, especially bottom dwelling organisms and fish?

This chapter grew out of these questions. Along with describing various parts of the stream ecosystem and important processes that connect land to water, the chapter also offers some basic tools for monitoring the physical, biological, and chemical condition of a stream. With consistent monitoring over time, you can begin to evaluate the influence of your management practices on all parts of a stream system.

You Can Make A Difference

To make the best use of the tools offered in "Monitoring Streams," first review your whole farm goals. Remember, holistic farm goals recognize the interconnectedness between people and the environment.

Your farm exists within a local *watershed,* a term for all the land and water within a natural drainage area. This is true whether you have a stream running through your land or not. Local watersheds are part of regional watersheds like the Minnesota River, which are part of continental watersheds like the Mississippi River-Missouri River watershed.

Obviously, your actions have the greatest and most immediate impact on the land and water resources of your farm. But by engaging in land management practices that improve water quality and enhance the surrounding landscape of your stream, you also contribute to the well-being of the whole watershed system. In other words, what you do on your farm makes a difference off your farm as well.

Develop A Monitoring Plan

Once you are clear about goals for your farm, you can put together a meaningful monitoring plan.

Summarize Your Current Farming Practices

First summarize your current farming operation and identify any current practices that might be affecting your stream. For example:

- Is the land adjacent to the stream in row crops, or pasture?
- If in row crops, do you farm on the contour or not; do you use narrow strips or is it one continuous field?
- If in pasture, how do you currently manage it?
- What is the location of livestock facilities in relation to your stream?
- What is your current fertility program? Do you apply manure to your land, and if so when?
- When, where, and how do you use pesticides, if at all?

Identify Clear Objectives

Different tools provide different types of information, so first review the tools offered in this chapter in light of your farming operation. Then ask yourself, "What information do I want to learn from monitoring my stream?" From here, build your plan around a manageable number of clear objectives. For example:

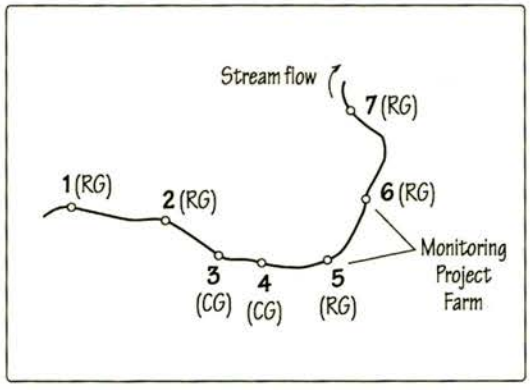
Objective: I'd like to know how much soil is eroding from my fields and entering the stream.

Plan: Monitor water clarity and embeddedness after rainstorms. How clear is the water normally? Does even a small amount of rain cause the water to cloud? Will physical conditions improve in time if I add grass waterways to my fields?

Making a Difference

Given the number of individual farms impacting a stream system, any one of these farmers might rightly ask, "If I change my farming practices, does it really make a difference?" Based on the first three years of the Monitoring Project's work on the stream that flows through one of the Project farms, the answer is yes.

Monitoring Project team members from the Minnesota Cooperative Fish and Wildlife Research Unit set up seven monitoring stations along approximately three miles of the stream: four upstream of the farm, two on the farm, and one downstream (see map). All the stations, except the third and fourth, ran through pasture managed with rotational grazing (RG); stations 3 and 4 ran through continuously grazed pasture (CG).



Even though these seven monitoring stations were located in the middle of the watershed, meaning many upstream management practices could potentially influence the results, two important trends were noted:

1. Fecal coliform (a bacterium associated with cattle manure) consistently peaked at station 4 (the downstream point of the continuously grazed segment) and fell off considerably at station 7.

2. Turbidity levels (reflecting the muddiness or clarity of the water) also peaked at station 4 and fell off at station 7.

The Monitoring Project farmer interprets these results in this way: "I find it very exciting that what I'm doing on my land is improving the quality of my stream. It's telling me that management intensive grazing is helping me to improve the land resource my farm depends on for its success."

With management intensive (or rotational) grazing this farmer still allows his cows access to the stream. But, he limits the amount of time the cows spend in and near the stream, minimizing the threat of pollution. Controlling when the cows have access to the stream and the duration of that access also helps keep the streambank covered with adequate vegetation, reducing the threat of soil eroding into the stream bed.

In most continuously grazed pastures with streams, the banks are constantly exposed to the trampling impact of the animals. This often leads to a high percent of bare soil on the banks, wider and shallower channels, and muddy, polluted water—as was documented with the pasture immediately upstream from the Monitoring Project farm.

How individual farmers manage their land makes a great deal of difference with regard to the conditions of streams and watersheds. The real question is whether the impact is positive or negative; the answer depends on the decisions of individual farmers. As more and more individuals decide to make changes that positively affect their land and their streams, the impacts can begin to add up in truly effective ways.

Check with your county water planner or an area natural resource agency office to learn about the concerns and goals identified for your local watershed. Ask what you can do on your farm to help make a positive difference.

Objective: I'd like to know if runoff from my livestock yards is impacting the water quality of my stream.

Plan: Monitor bottom-dwelling organisms below the runoff entry area twice a summer. Does the stream have high levels of pollution-tolerant organisms? Will creating a wetland in the runoff path help absorb pollutants and allow cleaner water to enter the stream? Will this increase the number of sensitive organisms?

Information derived from the various tools may not always lead to the same conclusions, but when put together they can reveal overall trends.

Choose Your Stream Monitoring Stations

The next step in developing your monitoring plan is to select your *monitoring stations,* the specific areas you will monitor from year to year.

How to Select Sites

The location and number of sites depends on the length of your stream, the habitat/land use areas along it, and your monitoring objectives.

If your stream is fairly uniform, choose station sites that seem typical of the overall stream. If your stream runs through significantly different habitats or land use practices (a tilled field, a pasture, a wooded area, close to a feedlot, and so forth), select at least one station within each of these different areas. At the very least, you might set up two sites: one at the upstream portion of your land to assess the upland watershed effect; and, one at the downstream end of your farm to learn how your practices are influencing water quality and physical conditions. You could also set up stations above and below an area in which you plan to make some management changes.

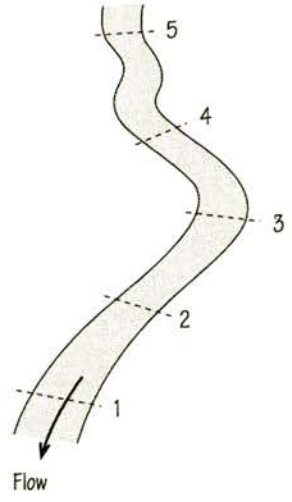


Figure 2: Selecting monitoring sites

Mark and Label Sites

Use a specific reference point, such as a large tree or fence post, to pinpoint the location of each station site so that it is easy to find every time you monitor.

Determine the physical dimensions of your station by stretching a plastic tape measure from the top of one bank to the other. The streambank extends up from the water's edge to where the slope levels out. The station consists of the area extending three feet on both sides of the tape and up both banks. Set surveying flags at the corners if you like. The line of the tape across the water is your *transect,* which is used for a number of the tools that measure the physical condition of your stream. (See Figure 3.)

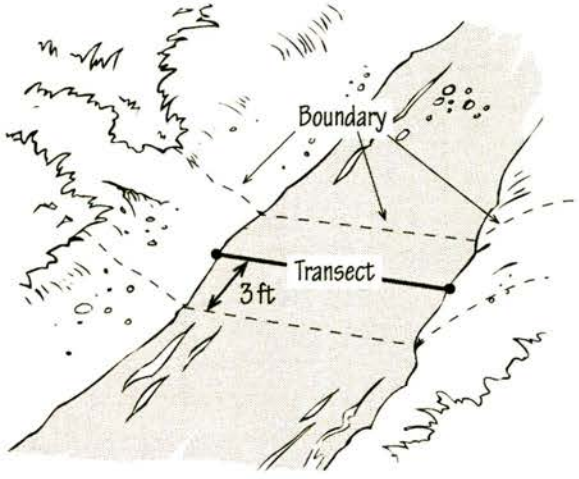


Figure 3. Monitoring station showing boundaries and stream transect

Label each station and record the identifying information (the reference point) in a field notebook. Also, take a photograph of each station and include the reference point within the picture frame. On the photograph, note the station location and the date. Do this every time you monitor to create a solid record of any changes that might occur along your stream over time.

Keep These Points in Mind

Remember that your first year of monitoring provides you with information about the initial condition of your stream. This information gives you a baseline from which to compare information gathered in subsequent years and to track how changes you make in your farming practices affect the stream.

Each time you prepare to go out to your stream to monitor, remember this important point: **The key to good stream monitoring is to closely follow the same procedures every time you use a particular tool.** This applies to selecting stations, to taking measurements, taking samples, analyzing data, and every other procedure involved in stream monitoring. And so, each year before you do your stream monitoring, take some time to review the material in this chapter to refresh your memory.

Also, feel free to supplement your stream monitoring with information and tools besides what is offered in this chapter. Consult the "Additional Resources" section at the end of the chapter for ideas. You may even want to invite an experienced aquatic biologist along the first time you monitor your stream.

Most of all, get in the water and become more acquainted with your stream. You may be amazed at what you discover.

Monitoring Physical Conditions

This section offers a number of tools for monitoring the physical condition of your stream. These include tools for identifying habitat types, examining the condition of streambanks, calculating the width-to-depth ratio of the stream, analyzing the makeup and condition of the stream's bottom material, and monitoring water clarity and aquatic plant growth. (See Figure 4.)

The information you collect using these tools can be recorded on photocopies of the Physical Conditions Record Sheet provided at the end of this chapter. Do not write on this master copy; use it only to make photocopies. Other equipment needs include the following:

- hip waders or tall rubber boots,
- a clipboard and pencil,
- a plastic tape measure,
- a yardstick or other depth measuring device, and
- a bank angle protractor (provided at the end of this chapter).

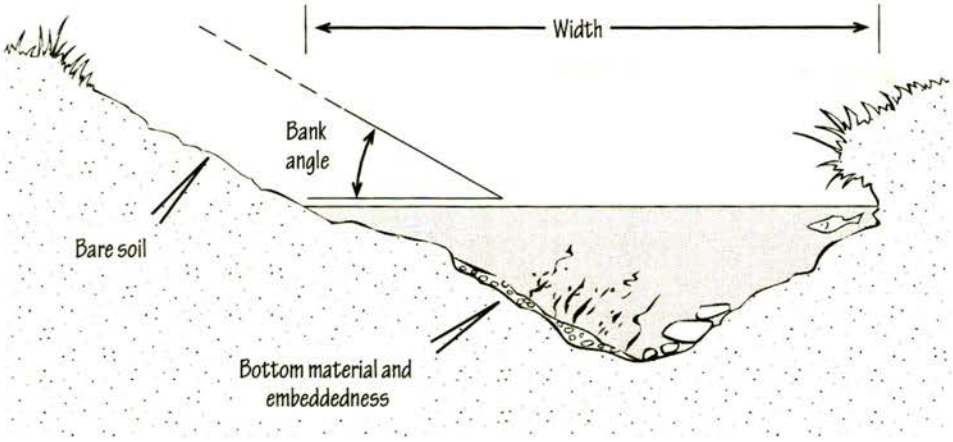


Figure 4: Monitoring physical conditions

Identify Habitat Types

A healthy stream provides many kinds of habitat for fish, amphibians (like frogs and toads) and stream invertebrates (like crayfish or insect larvae). Use the following information about stream habitat types in two ways:

- to identify the habitat characteristics of each of your monitoring stations, and
- to familiarize yourself with the habitat composition of the entire section of stream running through your farm. (See Figure 5.)

For this second option, note which habitats described below are present or missing, the number of each, and the general sequence of habitats from one end of your property to the other.

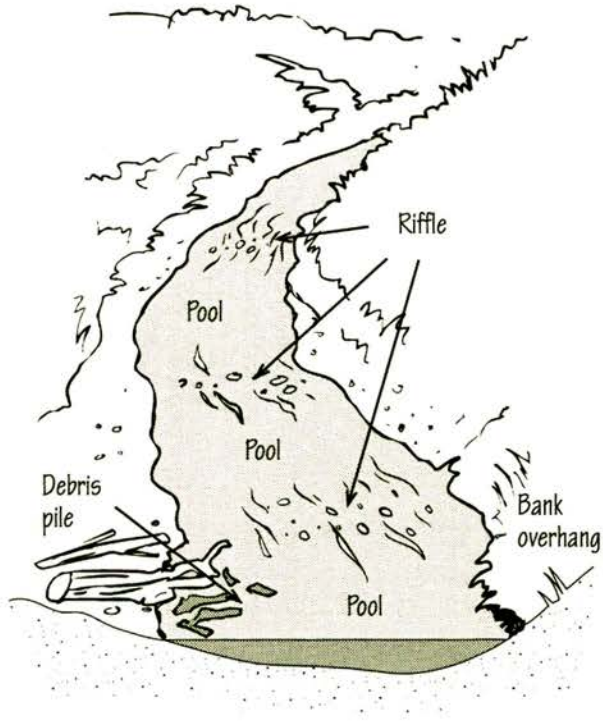


Figure 5: Habitat types

- ***Riffles*** are the shallow areas along a stream where water moves rapidly over rocks or gravel. The greatest abundance of organisms tends to be found here.
- ***Pools and runs*** are the deeper areas between riffles. The current is slower here, providing places for fish to hide and rest. These areas tend to be silty and are often inhabited by burrowing organisms such as dragonfly nymphs. (See Figure 6.)
- ***Bank overhangs*** are places where streambanks cut under grass and tree roots. The roots extend over the water, shading the stream channel below. Overhangs provide great habitat for fish and insect larvae.
- ***Debris piles*** include tree branches and logs that fall into the water, as well as leaves and crop residues. Debris piles provide habitat and food for insects and hiding places for fish.

Record your findings in your field notebook and collect this information every two to three years to keep track of changes in your stream's habitat composition.

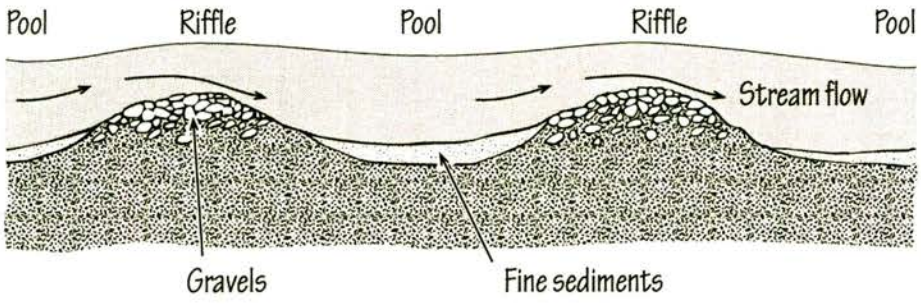


Figure 6: Pool/riffle sequence

Monitor Streambanks

The condition of a stream's banks varies depending upon the habitat through which it runs, as well as the land use practices immediately next to the stream and within the local watershed.

Use the following tools to monitor the condition of the streambank at each of your monitoring stations. Record your findings on the Physical Conditions Record Sheet.

Estimate the Percent of Exposed Soil

Stand in the water just behind the lower boundary of the station, facing upstream. Examine the six foot wide area on the right bank and estimate the percent of exposed or bare soil in that area; repeat the procedure for the left bank. You may also want to take a photograph for your records. (See Figure 7.)

Ideally the banks have no bare soil, but levels up to 10 percent bare soil generally indicate good bank stability. Generally, the more vegetation, the greater the stability of the bank.

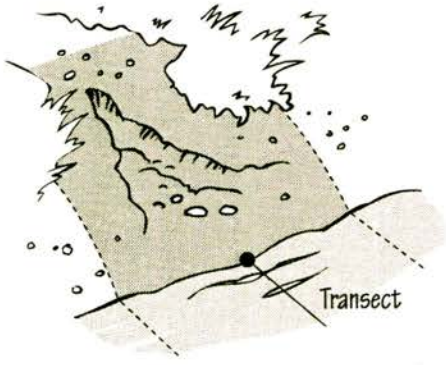


Figure 7: Streambank with 80% exposed soil

Measure the Bank Angle

Use your bank angle protractor to measure the angle of both banks. Pick a spot within the station area that represents the average slope for that side. Note that the protractor will only give readings for banks that are not undercut.

In situations with simple slope profiles, place a yardstick parallel to the bank slope and place the protractor on the inclined yardstick. The weighted string will hang vertically across the protractor giving you the bank angle. (See Figure 8a) For more complex slopes, two people can stretch a tape or string between them to approximate the angle of the bank. Both ends of the tape should be the same distance from the ground. (See Figure 8b.)

Banks tend to be most stable when the slope is between 25 and 45 degrees. If your bank angles fall outside of this range, consider the causes, such as lack of vegetative cover, erosive run off patterns, the type of soil, the shape of the stream channel. Explore your options for improving bank stability.

Figure 8a: Measuring bank angle with protractor and yardstick

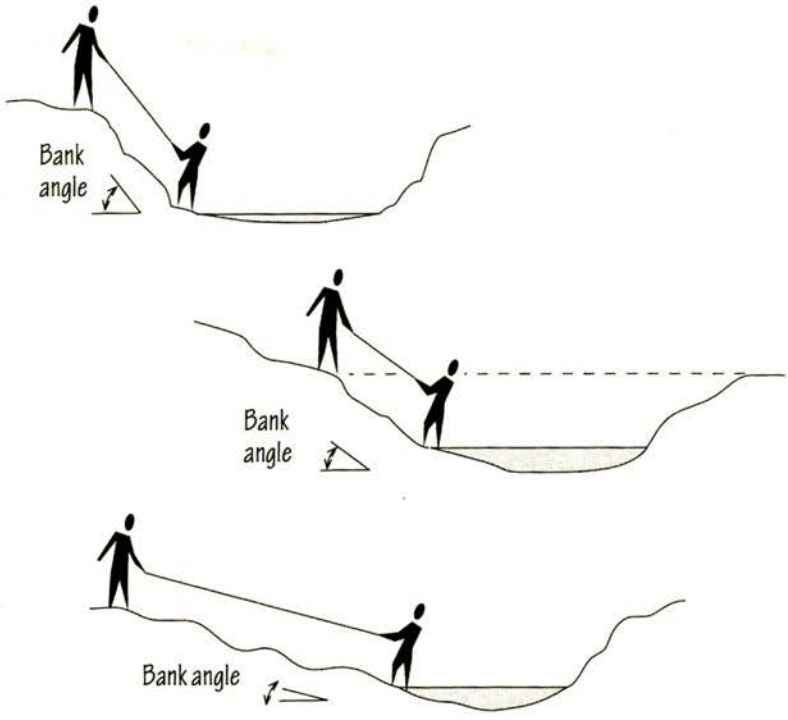


Figure 8b: Two people measuring the angles of more complex streambanks

Measure the Width to Depth Ratio

To monitor the width to depth ratio of your stream, follow these steps:

1. Measure the width of the stream along the transect.
2. Locate four evenly spaced points on the transect. To do this accurately, divide the total stream width by four to determine the length of each quarter section of the transect. (See Figure 9.)
3. Moving from the left bank to the right, locate the first site, then the second, and so forth. At each point, use a yard stick to measure the depth and record the figures in the appropriate column on the Physical Condition Record Sheet.
4. Add the four depth measurements and divide by four to determine the average depth.
6. Determine width:depth ratio by dividing the width by the average depth. Record this number as well.

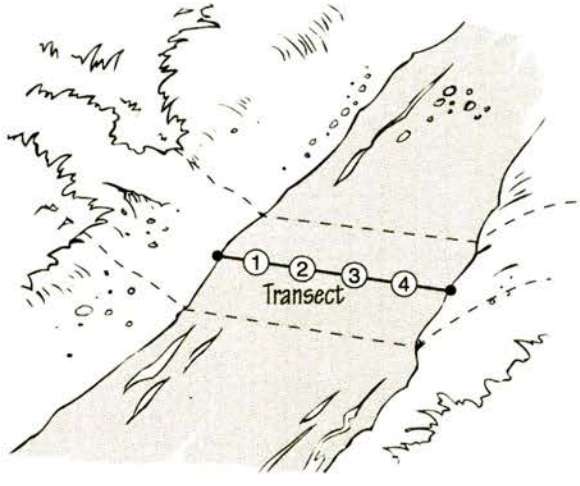
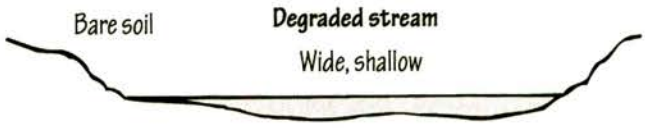


Figure 9: Stream transect showing four equally spaced measuring locations

A good width:depth ratio is generally less than 50:1, indicating a deeper channel and a constricted bank. The wider and shallower the stream, the higher the ratio and the more degraded it is. (See Figure 10.) The



Healthy stream

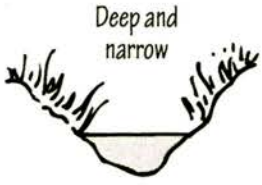


Figure 10: Degraded and healthy streams

width:depth ratio should decrease over time if the streambanks were initially bare but are then managed to maintain continuous vegetation. This will help the stream narrow and deepen.

Examine the Streambed

Major stream degradation often occurs when soil from poorly covered hillsides and streambanks, as well as off of agricultural fields with poor soil structure and surface conditions, washes into stream channels. This soil covers rocks that provide habitat for insects and fish. Small particles smother developing fish eggs, eliminate space between rocks where insects feed and hide, and block the light needed by underwater plants and algae. By monitoring the material in the streambed, or *substrate*, you can learn whether or not the animal and plant communities of your stream are being threatened by erosion.

The four points along the transect, determined earlier in order to measure stream depth, are also used in the following two tools.

Determine the Substrate Composition

In an area about one square foot around each point along the transect, reach into the substrate with your hands and estimate the percent of

- **fine material** (silt, clay and sand that is under 1/16 inch in diameter),
- **coarse material** (gravel, cobbles or boulders; 1/16 inch or larger in diameter), and
- **organic material** (woody debris, crop residue, aquatic plants or algae).

Record this information on the Physical Condition Record Sheet.

Estimate Embeddedness

At the same time, estimate the stream's *embeddedness*—the degree to which the coarse material is covered by fine material. Use the list below and Figure 11 as guides and record the data on the Physical Condition Record Sheet. If there is no coarse bottom material to be covered, mark this line with a slash.

0% — rocks completely free of fine materials

25% — fine material partially surrounds rocks, but tops are clear

50% — fine material completely surrounds rocks, but tops are clear

75% — fine material completely surrounds rocks; tops are half-covered

100% — rocks are totally buried

Embeddedness greater than 50 percent in a riffle probably indicates that sediment loads are too high. Pools tend to have large areas where embeddedness is greater than 50 percent. However, if embeddedness is

greater than 50 percent at the upstream end of the pool where water velocities are faster, this may also indicate high sediment loads.

Measure Water Clarity

If your stream is susceptible to soil erosion, consider measuring the *clarity,* or cloudiness, of the water after a measurable rainfall. Check the stream several times, such within the first twenty-four hours of the rain, a few days later, and a week later.

One way to measure water clarity is to install a *permanent depth meter*—a pipe or metal fence post with white markings painted at regular intervals, such as every five inches—in the stream at a convenient, easily-viewed location. Use the submerged white markings on the post as a visual reference and note how many you can see. If you do not have a permanent depth meter, the stream bottom or a stick poked into the water can also serve as a visual reference. This information can be recorded on the Physical Conditions Record Sheet.

Pay attention to the trends: Does the stream run muddy only after heavy rainfalls? Or, does even a small amount of rain cause the water to cloud? If need be, investigate further to see if the erosion is taking place on your farm or upstream of it. Also, use the permanent depth meter to keep track of yearly differences in flow levels. Higher flow levels tend to increase turbidity. (See the *Tool Box* chapter, "Monitoring Soil," for information on how to prevent soil erosion.)

Monitor Aquatic Plant Growth

A healthy stream is home to a diversity of life forms, both plant and animal. But when excessive amounts of nutrients enter the stream from farm fields and other sources within the local watershed, aquatic plant growth (especially algae) can explode and take over the stream. As the excess algae break down, the level of *dissolved oxygen*—the amount of available oxygen molecules in the water—declines.

The dissolved oxygen level, in part, determines which fish and invertebrates are able to live there. Measured in parts per million (ppm), the maximum level of dissolved oxygen in water is 15 ppm. Sensitive organisms, such as stonefly and mayfly nymphs, need close to 10 ppm of oxygen to survive. Organisms such as midge larvae can more easily survive at lower oxygen levels.

In agricultural areas, expect to see more aquatic plant growth in a stream in the spring, when rain is more frequent and most fertilizers are applied to fields. Later in summer, stagnant, slow-moving areas will also tend to have higher algae levels. But if high levels of algae are present in non-stagnant areas beyond the spring flush, the stream may be carrying excessive nutrients and negatively impacting oxygen levels.

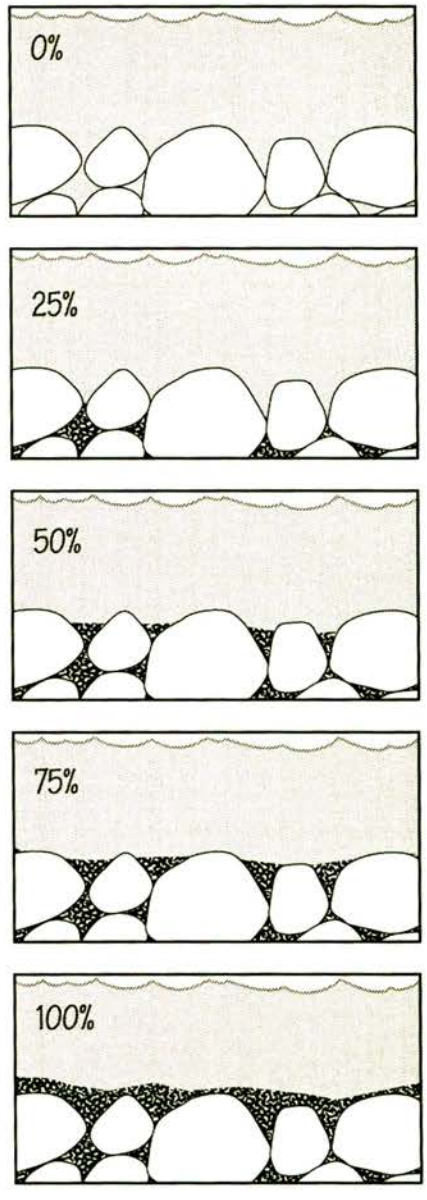
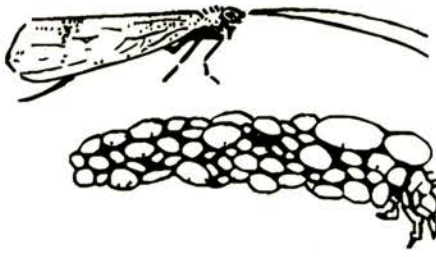


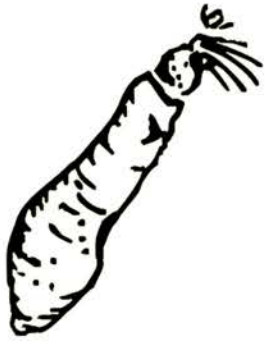
Figure 11: Estimating percent embeddedness

Monitoring Stream Organisms

Many fish and other stream organisms cannot survive in degraded conditions. Monitoring the types and population levels of the aquatic organisms in your stream can tell you whether or not there are problems with its physical and chemical conditions, and reveal clues as to what may be negatively affecting the stream.

The focus of the following material is on monitoring *benthic macroinvertebrates,* organisms without a spinal column that live on the bottom (or *benthos*) of a stream or lake and that are visible to the naked eye. (See the identification key, "Stream Insects and Crustaceans," included with this chapter.) This section also includes some information related to monitoring a stream's fish community.





Survey Bottom Dwellers

Doing a yearly survey of a stream's bottom dwelling organisms can be a way to track the health of a stream over a period of years. This tool is useful for detecting changes in water quality because certain macroinvertebrates have a limited tolerance range to chemical and physical changes.

More complex methods for surveying macroinvertebrates are available. However, these require more specialized training to identify organisms and interpret results. If you are interested in these measures, consider contacting an aquatic entomologist from a natural resource agency.

Equipment

To prepare for surveying your stream's benthic community, gather the equipment listed below:

- hip waders or tall rubber boots
- a collection net or sampler
- a clean bucket and spray bottle
- a sorting tray (such as a white dish pan)
- a couple of ice cube trays
- a magnifying glass or box
- forceps or tweezers
- a clipboard and pencil

Your collection data can be recorded on photocopies of the Bottom Dwellers Record Sheet, a master copy of which is provided at the end this chapter. To make your own collection net, see the sidebar on pages 18-19.

Collection

Methods for collecting and identifying aquatic organisms vary depending on the type of stream being sampled. Refer to your field notes on the habitat information for each of your monitoring stations and use the corresponding method as listed below to collect your samples. The main

objective in this collection stage is to net organisms from each of the habitat areas represented on your stream, so make sure you have set up at least one station for each representative area. Complete all four steps of the surveying process—collection, sorting, identification, and analysis—before moving to a different sampling station.

To avoid disturbing the macroinvertebrates, approach the sampling station from the downstream end, walking into the current. To net the organisms, always place your collection net so that the current flows into it. The organisms are transferred from the net to a collection bucket by spritzing the net with a spray bottle filled with clean stream water. This flushes the contents of the net into the bucket. (See Figures 12a-12c.)

At riffles: Choose an area in the riffle about one square yard in size. With your foot or hand, disturb the area in front of a D-frame net or a kick-seine net so that dislodged organisms will float downstream and into the net. You can also pick up larger rocks and brush the organisms into your net or directly into your collection bucket.

At pools or runs: To sample with a D-frame net, jab the net through the sediment in an upstream direction. Make an attempt to dislodge all organisms within one yard of the starting place. If working with another person, the kick-seine net works well: one person stirs up the substrate (bottom materials) in an upstream direction and a partner holds the seine.

At bank overhangs: Using a D-frame net, sweep through the vegetation of an overhang to loosen organisms attached to the vegetation.

At debris piles: Hold the D-frame net or kick-seine downstream of the debris pile and disturb the pile to dislodge the organisms.

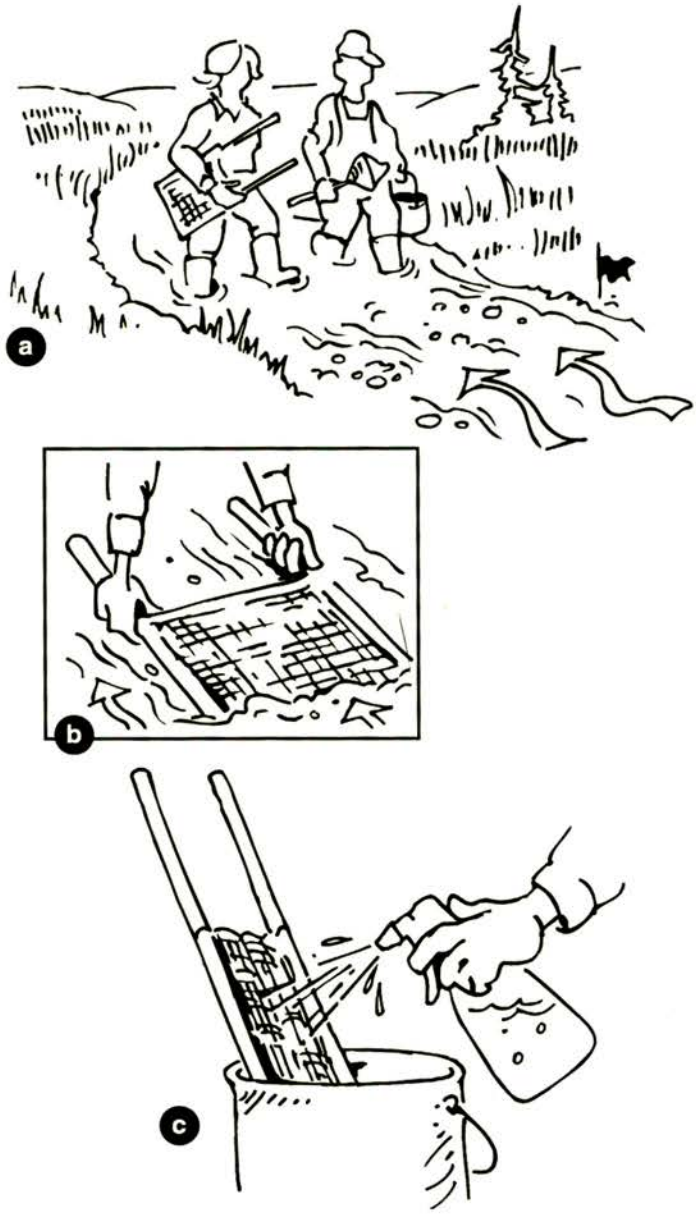


Figure 12: Collecting macroinvertebrate samples

a) Approach sampling station from downstream.

b) Place collection net so that the current carries the dislodged organisms into the net.

c) Flush organisms off the net into a collection bucket.

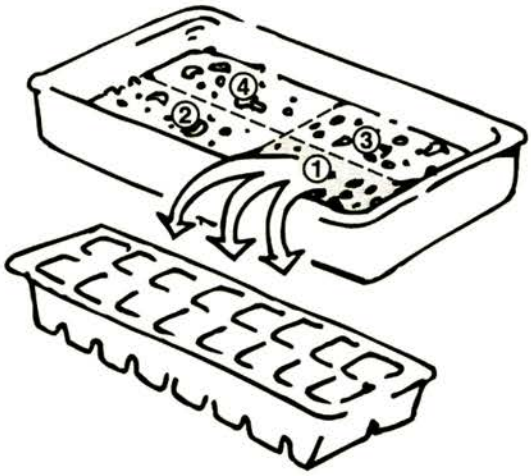


Figure 13: Mentally divide your sorting tray into four quadrants. From one of the quadrants, sort the organisms by type into ice cube trays; then go to the next quadrant and the next, until you have at least 100 organisms.

Sorting

Transfer your sample from the collection bucket to your sorting tray. (If you have a lot of material, divide the sample in half.) In your mind's eye, divide the sorting tray into four equal quadrants. Starting with one of the quadrants, use forceps or tweezers to pick out all of the organisms you can detect there, sorting them by type into the ice cube trays as you go. The quadrant system ensures that you are not just picking out the larger, more colorful, or more active organisms in your sample. (See Figure 13.)

Follow the same procedure for the remaining quadrants until you have at least a hundred organisms. If you reach this quota before you are done with a quadrant, go ahead and finish picking out the organisms in that quadrant and count these as part of your sample. Note that if you are using a D-frame net to collect your sample, you may need to make several attempts within the square yard sampling area to make sure you collect enough organisms.

Identification

Next, use the "Stream Insects and Crustaceans" identification key to sort your sample into the different groups listed on the guide:

- **Group One:** very sensitive to pollution
- **Group Two:** somewhat sensitive to pollution
- **Group Three:** tolerant to pollution

A magnifying glass helps with this process. Be sure to count and record the number of organisms in each group and the total number of organisms collected. When you finish counting and recording, the organisms can be returned to the stream. To preserve and store organisms for further comparisons or identification, put them in a 70-75 percent ethyl alcohol solution in a lidded jar.

If you are unable to identify a particular organism using the key provided, other keys are available. Refer to the "Additional Resources" section at the end of the chapter. One recommendation is *Aquatic Entomology* by W. Patrick McCafferty, written for fishermen and ecologists. You might also seek the help of a biologist or aquatic entomologist.

Life Underwater

The majority of organisms that inhabit the bottom of a stream are not adults. In fact, many of the insects you see flying in the air began their life in water.

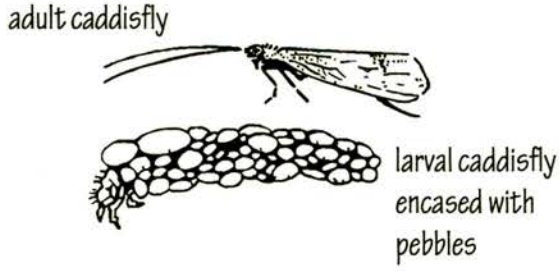
These insects go through several *larval,* or immature, stages in the water before they become adults. During the last stage before becoming an adult, the insect is called a *pupa*. At this stage it builds a case (like a caterpillar) and undergoes a process called *metamorphosis*. During metamorphosis, the internal larval structures are replaced by those of an adult. Once this process is complete, the adult insect emerges from its case and the water.

Some of the insects that begin their life in streams and ponds include the caddisfly, the mayfly, and the gnat.

The Caddisfly

The caddisfly (order Trichoptera) is found in a variety of sizes and colors. Like its relative, the butterfly, most caddisfly larvae build cases to protect themselves. Some caddisfly larvae use small pebbles to build their case. Other caddisflies form cases from dead leaves or sticks. Without the case, caddisflies can be identified by their "c" shaped body and the single claw protruding from each leg.

This order of insects is relatively sensitive to pollution. Their presence or absence can serve as a good indicator of water quality conditions.

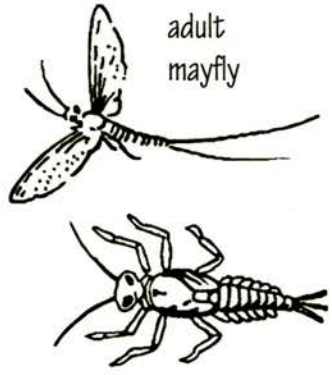


The Mayfly

The term "caddis hatch" is often used to describe the sudden appearance of swarms of delicate insects called mayflies. Sometimes the swarms are so dense they can obstruct traffic. But the term "caddis hatch" is actually a misnomer. Mayflies are not a type of caddisfly; they belong to a different insect order, Ephemeroptera.

Adults mayflies are short lived, generally dying within three days of hatching from their larval stage. They only live long enough to mate and lay eggs; most never eat before they die. Swarms of mayflies seen on a summer night often pulse and move, as males attempt to defend their small territory and make contact with as many females as possible.

Ephemeroptera larvae, on the other hand, can live on stream bottoms for up to two years. These larvae are characterized by their two or three-part tails, and usually by plate-like gills coming from their abdomen, the body segment to which the legs attach.



The Gnat

No doubt you have picked a gnat from your eye on occasion. Gnats (or midges) belong to the Chironomid family of insects, and are only one member of a large order of insects called Diptera (true flies).

Along with their cousins the crane fly, the black fly, and the mosquito, midge larvae are fairly tolerant to pollution. Chironomids often live buried in stream sediments and can tolerate lower dissolved oxygen levels than insects like the caddisfly.

Chironomids are a favorite food for many insect-eating fish. In fact, a common variety called the blood-worm often makes its way into the pet store shelves as freeze-dried fish food. If your stream is home to high percentage of Chironomids, its water quality may be degraded.

Analysis

The main calculations for analyzing your collection data involve finding out the percent of total for each of the three groupings: very sensitive, somewhat sensitive, and tolerant.

The bottom of the Bottom Dwellers Record Sheet provides some space to do your percentage calculations using the general equation given here:

Group Total ÷ **Total Collected** x 100 = Percent of Group

If the number of organisms in Group One is 25 and the total number of organisms collected is 110, to find the Group One percent, your calculation looks like this: 25 ÷ 110 x 100 = 22.7. The percent of total for Group One is approximately 23.

A benthic macroinvertebrate community with organisms from each group indicates good water quality. If, over time, the percent of Group One organisms rises, this signals increasing water quality. If your Group Three organisms constitute more than 50 percent of the total sample, your stream may be experiencing environmental stress or pollution.

Degraded areas also tend to be dominated by one type of organism. If a particular organism seems most prevalent in your sample, calculate the percent of total it represents. Then investigate what the predominance of this organism means for your stream's health—it may or may not mean the stream is degraded. (Some clean, cold water streams are dominated by leeches, a Group Three organism.)

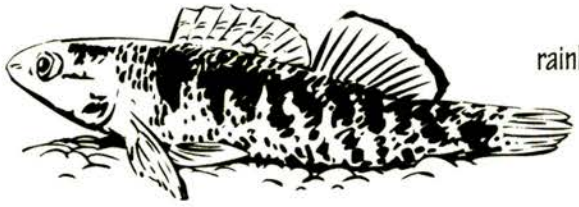
Fish as Stream Condition Indicators

Every stream has its own fish community. How that community changes over time may signal improvement (higher numbers of pollution-sensitive fish) or degradation (overall numbers decrease because habitat has been eliminated by siltation) in stream condition.

Many of the tools used to monitor a stream's physical condition can also help evaluate living conditions for fish. Fish need varied habitat to sustain good numbers and diversity. To reproduce, fish need fast flowing riffle areas with low embeddedness. This ensures that the eggs get plenty of oxygen. Fish also need places to rest and to hide. Log jams, boulders, overhanging grass, and deeper pools give fish refuge from predators. A diversity of habitats also increases the types and numbers of invertebrates, a major food source for many fish.

Because it is difficult to accurately determine the diversity and population levels of a stream's fish community through simple observation, consult a local fisheries biologist. They may be able to aid in collecting and identifying fish.

Common Minnesota Fishes



rainbow darter

The Rainbow Darter

The rainbow darter is one of the more common species of darters found in the small rivers and streams of southeastern Minnesota. As its name implies, it is one of the more colorful fish found in Minnesota's streams.

The rainbow darter only reaches a length of three inches and inhabits clear, rapid waters free of domestic waste. However, it is tolerant of average levels of agricultural enrichment.

The range of the rainbow darter extends from southern Minnesota to eastern Ontario and south to Alabama and Arkansas. In Minnesota, the rainbow dart is common in tributaries of the Minnesota River west of Mankato and in the Cannon, Cedar, Root, and Zumbro rivers.

southern redbelly dace

The Southern Redbelly Dace

The southern redbelly dace is another common, colorful fish found in the streams of southern Minnesota. The bright red color appears to help breeding adults recognize each other in spawning areas they share with other small fish.

An adult female may reach four inches in length, while a male only about three inches. The southern redbelly dace lives over many bottom types—sand, gravel and mud—but consistently lives where springs are present. It can be found in abundance in small streams during summer, but then migrates downstream toward large streams and rivers as winter approaches.

The distribution of the southern redbelly dace is centered in the Ozarks and extends into southern Minnesota in the Mississippi River system. This dace is known in Minnesota in tributaries as far north as the Cannon River in Goodhue County.

How to Make A Collection Net

Two basic styles of nets are used to collect organisms for a survey of the benthic community of a stream, a "D-frame" net and a "kick-seine" net.

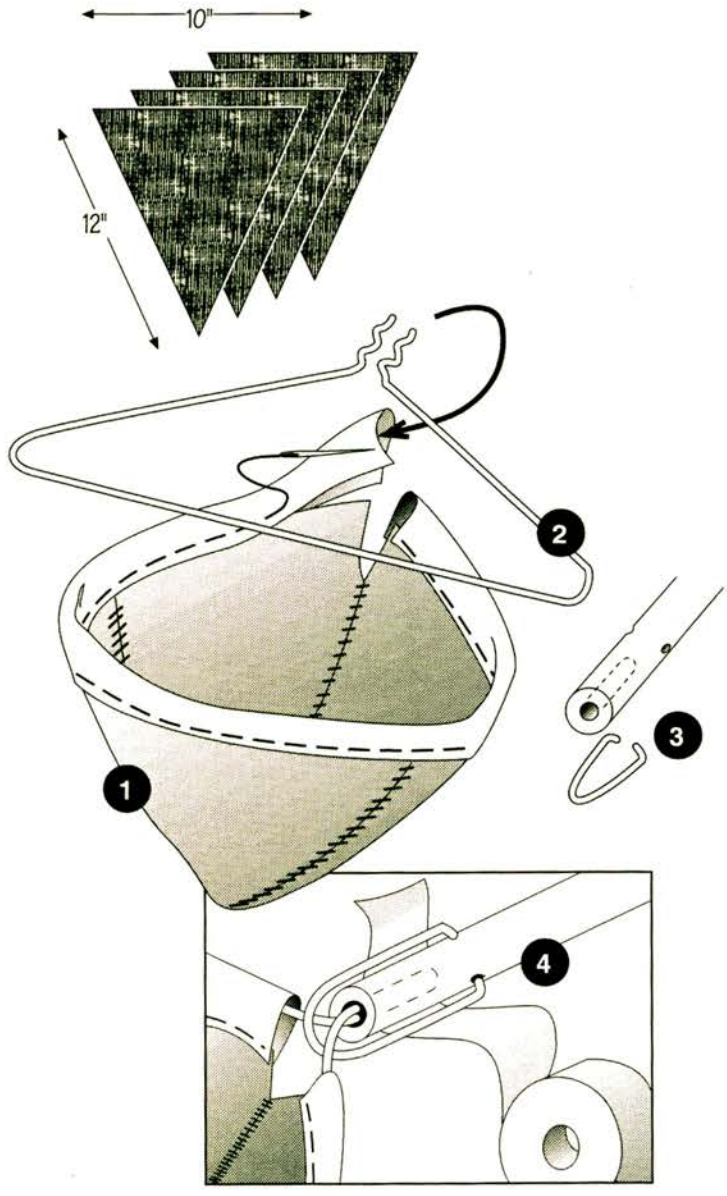
Constructing a D-Frame Net

To make a D-frame net, you will need the following materials:

- enough 1/25-inch mesh nylon netting to yield four, 10-by-12-inch triangles
- 40 inches of 1-inch bias tape
- a wire coat hanger or a somewhat heavier gauge wire you can bend
- a drill with 1/4-inch wood bit
- a 4-foot long wooden dowel or broom handle
- a pair of pliers
- duct tape
- scissors, needle and thread, or sewing machine

Follow these instructions and the accompanying illustrations to assemble your D-frame net:

1. Cut the four triangles from the mesh and sew them together to make a pocket. Sew the bias tape around the opening, leaving the ends open to receive the coat hanger.
2. Cut the hook off the coat hanger with the pliers and untwist the hanger. Slip the coat hanger into the bias-tape casing, and retwist.
3. Drill a hole in the end of the dowel and bend the hanger hook into a U-shape with short right angles on the end.
4. Insert the twisted end of the coat hanger into the hole and slip the U-shaped piece over the end of the dowel to retain the coat hanger frame. Drill holes in the sides of the dowel to receive the right-angle ends. Wrap with duct tape to secure the handle.



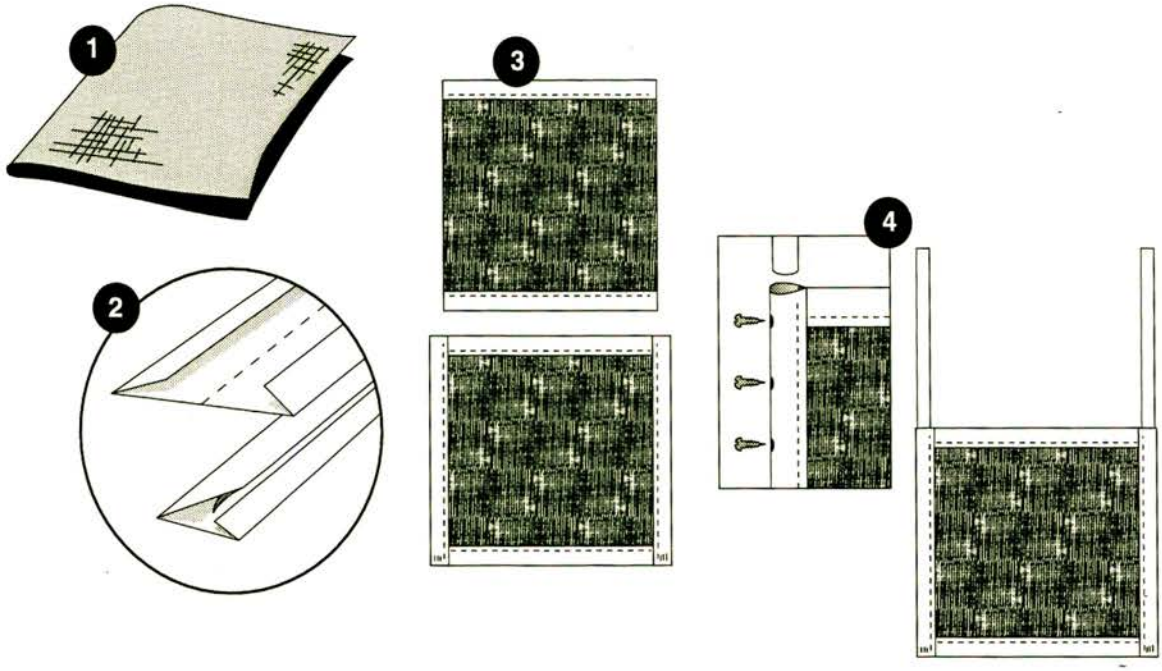
Constructing a Kick-Seine Net

To make a kick-seine net, you will need the following materials:

- 3-foot by 6-foot nylon screening, 1/16-inch mesh
- four 6-by-36-inch strips of heavy canvas
- two 6-foot broom handles or wooden dowels
- iron and ironing board
- scissors, needle and thread, or sewing machine
- wood screws and a screwdriver

Follow these instructions and the accompanying illustrations to assemble your kick-seine net:

1. Fold the nylon screen in half to form a 3-foot square
2. For each of the four canvas strips, make a 1/2-inch fold on each edge of the strip and press with the iron; then fold the strip in half and press again.
3. Sew a canvas strip to both the top and bottom of the mesh square. Then sew the other two strips to the sides to make casings into which you will slip the broom handles. Note that bottom end of the casing is stitched closed and the top end is left open.
4. Once you have inserted the broom handles, secure them to the canvas with wood screws.



Monitoring Water Chemistry

Having your stream's water chemistry tested may be a helpful follow-up to the other tools you use to monitor your stream. For instance, you may want to have water chemistry analysis done if

- your stream catches runoff from a feedlot or from a farmstead in which chemical pesticides are used,
- your stream has an unusually high amount of algae,
- your stream has very few Group One organisms or over 50 percent of Group Three organisms,
- your stream has either low numbers of fish or very little diversity in the fish community, or
- you suspect that a source upstream is adding chemicals to the stream.

Because measuring water chemistry can be complicated, expensive and time consuming, seek the help of an aquatic biologist. (In severe or sudden situations, call the state's Pollution Control Agency or your county's Public Health Department. They may be able to help investigate what is happening.) Some of the complications stem from the fact that water chemistry measures can vary with time of year, climatic events (droughts or floods), intensity of rainfall, and so forth. To account for these variations, a comprehensive sampling plan is needed.

The tools offered in this chapter represent only a small portion of information about stream monitoring. Yet, even if you use just a few of the tools, you can learn a lot about your stream and begin to see the connections between your farming practices, stream conditions, and the long-term sustainability of your farm.

Additional Resources

Publications

Many of the following references can be obtained through the interlibrary loan system, or contact your local bookseller for availability.

Aquatic Entomology: The Fishermen's and Ecologist's Illustrated Guide to Insects and Their Relatives, by W. Patrick McCafferty. (Boston, MA: Jones and Bartlett, 1981.)

Excellent guide to aquatic insects that covers insect biology and identification, ecological information, scientific and common names for insects, and contains great insect illustrations.

Fishes of the Minnesota Region, by Gary L. Phillips, William D. Schmid, and James C. Underhill. (Minneapolis: University of Minnesota Press, 1982.)

General guide to the fishes of Minnesota with photographs of selected species and accounts of individual species biology and natural history. Does not include a key to identification of fishes.

Fishes of Wisconsin, by George C. Becker. (Madison: The University of Wisconsin Press, 1983.)

In depth guide to fishes of Wisconsin that broadly applies to Minnesota. Includes a species-by-species account of the biology and ecology of fishes, distribution maps for individual species, and a key to the identification of fishes.

Guidelines For Evaluating Fish Habitat in Wisconsin Streams, by Timothy D. Simonson, John Lyons, and Paul D. Kanehl. (General Technical Report NC-164, U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station at St. Paul, MN, 1993.)

Methods For Evaluating Stream Riparian and Biotic Conditions, by William S. Platts, Walter F. Megehan, and G. Wayne Minshall. (General Technical Report INT-138, U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station at Ogden, UT, 1983.)

This publication and the previous one are technical reports describing specific methods for surveying the physical habitat of streams. Both are detailed accounts with very useful diagrams.

Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes, by George K. Reid. (New York: Golden Press, 1987.)

An inexpensive, informative, and well-illustrated guide to the plants and animals that live in or near ponds, lakes, streams, and wetlands. A highly recommended resource.

Sediment in Streams: Sources, Biological Effects and Control, by Thomas F. Waters. (American Fisheries Society Monograph 7, 1995.)

Excellent review of the sources and effects of erosion and sediment in Midwestern streams, and strategies for controlling sediment problems.

Other Resources

Department of Natural Resources (DNR) staff may be able to address specific questions or offer additional assistance. Contact your state DNR and ask for the office nearest you. In Minnesota call the general information number: (612) 296-6157.

Save Our Streams (SOS) is a citizen-oriented, hands-on stream conservation program developed by the **Izaak Walton League of America (IWLA),** founded on the belief that streams are best protected by the people who live near them. Through the free SOS program catalog, you can order publications on a number of topics, including stream restoration, how to organize a volunteer stream monitoring program, wetlands conservation and sustainability, plus a teacher's curriculum. The program conducts hands-on workshops and maintains a technical assistance hotline. For more information about the Save Our Streams program, call 1-800-BUG-IWLA (284-4952) or visit the IWLA web site at www.iwla.org.

The ***Volunteer Monitor*** is a national newsletter of volunteer water quality monitoring. The newsletter facilitates the exchange of ideas, monitoring methods, and practical advice among volunteer environmental monitoring groups across the nation. Different monitoring groups serve as co editor for each issue. It is published twice a year and subscriptions are free. To sign up, contact Eleanor Ely, editor, 1318 Masonic Avenue, San Francisco, CA 94117; (415) 255-8049. The *Volunteer Monitor* is also available on EPA's web site at www.epa.gov/OWOW/volunteer/vm_index.html.

Monitoring Streams

Physical Conditions Record Sheet

Station ID & Description _____

Date _____ Weather _____ Date of last rainfall _____

Habitat type (circle) riffle pool/run bank overhang debris pile

Streambank condition	right bank	left bank
% Bare soil	_____ %	_____ %
Bank angle	_____ °	_____ °

Width:depth ratio

Width _____ feet

Transect	**Point 1**	**Point 2**	**Point 3**	**Point 4**
Distance from edge	_____ feet	_____ feet	_____ feet	_____ feet
Depth	_____ feet	_____ feet	_____ feet	_____ feet

Average depth _____ feet

Width/depth ratio _____ :1

Substrate conditions

Transect		**Point 1**	**Point 2**	**Point 3**	**Point 4**
Material	% fine	_____ %	_____ %	_____ %	_____ %
	% coarse	_____ %	_____ %	_____ %	_____ %
	% organic	_____ %	_____ %	_____ %	_____ %
Embeddedness		_____ %	_____ %	_____ %	_____ %

Water clarity observations

Aquatic plant growth observations

Monitoring Streams

Bottom Dwellers Record Sheet

Station ID & Description _____

Date _____ Weather _____ Date of last rainfall _____

Habitat type (circle) riffle pool/run bank overhang debris pile

Sort the organisms you collect by Group using the "Streams Insect and Crustaceans" identification key.

Group One (sensitive)		**Group Two** (somewhat sensitive)		**Group Three** (tolerant)	
stonefly	_____	crayfish	_____	aquatic worms	_____
caddisfly	_____	sowbug	_____	midge fly larva	_____
water penny	_____	scud	_____	blackfly larva	_____
riffle beetle	_____	alderfly larva	_____	leech	_____
mayfly	_____	fishfly larva	_____	pouch and pond snails	_____
gilled snail	_____	damselfly	_____	other snails	_____
dobsonfly	_____	watersnipe fly larva	_____		
		crane fly	_____		
		beetle larva	_____		
		dragonfly	_____		
		clam	_____		
Group One total	_____	Group Two total	_____	Group Three total	_____

Total of all organisms (Groups One through Three) _____

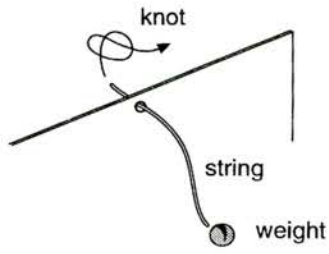
Percent of total sample	_____ %	Percent of total sample	_____ %	Percent of total sample	_____ %

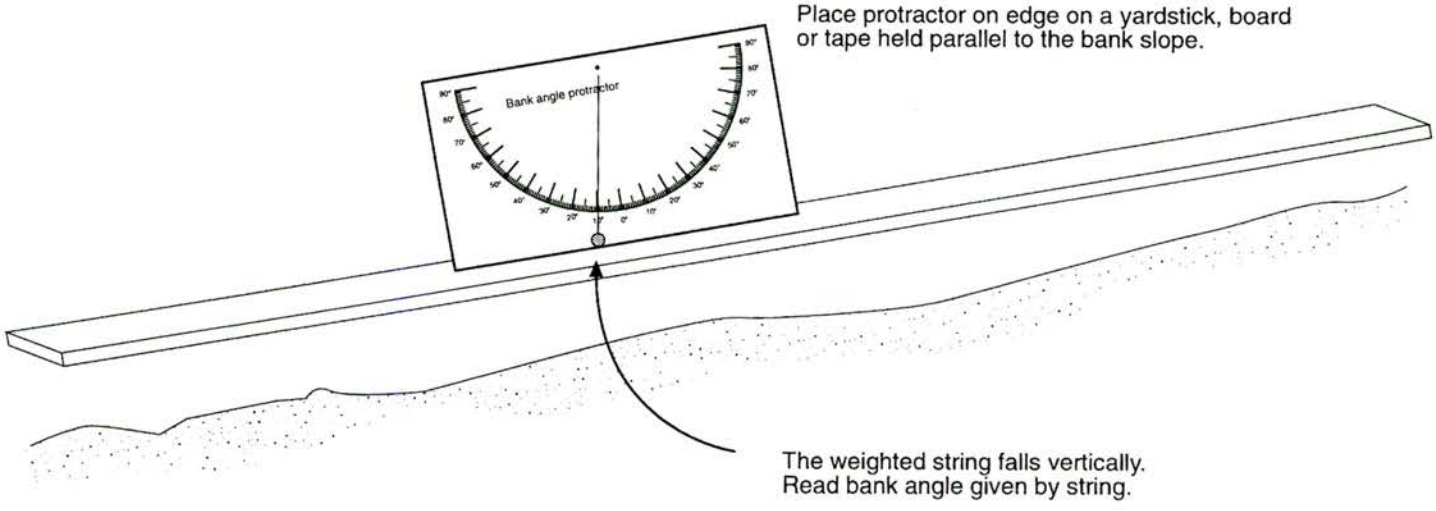
Notes and calculations

Monitoring Streams

Bank Angle Protractor

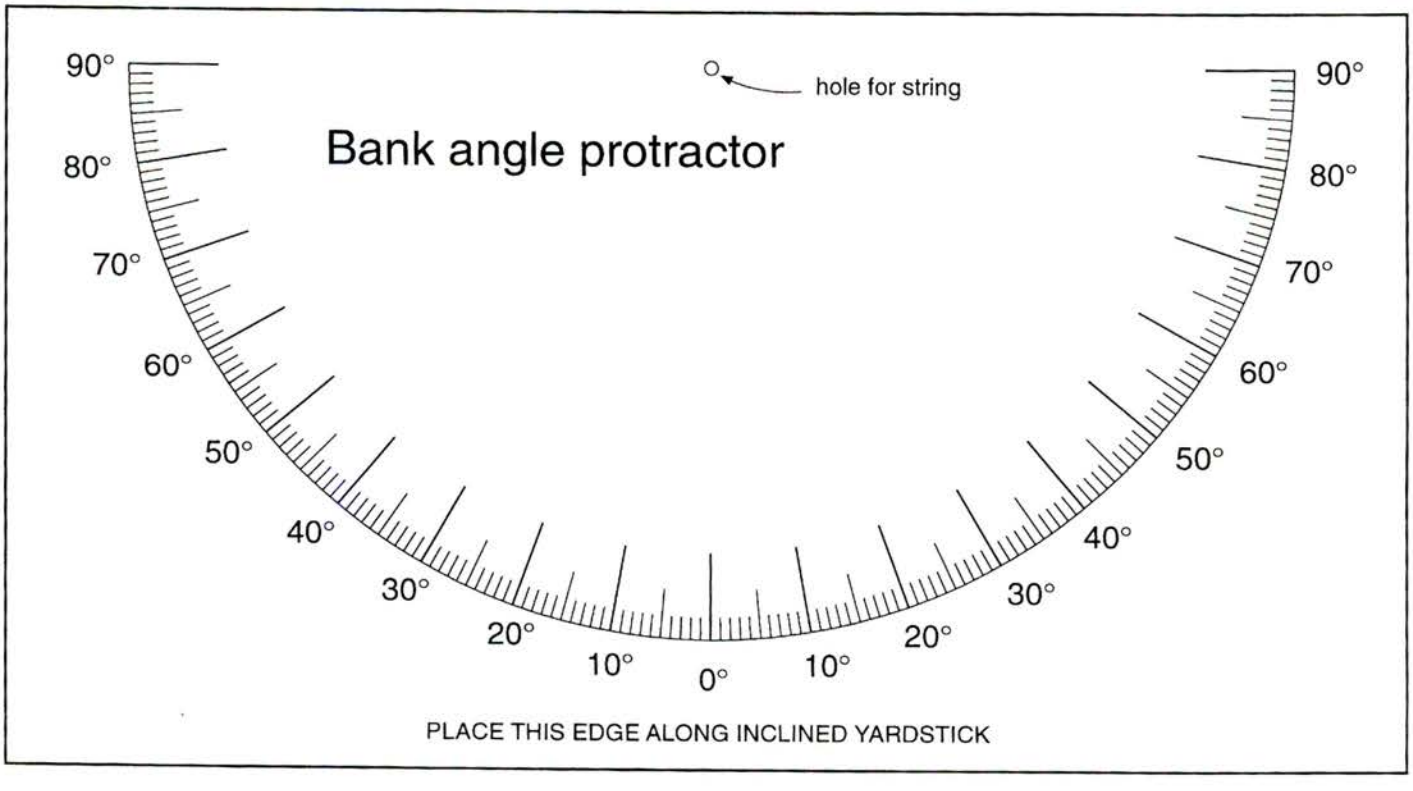
Puncture a small hole in the protractor and thread a short piece of string through the hole. Weight the end of the string with a fishing sinker or similar object, at a point just past the angle markings.

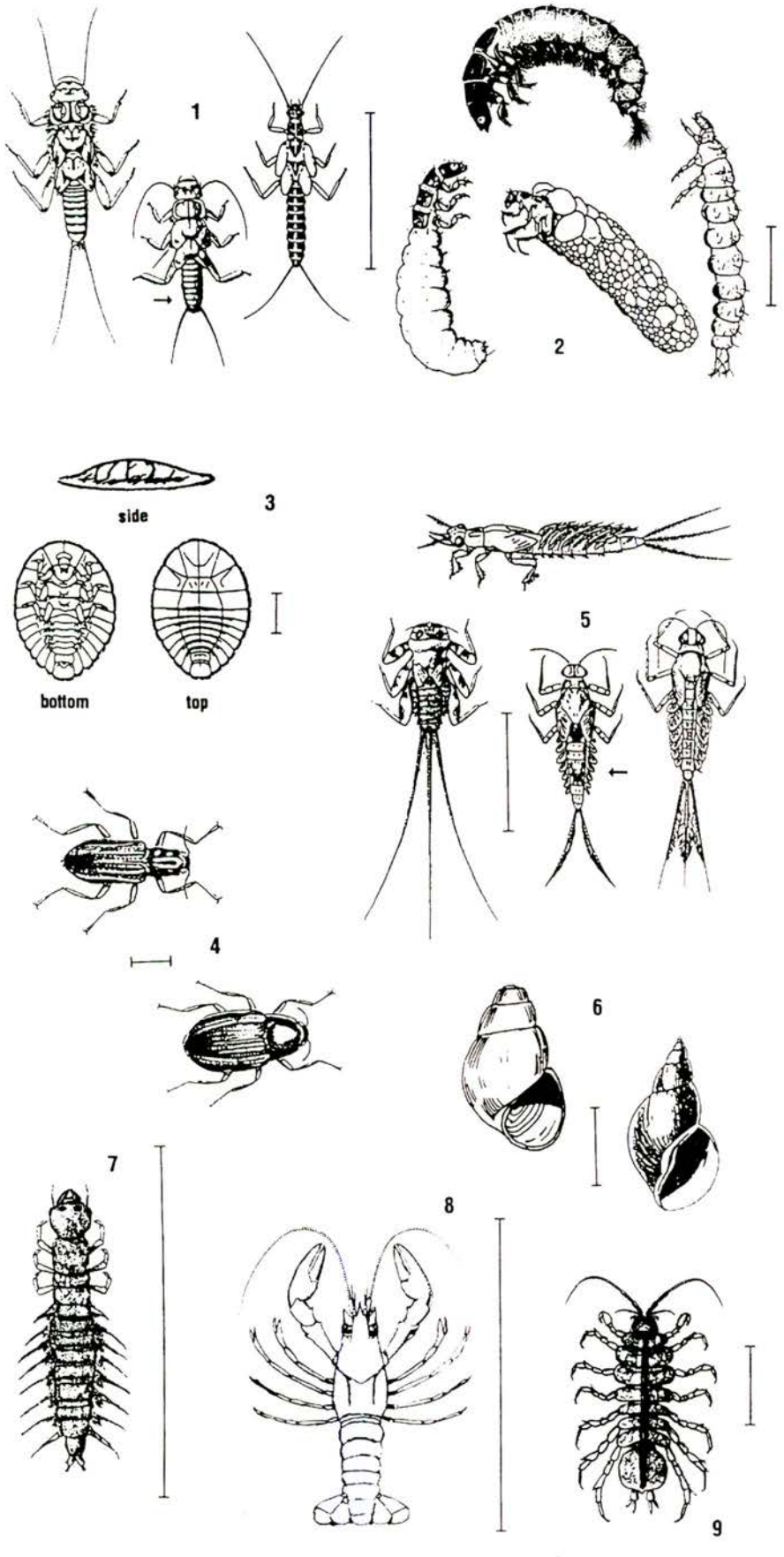




Place protractor on edge on a yardstick, board or tape held parallel to the bank slope.

The weighted string falls vertically. Read bank angle given by string.





Bar lines indicate relative size

Stream Insects & Crustaceans

GROUP ONE TAXA

Pollution sensititve organisms found in good quality water.

1 ***Stonefly: Order Plecoptera.*** 1/2" - 1 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails. Smooth (no gills) on lower half of body. (See arrow.)

2 ***Caddisfly: Order Trichoptera.*** Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock or leaf case with its head sticking out. May have fluffy gill tufts on underside.

3 ***Water Penny: Order Coleoptera.*** 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs and fluffy gills on the other side. Immature beetle.

4 ***Riffle Beetle: Order Coleoptera.*** 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 ***Mayfly: Order Ephemeroptera.*** 1/4" - 1", brown, moving, plate-like or feathery gills on sides of lower body (see arrow), 6 large hooked legs, antennae, 2 or 3 long, hair-like tails. Tails may be webbed together.

6 ***Gilled Snail: Class Gastropoda.*** Shell opening covered by thin plate called operculum. When opening is facing you, shell usually opens on right.

7 ***Dobsonfly (Hellgrammite): Family Corydalidae.*** 3/4" - 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

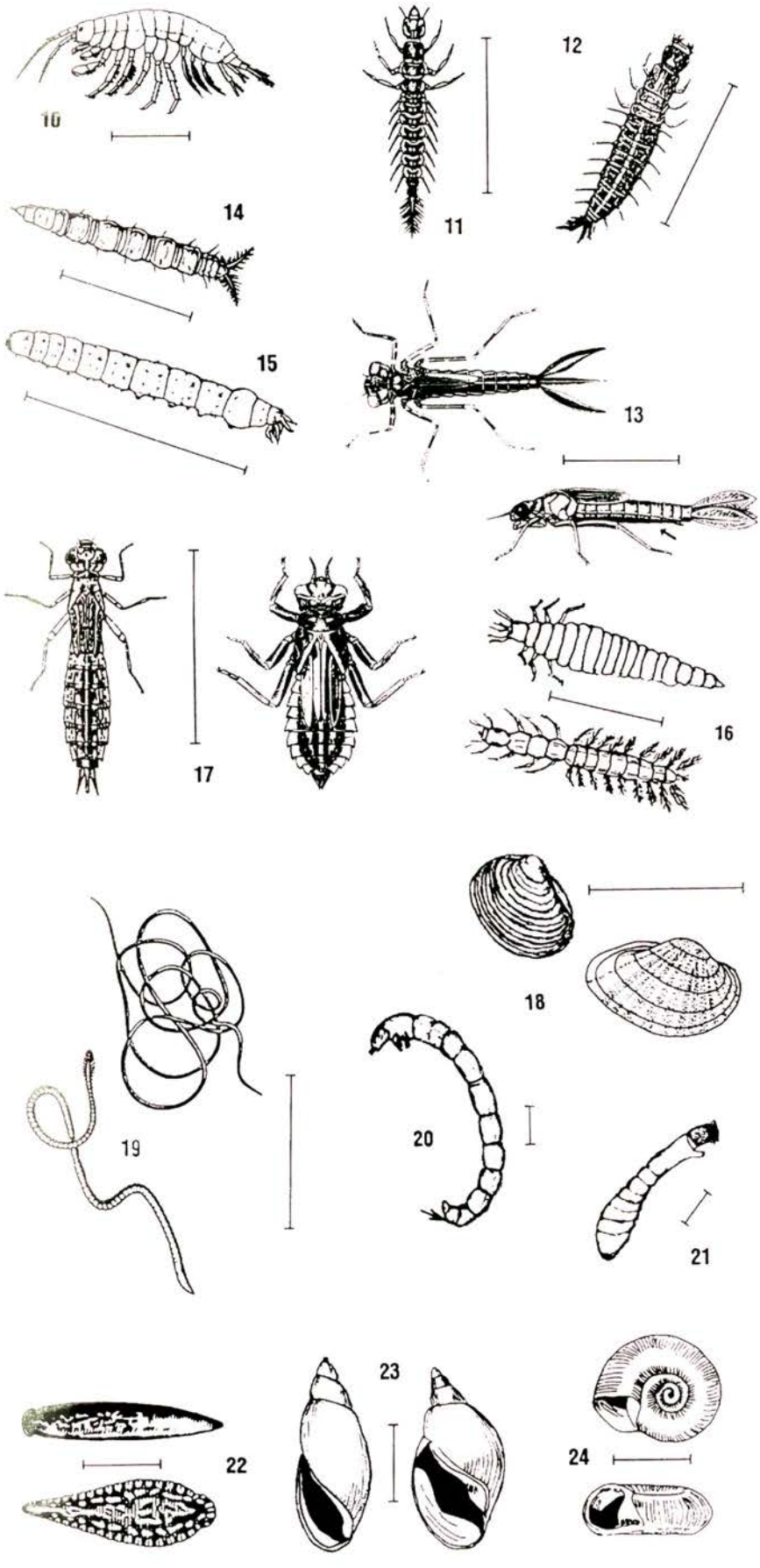
Somewhat pollution tolerant organisms can be in good or fair quality water.

8 ***Crayfish: Order Decapoda.*** Up to 6", 2 large claws, 8 legs, resembles small lobster.

9 ***Sowbug: Order Isopoda.*** 1/4" - 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

Save Our Streams

Izaak Walton League of America
707 Conservation Lane
Gaithersburg, MD 20878-2983
1(800)BUG-IWLA



Bar lines indicate relative size

GROUP TWO TAXA CONTINUED

10 ***Scud: Order Amphipoda.*** 1/4", white to grey, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 ***Alderfly Larva: Family Sialidae.*** 1" long. Looks like small hellgrammite but has 1 long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 ***Fishfly Larva: Family Corydalidae.*** Up to 1 1/2" long. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.

13 ***Damselfly: Suborder Zygoptera.*** 1/2" - 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 ***Watersnipe Fly Larva: Family Athericidae (Atherix).*** 1/4" - 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 ***Crane Fly: Suborder Nematocera.*** 1/3" - 2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 ***Beetle Larva: Order Coleoptera.*** 1/4" - 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 ***Dragon Fly: Suborder Anisoptera.*** 1/2" - 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 ***Clam: Class Bivalvia.***

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 ***Aquatic Worm: Class Oligochaeta.*** 1/4" - 2", can be very tiny; thin worm-like body.

20 ***Midge Fly Larva: Suborder Nematocera.*** Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 ***Blackfly Larva: Family Simulidae.*** Up 1/4", one end of body wider. Black head, suction pad on other end.

22 ***Leech: Order Hirudinea.*** 1/4" - 2", brown, slimy body, ends with suction pads.

23 ***Pouch Snail and Pond Snails: Class Gastropoda.*** No operculum. Breathe air. When opening is facing you, shell usually opens on left.

24 ***Other Snails: Class Gastropoda.*** No operculum. Breathe air. Snail shell coils in one plane.

DEFENDERS OF SOIL, AIR, WOODS, WATERS AND WILDLIFE
THE IZAAK WALTON LEAGUE OF AMERICA

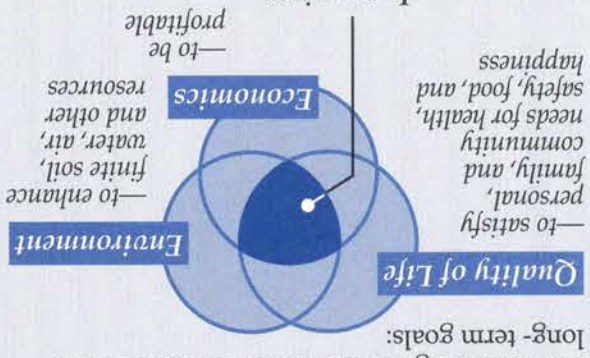
Minnesota Institute for Sustainable Agriculture

A joint venture of the College of Agricultural, Food, and Environmental Sciences University of Minnesota and the Sustainers' Coalition

Minnesota Institute for Sustainable Agriculture
411 Borlaug Hall
1991 Buford Circle
St. Paul, Minnesota 55108-1013

What is Sustainable Agriculture?

Sustainable agriculture seeks to balance three long-term goals:



In any given situation, the most sustainable choice is the one where the net effects come closest to meeting all three goals.

Developing sustainable agriculture systems means . . .

Looking at the farming system as a whole

—constantly reassessing objectives and progress, then experimenting and changing practices to meet them.

Finding site-specific solutions

—in an evolving system of management that is site- and manager-specific. Sustainable agricultural practices will be different for every farm and every community.

Preserving options

—so that farmers and other decision makers will always be able to choose the management options most appropriate for their situations.

Staying open to new ideas

—with farmers, researchers, educators, business people, policy makers, and community members employing a broader perspective as they consider the impacts of decisions on the natural environment, the social stability of communities, and profitability for producers, processors, and distributors.

The Minnesota Institute for Sustainable Agriculture (MISA)

MISA is a partnership between the University of Minnesota's College of Agricultural, Food, and Environmental Sciences and the Sustainers' Coalition, a group of individuals and community-based, non-profit organizations.

Purpose and Goals

MISA's purpose is to bring together the agricultural community and the University community in a cooperative effort to develop and promote sustainable agriculture in Minnesota and beyond.

MISA's goals are to:

- Increase the University's response to the needs of the sustainable agriculture community and increase practitioners' influence on the University.
- Promote sustainable agriculture thinking within the University so that the concepts permeate teaching, research and extension.
- Work with rural communities in discovering and implementing the values of sustainability.

The Board of Directors, Joint Seminar, and Staff welcome your questions and comments:

Minnesota Institute for Sustainable Agriculture
University of Minnesota
411 Borlaug Hall; 1991 Buford Circle
St. Paul, Minnesota 55108-1013

(612) 625-8235; fax (612) 625-1268
Toll-free 1-800-909-MISA (6472)
misamail@tc.umn.edu
http://www.misa.umn.edu/

Who We Are

Board of Directors

MISA's fifteen-member Board of Directors includes at least seven farmers and no more than four University representatives, with the balance coming from the broader community.

- Bill Wilcke, Chairperson, Biosystems and Agricultural Engineering, University of Minnesota
- Carol Ekarius, Vice-Chairperson, Livestock Farmer, Verndale
- Jon Evert, Farmer and Seedsman, Moorhead
- Carmen Fernholz, Farmer, Madison
- Muriel French, Dairy Farmer, Dodge Center
- Ralph Hilgendorf, Organic Milling, St. Paul and Welcome
- Dana Jackson, Land Stewardship Project, White Bear Lake
- Loni Kemp, The Minnesota Project, Canton
- Richard Levins, Applied Economics, University of Minnesota
- Jerry Perkins, Farmer, Worthington
- Mark Ritchie, Institute for Agriculture and Trade Policy, Minneapolis
- Deon Stuthman, Agronomy & Plant Genetics, University of Minnesota
- Mary Tacheny, School Sisters of Notre Dame, Mankato
- Mark Thell, Farmer, Wrenshall
- Bruce Vondracek, Minnesota Cooperative Fish and Wildlife Research Unit, University of Minnesota

Joint Seminar

The Joint Seminar is comprised of forty people appointed by both the College of Agricultural, Food, and Environmental Sciences and the Sustainers' Coalition. It nominates the Board of Directors and meets three times each year to discuss sustainable agriculture issues.

Staff

- Donald Wyse, Executive Director
- Helene Murray, Coordinator
- Debra Elias, Associate Program Director
- Charlotte Conn, Senior Secretary

MISA's Partner Organizations

Institute for Agriculture and Trade Policy
2105 1st Avenue South
Minneapolis, Minnesota 55404
(612) 870-0453; fax (612) 870-4846
http://www.igc.apc.org/iatp/

Land Stewardship Project
2200 4th Street
White Bear Lake, Minnesota 55110
(612) 653-0618; fax (612) 653-0589
http://www.misa.umn.edu/lsphp.html/

Minnesota Food Association
1916 South Second Avenue
Minneapolis, Minnesota 55403
(612) 872-3298; fax (612) 870-0729
http://www.misa.umn.edu/mfa.html/

The Minnesota Project
1885 University Avenue West, No. 315
St. Paul, Minnesota 55104
(612) 645-6159; fax (612) 645-1262
http://www.misa.umn.edu/mnproj.html/

Organic Growers & Buyers Association
7362 University Avenue NE, Suite 208
Fridley, Minnesota 55432
(612) 572-1967; fax (612) 572-2527
http://www.misa.umn.edu/ogba.html/

Sustainable Farming Association of Minnesota
Route 1, Box 4
Aldrich, MN 56434
(218) 445-5475; fax (218) 445-5673
http://www.misa.umn.edu/sfa.html/

MISA

Projects and Programs

Information Exchange

The Sustainable Agriculture Information Exchange

MISA's Sustainable Agriculture Information Exchange provides the public with fast, easy access to sustainable agriculture information and resources.

Services and activities include:

- A resource center located in 413 Hayes Hall on the St. Paul Campus
- A toll-free number for easy access *800-909-MISA (6472)*
- Individualized responses to questions and requests for information
- A World Wide Web site that provides access to current sources of information on sustainable agriculture *http://www.misa.umn.edu*
- A research needs program that matches and provides support for faculty, farmers, and community members for collaborative research and education projects
- Creation of new educational materials on sustainable agriculture

Team Grants

Research and Education Team Grants

MISA facilitates the development of interdisciplinary research and education teams that address key issues affecting community and agricultural sustainability. MISA helps support team development by providing funding for team building and planning through a competitive grants process. It then provides funds to developed teams for research and education activities.

MISA-funded teams include:

- Biological, Financial and Social Farming Systems Monitoring
- Establishing Beginning Dairy Farmers
- Evaluating Approaches in Comprehensive Farm Planning
- Integrated Approaches in Natural Resources and Agricultural Management: Establishing a Research and Educational Agenda for Minnesota
- Sustainable Dairy Farming
- Visioning, Whole Farm Planning, and Alternative Economic Uses of Environmentally Sensitive Areas in the Chippewa River Basin

Endowed Chair

School of Agriculture Endowed Chair in Agricultural Systems

This Chair is dedicated to stimulating discussion, new ideas, and leadership in agriculture leading to a healthy environment, vital communities, and economic profitability over the long term.

The Chair program is:

- flexible—focusing attention on timely issues;
- adaptable—rotating different individuals into the position as needed; and
- interactive—communicating with many diverse stakeholders in agriculture.

The Chair is filled by agricultural leaders from the private, public, and academic arenas. MISA manages the Chair program, and is responsible for identifying topics and filling the Chair on an on-going basis.

Education

Educational Programs in Sustainable Agricultural Systems

Graduate Education
Developed by a MISA-funded team, a minor in Sustainable Agricultural Systems at the University of Minnesota is available to M.S. and Ph.D. students in any discipline. Students in the Minor program complete coursework and a ten-week internship with agricultural producers, non-profit organizations, or government agencies working on sustainable agriculture issues.

Undergraduate Education
A minor in sustainable agriculture and an internship program are also available to undergraduate students.

Seminar Series
Each year, in partnership with the Sustainable Agriculture Study Group, MISA sponsors a number of seminars on campus. Most seminars are informal, lunch-time gatherings open to anyone within and outside of the University. If you would like to be placed on the seminar series e-mail or mailing list, please contact us.

Collaboration

MISA collaborates with many individuals, departments, and organizations within and outside of the University on projects such as these:

- Center for Agricultural Impacts on Water Quality: *Sustainable Agriculture Information Exchange*
- Center for Alternative Plant and Animal Products: *Biomass for Energy Project, Sustainable Agriculture Information Exchange*
- Center for Integrated Natural Resources and Agricultural Management: *Development of Agroforestry Coalition, Field day co-sponsorship*
- Minnesota Department of Agriculture: *Sustainable Agriculture Information Exchange, research and education projects*
- Program for Decision Cases: *Sustainable Agriculture Professional Development Training*
- Sustainable Farming Association of Minnesota: *Field day co-sponsorship, research and education projects*
- University of Minnesota Extension Service Sustainable Agriculture Initiative: *Sustainable Agriculture Newsletter, Sustainable Agriculture Professional Development Training*
- Visions for Change Project: *Steering committee*

Funding

Individuals and organizations are invited to provide financial support to MISA by making one-time or annual gifts. Contributions may support specific projects or programs of donor's choice, such as the research and education teams, the Information Exchange, internship support and scholarships for students in the Sustainable Agricultural Systems Minor program, and the seminar series. The School of Agriculture Endowed Chair in Agricultural Systems is also an option for those who wish to make endowment gifts.

Those interested in making a gift may contact:

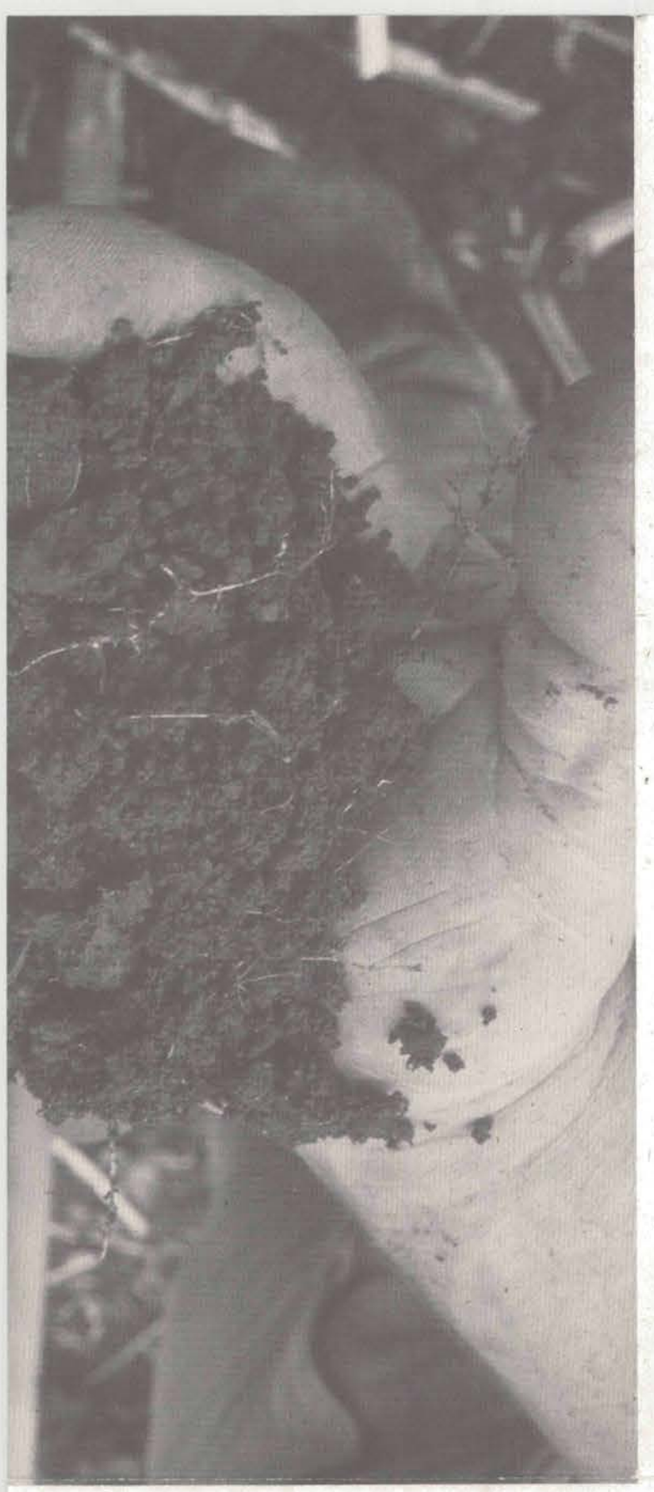
Sue Shepard, Director of Development
College of Agricultural, Food, and Environmental Sciences
277 Coffey Hall
St. Paul, MN 55108
(612) 624-3625; fax: (612) 625-1260

In addition to contributions, MISA's annual funding is provided by the College of Agricultural, Food, and Environmental Sciences. This is supplemented by income for specific projects and programs from entities such as the Minnesota State Legislature (for MISA's Sustainable Agriculture Information Exchange and the School of Agriculture Endowed Chair in Agricultural Systems); the School of Agriculture Alumni Association (for the School of Agriculture Endowed Chair in Agricultural Systems); the W.K. Kellogg Foundation; and the USDA Sustainable Agriculture Research and Education Program.

MISA

Minnesota Institute for Sustainable Agriculture

11/97



Working to Keep the Land and People Together

Land Stewardship Project

YES! I'd like to JOIN the Land Stewardship Project and work for a more sustainable future for people and the land.

_____ $30 basic membership fee

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Return to:

Land Stewardship Project,
2200 4th St., White Bear Lake, MN 55110
612-653-0618

or the LSP office nearest you:

LSP Southeastern MN Office
180 E. Main St., P.O. Box 130
Lewiston, MN 55952
507-523-3366

LSP Western MN Office
103 W. Nichols, Montevideo, MN 56265
612-269-2105

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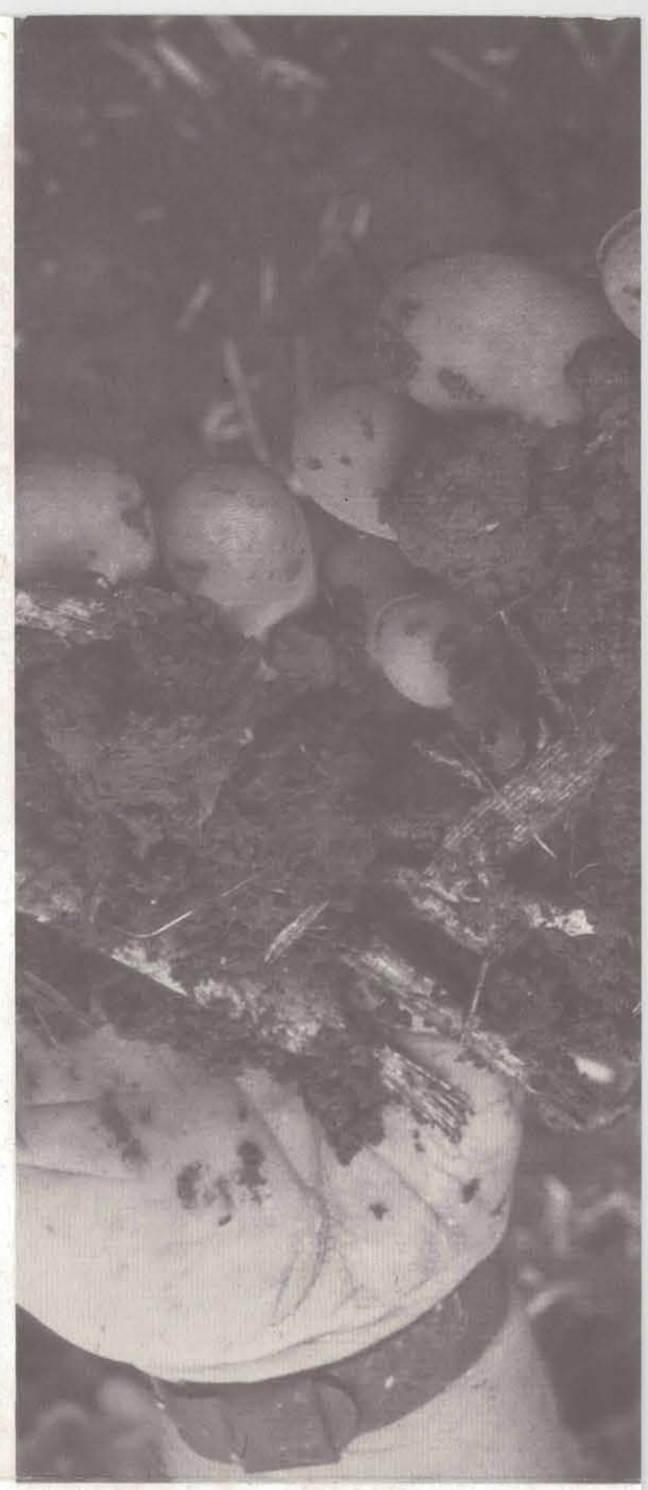

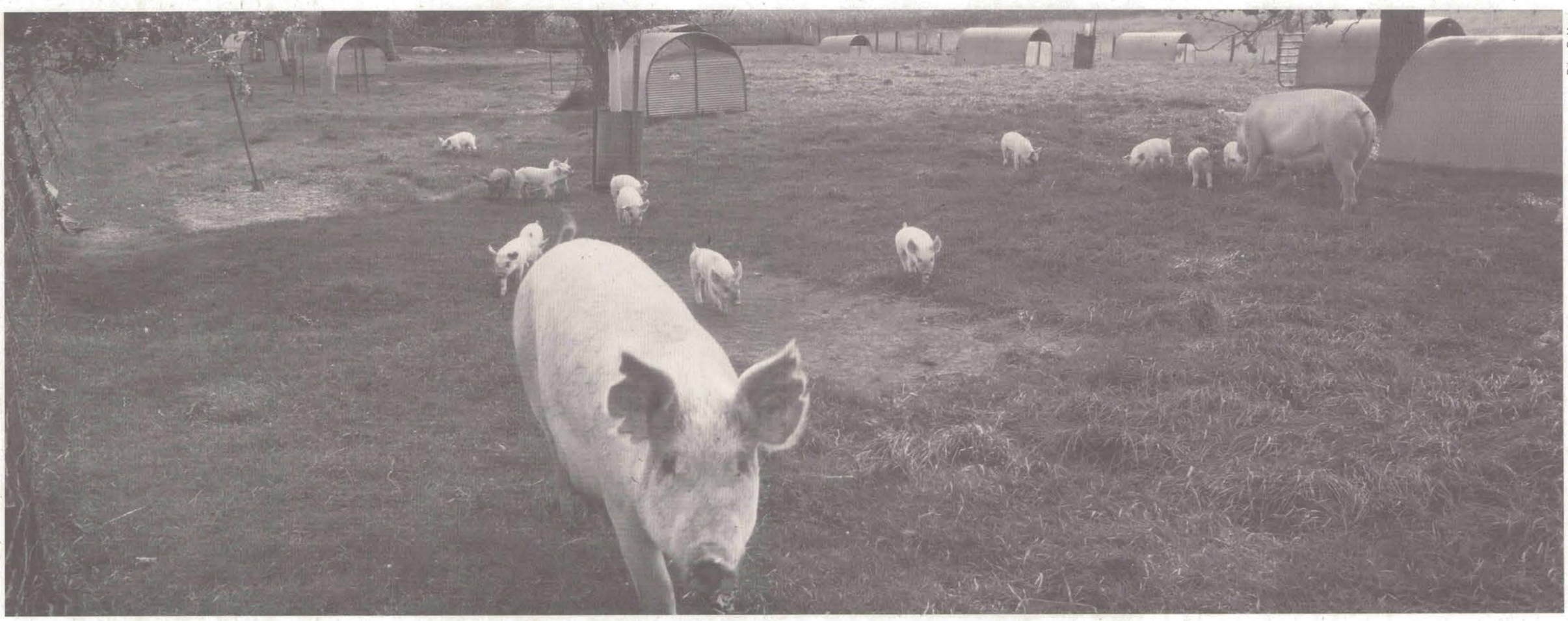

Brian DeVore

Something positive is taking root on the land and in our communities.

An increasing number of farmers and consumers are realizing that the industrial model of agriculture, with its single-minded emphasis on filling grain bins and packing plants at all costs, is neither positive nor inevitable. People are beginning to look at the land not just as a source of record corn harvests or as a dumping ground for millions of gallons of livestock manure. The notion that the best crop metro-area farmland can produce is a residential subdivision no longer goes unchallenged. Farms, communities, watersheds and entire regions are being viewed as a whole working together, not as separate entities that have no relation to each other.

For an increasing number of people, the source of such positive thinking is the Land Stewardship Project (LSP). LSP, founded in 1982, is a private, nonprofit membership organization devoted to fostering an ethic of stewardship toward farmland. It is working to develop and promote sustainable communities and a system of agriculture that is environmentally sound, economically viable, family-farm based and socially just.

The Land Stewardship Project

The true costs of modern farming

LSP was born out of the realization that despite the present ability of American agriculture to produce surpluses, the true costs of such production – rapid erosion and degradation of our soil, the chemical contamination and depletion of our water, the loss of genetic diversity, the poisoning of wildlife and destruction of habitat, and the terrible loss of family farmers and rural communities – are not sustainable. Members of an American Association for the Advancement of Science panel recently expressed concerns that the United States will cease to be an exporter of food by the early part of the next century if current trends continue. As one panel member put it: "Modern agriculture is using land to convert petroleum to food."

Without a major ecological, economic and social correction in mainstream agriculture, the productivity needed to nourish a growing population will not be possible in the future.

LSP believes that all people – farmers and non-farmers alike – have a fundamental responsibility to care for the land that sustains us. That's why our work is based in grassroots organizing and constant dialogue with the people who share a vision of a sustainable future on the land. LSP relies on the power of the people to make positive change– whether it be in organizing against factory farming, developing sustainable farming systems, or coming up with visions of what a metropolitan region should look like in the future.

Based on a series of meetings held with constituents from around Minnesota, a three-part goal has been developed. This vision is guiding LSP in its second decade of service.

Brian DeVore

1. Prosperous, Diversified Family-sized Farms

This will require:

- Integrating quality-of-life issues, profitability and long-term health of the ecosystem into farming decisions.
- Developing improved farming approaches that increasingly replace reliance on purchased inputs with people-based management and on-farm biological resources.
- Changing public and corporate policies that encourage bigness, vertical integration and ecologically damaging farming systems.

2. Land Reform in the Upper Midwest

This will require:

- Bringing people together to develop visions, goals and action plans for change.
- Increasing public understanding of the need for more people on the land.
- Providing access to farmland and education in the principles and practices of sustainable agriculture for all farmers.
- Preserving farmland threatened by development in metropolitan and rural areas.

Brian DeVore

3. Healthy Communities

This will require:

- Bringing people together to develop visions, goals and action plans for change.
- Organizing public support for policies that will help sustainable family farms to thrive.
- Supporting the growth of meaningful, well-paying employment opportunities in rural areas, including those based on farming.
- Encouraging understanding, interac tion and respect for cultural diversity in terms of race, gender, age, profession, heritage and faith.

The Roots of Change

How is LSP making these visions a reality? By instituting programs that are rooted in the deep, fertile soil of communities like yours. LSP is working with people on farms, in the inner city and in suburbs. We are working with farmers, consumers, policy makers, businesses, academics, commodity groups, environmentalists and people concerned with justice in our society. The awareness that activities such as promotion of environmentally and economically sound farming systems, marketing products grown in sustainable systems, community supported agriculture, farm policy reform, land-use planning, factory farm opposition and watershed-wide protection are all interconnected directs LSP's work.

Here is what we have done

Thanks to LSP's organizing and the efforts of committed farmers, hundreds of farm families in Minnesota are networking through the Sustainable Farming Association. LSP has successfully promoted environmentally and economically sustainable farming methods such as management intensive grazing and Holistic Resource Management. Through committees of farmers and rural citizens, LSP has initiated projects to bring consumers and local growers together and to help beginning farmers gain access to land, credit and mentoring from experienced farmers. Through grassroots organizing and education, LSP has held insurance companies accountable for extensive soil loss on farms they own and exposed the negative impacts of factory hog farms upon natural resources and rural communities.

LSP's 1000 Friends of Minnesota program has educated thousands of citizens and influenced local and state government officials to consider sustainable development patterns that conserve farmland and natural resources and promote healthy, livable communities. LSP has also been deeply involved in community partnerships based on watershed systems by helping to organize Clean Up our River Environment (CURE) and the Chippewa River Stewardship Partnership (CRSP). These groups have been effective at bringing farmers, urban environmentalists and business people together to improve water quality in the Minnesota River watershed.

Here's What You Can Do

A grassroots organization thrives with an active membership. A lot has been accomplished in the last several years, but we need your help to continue this journey to sustainability. Join the Land Stewardship Project and become a member of an organization that believes the seeds of a healthy society are imbedded in the land and its people.

Christopher Faust, from the Suburban Documentation Project Archives.

Sustainable Farming Association Chapters in Minnesota

For more information about the SFA network, the *CornerPost* newsletter, or a chapter near you, contact:

The Sustainable Farming Association of MN

Carmen Fernholz
State Board Chair
RR 2 Box 9A
Madison MN 56256
(320) 598-3010
fernholz@tc.umn.edu

DeEtta Bilek
Program Manager
20415 CORD 2
Aldrich MN 56434
(218)445-5475
deebilek@wcta.net

"Farmers must seek agricultural solutions to their farm problems, and judge new ideas in agriculture by their ability to create not more unforeseen problems, but more potential solutions."

- Wendell Berry

"The best fertilizer on the land is the footsteps of the owner."

-- Aristotle

"Study how a society uses its land, and you can come to a pretty good conclusion as to what its future will be."

-- E.F. Schumacher

"No race can prosper till it learns there is as much dignity in tilling a field as there is in writing a poem."

-- Booker T. Washington

Sustainable Farming Association of Minnesota

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State Board Chair: Carmen Fernholz
RR 2 Box 9A
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Program Manager: DeEtta Bilek
20415 CORD 2
Aldrich MN 56434
(218) 445-5475 deebilek@wcta.net

Farmer to Farmer

Farmers: Agriculture's Experts

Mission:

The Sustainable Farming Association (SFA) recognizes the wisdom within ourselves and our communities to find ways of farming that are economically viable and ecologically sound. In the spirit of cooperation we offer mutual support and fellowship to strengthen our families and communities. Our diversity enhances the sharing of resources, new ideas and approaches to farming.

Aims and Purposes:

* To develop a support group for family farmers to acquire knowledge and understanding of economically and environmentally sound practices of production farming.

* To support this group through newsletter, farm tours, seminars, on-farm meetings, and research opportunities.

* To serve as a vehicle for information sharing about farming methods, without endorsing commercial products.

* To support and encourage extension and university research programs that promote sustainable agriculture.

* To promote farming as a positive way of life.

Structure:

The SFA is a farmer-run, nonprofit organization based in Minnesota. The SFA was founded in 1988 in southeast Minnesota by farmers wishing to create an information-sharing network about sustainable farming practices. It is our belief that farmers are experts in agriculture. Farmers, better than anyone, can inform each other about what is needed to sustain our farms and communities.

By 1989, there were two SFA chapters which decided to incorporate into an independent, statewide organization. This provided a structure for the development of new SFA chapters.

Each chapter has a Board of Directors. Each chapter also has two board representatives on a State Board of Directors. The State Board oversees the SFA legal structure, integrity, and financial reporting. The Board also serves as an idea and resource sharing body between the chapters, coordinates the *Cornerpost* newsletter, assists with chapter development strategies, and plans the State Annual Meeting.

We do not believe farmers can go it alone as we search for the path to a sustainable agriculture and sustainable rural communities. We must join together, in equal partnership, with other organizations and institutions. SFA is currently engaged in or exploring partnerships with the Legislative Commission on Minnesota Resources, Kellog Foundation, Agricultural Utilization Research Institute, Nebraska Sustainable Agriculture Society, Land Stewardship Project, U.S.D.A., Minnesota Project, University of Minnesota Southwest Experiment Station, and others.

We welcome all people committed to safe and sustainable farming systems and communities. Our membership is not denied to any person because of race, color or creed.

SFA Membership Application

for New Members Only Please

Please enclose annual membership fee of $20.00*. Members will be assigned to the chapter nearest their home. (*Some chapters may charge slightly more.)

Check Payable to: SFA of MN

Mail to: DeEtta Bilek, Program Manager
20415 CO RD 2 Aldrich MN 56434
Tel. 218-445-5475 deebilek@wcta.net

Name _____

Address _____

City _____ State _____

Zip _____ Phone (____) _____

Areas of interest _____

Sustainable Farming Association Chapters in Minnesota

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30468 Canada Ave Northfield MN 55057
(507) 663-1153 renlundwergin@microassist.com

Central - DeEtta Bilek, Coordinator
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(218) 445-5475 deebilek@wcta.net

Coteau Ridge – Jim Rossow, Coordinator
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(507) 487-5557 westfork@prairie.lakes.com

Crow River - Greg Reynolds, Coordinator
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(612) 972-3295 riverbend@mail.usinternet.com

East Central – *No Contact at this time.*

Hiawatha - Carol Thornton
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(651) 345-4670 ethorn@rconnet.com

Lake Agassiz - Joe Schafer, Chair
Rr 2 Box 270 Red Lake Falls MN 56750
(218) 253-2501 jschafer@redlakefalls.means.net

Northeast - Jenifer Buckley, Coordinator
PO Box 307 Carlton MN 55718
(218) 727-1414 sfa@skypoint.com

Princeton – Frank Foltz, Contact
7910 335th Ave NW Princeton MN 55006
(612) 389-4920 northwind9@juno.com

Southeast - Bev Sandlin, Coordinator
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(507) 689-2988 storm@rconnect.com

South Central – Marlene Vogelsang, Coordinator
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(507) 256-4839 marivogel@hotmail.com

Western - LeeAnn VanderPol, Coordinator
4075 110th Ave NE Kerkhoven MN 56252
(320) 847-3432 vanderpol@prairiefare.com

The Monitoring Tool Box

The ***Monitoring Tool Box*** is not really a tool box, of course, but it is available for purchase. Packaged in a three-ring binder, this 115-page guide covers the monitoring of quality of life issues, farm sustainability with financial data, birds, frogs, soils, and streams. Besides the hands-on methods detailed in each chapter, there is plenty of help with understanding why monitoring matters. Also included are resources of all sorts to further you along in your efforts.

For a copy of the ***Monitoring Tool Box*** and the ***Close to the Ground*** video, send $42 ($38.50 for LSP members) to: Land Stewardship Project, P.O. Box 130, Lewiston, MN 55952. For Minnesota residents, please add 6.5% sales tax. The price includes shipping and handling. Bulk orders receive discounts. Call Karen Benson at (507) 523-3366 for more information.

You may have noted and then forgotten that your **Monitoring Tool Box** has a place for a chapter on Pasture Vegetation. We hope to fill it this winter. Stay tuned.

■ *Research, Continued from page 4*

You need to be able to track which enterprises are profitable."

During the SFS Project's first year of monitoring, participants measured enterprise operating expenses and productivity, returns to capital and labor investments, and whole farm profitability. These analyses were conducted in cooperation with the Minnesota Farm Business Management Assoc. using FINPACK™ software. At the same time, team members began measuring their family's progress toward farm, community, and environmental goals with help from a worksheet from the ***Monitoring Tool Box*** developed by University of Minnesota economist Dick Levins.

One year is not enough to understand how the variables work out over time, so we intend to conduct this research for two more years. Building a sustainable farm business doesn't happen overnight!

Gigi DiGiacomo is available for more discussion about economic monitoring at 612-545-8634 or digia002@tc.umn.edu.

Resources/Tools

Minnesota Weather Guide, The Environmental Calendar 2000 (Fresh Water Society) includes a monthly page with sun, moon, precipitation, and average high and low temps plus additional pages on monthly meteorology, phenology, and astronomy information. Wall or book size. Available in local grocery stores, bookstores or by calling toll free 888-471-9773. $13.95 plus $2 shipping.

A Wildlife Manager's Field Guide to the Farm Bill (Wildlife Management Institute). A 44-page booklet that reviews agricultural conservation programs that affect wildlife and the USDA agencies that administer them. Targeted at wildlife managers, but lots of useful information for farmers and landowners. Available through the Institute, 1101 14th St. NW., Suite 801, Wash., D.C. 20005 or by telephone, 202-371-1808. $4 postpaid.

Land Stewardship Project
P.O. Box 130
Lewiston, MN 55952

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Fall 1999/Winter 2000 • Vol. 1, No. 3

Close to the Ground

Keeping You Up-to-Date on the Art and Science of On-Farm Monitoring

Welcome

Here we are again, bundled up a little more than last time...that is, if you are in or near Minnesota. Regardless of where 'home' is, some things have changed over time. See how we monitor our own lives—it is such a normal, natural process.

This issue will help you think through a few monitoring conundrums, or perhaps create a couple more. One article presents the questions of farm economics as a function not just of cash flow but of ecological worth as well. The continued debate on over-wintering cattle is furthered in our cover story with special attention paid to pasture regrowth. And we offer a love story, bluebird style!

Three final tidbits: the muskmelons mentioned in the last issue materialized soon after and were scrumptious! You will notice that this publication is meant to be hole-punched and included in your ***Tool Box***. And some of you returned a survey on your impressions of the ***Monitoring Tool Box***. We'll report the results when they're available.

LSP and collaborators in Minn. and Wisc. have begun a project focused on monitoring and riparian grazing, subjects that need optimum discussion. Publications, presentations and grazing schools will get the word out. If you or someone you know is interested in sharing your experiences and/or farm, please contact LSP.

Please do send us your words and pictures about how you're being intentional in your land use. You'll help someone else along the way with an idea, a bit of inspiration.

Cover Story

Cows on Snow... Really!

by Ralph Lentz

Grass farmer Ralph Lentz conducted a two-year study in 1994-96 as part of the Energy and Sustainable Agriculture Program (ESAP) of the Minnesota Department of Agriculture. His goal was to investigate several winter-related, low-input pasture management practices and their affect on herd health, pasture ecosystems, and his daily life. Lentz's research and personal observations began several years prior to the ESAP study and continue to this day. Below is an abbreviated report of his findings for 1994-96 and an update from this fall.

Ralph Lentz farms in the Mississippi River bluffs region of southeast Minnesota. His farm is a mixture of hills and relatively flat areas, 17 different soil types, and the influences of 1600 adjacent acres that drain through his place. Some of the poorer soils include clay-loam gumbo types, which make for poor drainage and difficult tillage. Consequently, Lentz feels Continued on p. 2

Lentz rotates his winter paddock each year to keep his beef cow operation financially viable, enhance overall pasture health with additional manure, control erosion, accelerate snowmelt, and incorporate seed.

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■ Cows on Snow, Continued from page 1

his farm is best suited for grazing livestock, at a rate of about 40 beef cows year-round. His buildings and equipment are minimal: a barn to wean calves and house winter replacements, a 90 horsepower diesel tractor, and hay-making implements.

The research project addressed three different but related aspects of grass-fed beef cow production:

1. the use of animal impact and over-wintering to establish and maintain pastures;
2. the establishment of warm season native prairie grasses using cattle as the planting mechanism;
3. the environmental impact of feeding cattle on frozen ground.

To explore the first aspect, Lentz utilized three 4-acre paddocks that had last been cropped in oats in 1992, with no subsequent fertilizers, herbicides or tillage. In one paddock, quack grass and other species returned to allow 18 days of grazing.

Another paddock was winter-seeded on top of snow in early January, then stocked with hay-fed cattle to work the seed into the soil. By spring the herd had left sizable hoof depressions and little residue, but there was little manure runoff or soil erosion. The paddock was rested until mid-June and then successfully grazed for 10 days. Over-wintered sites continue to produce about twice as many grazing days as non-wintered areas.

The second part was motivated by Lentz's understanding of warm season grasses as a source of abundant forage when common pastures go dormant. Lentz plowed an old alfalfa field in the fall and planted it to rye, hoping that rye's allelopathetic qualities would clear the field of common weeds. This worked, but within a week of cutting in June (at flower stage for bedding) quack grass filled the field.

So Lentz sprayed Roundup and in early July hired a custom operator to plant a mixture of barley, bluestem, switch grass, and Indian grass. Grazing the following June controlled all weeds, allowing the prairie species to become established and eventually to go to seed. Lentz rested the five acres until November, when 44 cows and 33 calves grazed it and trampled in the seed.

Overwintering cattle on pasture appears to have a positive impact on biomass production, soil erosion, and manure runoff, in spite of the surface appearance in spring. Lentz observed that:

1. A low input system helped him weather depressed feeder cattle prices;
2. The added manure helped increase biomass production and added heat for cattle warmth and earlier snow melt than in other paddocks;
3. Energy savings from not distributing 10-15 tons of manure per cow per year were considerable;
4. Field song bird populations increased with the establishment of paddocks;

Continued on p. 4

Grass farmer Ralph Lentz and friend, Jake, frequently illustrate the merits of intentional grazing on the farm. This picture was taken during a grazing school field day held this fall.

Close to the Ground

Keeping You Up-To-Date on the Art & Science of On-Farm Monitoring

Fall 1999/Winter 2000
Vol. 1, No. 3

Close to the Ground is a quarterly publication of the Land Stewardship Project, a private, nonprofit organization dedicated to fostering an ethic of stewardship for farmland. This newsletter was launched by the Biological, Social, and Financial Monitoring Project. This initiative was organized and administered by the Land Stewardship Project in association with the Minnesota Institute for Sustainable Agriculture and six farm families who are members of the Sustainable Farming Association of Minnesota. The University of Minnesota, the U.S. Fish and Wildlife Service, the Minnesota Department of Natural Resources, the North Central Research Center, the U.S. Department of Agriculture and the Minnesota Department of Agriculture also had major roles in the Monitoring Project.

All inquiries pertaining to the editorial content of this newsletter or to general information on the Monitoring Project should be directed to LSP, Monitoring Project, 2200 4th St., White Bear Lake, MN 55110; phone: (651) 653-0618; e-mail: lspwbl@mtn.org

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Rebecca S. Kilde,
Windmill Graphics

Field Notes

Monitoring Bluebirds for a Love Song

by Jodi Dansingburg

"The eastern bluebird's love song is why it is referred to as the bluebird of happiness. If you have not heard their song on a cool spring morning, you have not yet lived! It is as if he has ripped a rainbow from the sky, sprinkled it with stardust, converted it to music, and poured it from his heart. Ahhh, this is the sound of our bluebirds, this is the sound of spring."
- Texas Bluebirder Keith Kridle

Last April I got wind that the annual meeting of the Bluebird Recovery Program was being held in Winona, Minn., just up the road from our farm. It seemed like the ideal opportunity to learn more about this attractive species, which has declined in numbers since the beginning of the century due to loss of habitat and the introduction of two bird species from Europe - the house sparrow in 1850 and the starling in 1890.

Speakers shared information on everything from placing and managing bluebird boxes to advantages and disadvantages of various designs of bluebird houses. We even learned how to photograph bluebirds from the well-known Minnesota Department of Natural Resources author Carroll Henderson, author of *Landscaping for Wildlife* and *Wild About Birds*.

I left the conference all excited and ready to move those bluebird houses out of our shed and wait for the "little blues" to move in and set up housekeeping. We were lucky enough to have a pair of bluebirds settle into one of the four houses set up on the farm!

There are several things that stick with me from the conference and my subsequent monitoring experiences which may be of interest to others.

1. Bluebirds are not scared off by people and benefit from the watchful eyes of human admirers. Here's why. Bluebird houses are used by a variety of other bird species. House sparrows and wrens are the least desirable users of bluebird houses and wrens are the most destructive. They destroy the nests of their competitors (ie. bluebirds), by poking holes in eggs, pulling nests apart, and removing eggs from the nests.

Chickadees and swallows make use of bluebird houses without harming bluebird nests. Placing houses within 15 feet of each other allows one for a bluebird pair and one for another species. This keeps swallows from taking both boxes and may reduce wren predation.

The key to producing successful bluebird fledglings is weekly monitoring of the birdhouses. A good bluebird house can be opened without disturbing the nest to see what's in it (bluebird eggs are blue!). You won't scare off the bluebirds by doing this. If you discover a nest full of feathers or speckled eggs, or observe a wren or sparrow nesting in the box, you may want to remove the nest.

2. If you really want to attract bluebirds to your site you can feed them. I tried this with a few containers of meal worms which I was able to keep in their container in the fridge until I was ready to use them. To the thrill of our family and our neighbors, a couple of bluebirds used a house and feeder we set up on the edge of a sheep pasture. Our monitoring was nearly daily as the kids and I kept a close watch on the eggs and then the babies as they hatched, grew and flew.

(PVC-plastic)

3. Some bluebird houses are more effective than others. Two types generally produce good results. The first is the Peterson box with its angled front door and the second is a PVC plastic design with a wooden removable roof. The more square boxes seemed more likely to suffer from dampness and insect infestations.

4. There is a well-organized and extensive network of bluebird watchers. Minnesota's Bluebird Recovery Program of the Audubon Chapter of Minneapolis (P.O. Box 3801, Mpls, MN 55403) coordinates bluebird monitoring and reporting efforts. They have an easy-to-use form to keep track of changes in the populations and methods of encouraging nests and successful fledglings. Members also do educational presentations to inspire would-be "bluebirders." An $8 membership fee entitles you to the organization's newsletter and resource catalog. Consider attending next year's annual conference at the University of Minnesota's Arboretum in Chaska on April 15, 2000.

The network of bluebird enthusiasts extends beyond Minnesota. If you have access to the web, you can subscribe to BLUEBIRD-L@cornell.edu which offers an exchange of ideas and bluebird news from all over the country. The national North American Bluebird Society's next annual meeting will be near Galena, Illinois from June 22-25, 2000 (call 815-845-2390 or go on-line at www. nabluebirdsociety.org for more info.) Here's another site: www.npwrc.usgs.gov/resource/1999/bluebird/bluebird.htm. You can also check with your local Audubon chapter or state natural resource management department to find groups in your state.

Jodi Dansingburg and her family raise goats and watch bluebirds on Dancing Meadow Farm in southeast Minnesota. She worked for LSP with the original Biological, Social, and Financial Monitoring Project, the forerunner to the ***Monitoring Tool Box****. She can be reached at 507-454-4024 or jodid@landstewardshipproject.org.*

The Soil Health Card

Gauging quality with just a hand or an eye

by Ann Lewandowski

Do you have healthy soil? How do you know?

Maybe you make formal measurements and send them to a lab, or conduct an in-field respiration test, or take an infiltration measurement. There are several tests in the ***Monitoring Tool Box*** that require rudimentary or home-made equipment.

But you may depend even more on informal observations such as how well a field drains after a heavy rain, the health of your crops and weeds, and ease of tillage. A soil health card is a simple rating system created by farmers that takes advantage of these visual observations.

Farmers can use a soil health card to quickly evaluate soil quality and to compare the effects of management practices on soil quality over time.

Because the card relies on qualitative observations, you can't easily compare your ratings with those made by your neighbor. But there are some unique advantages of a soil health card:

1. It is written in farmers' terms.

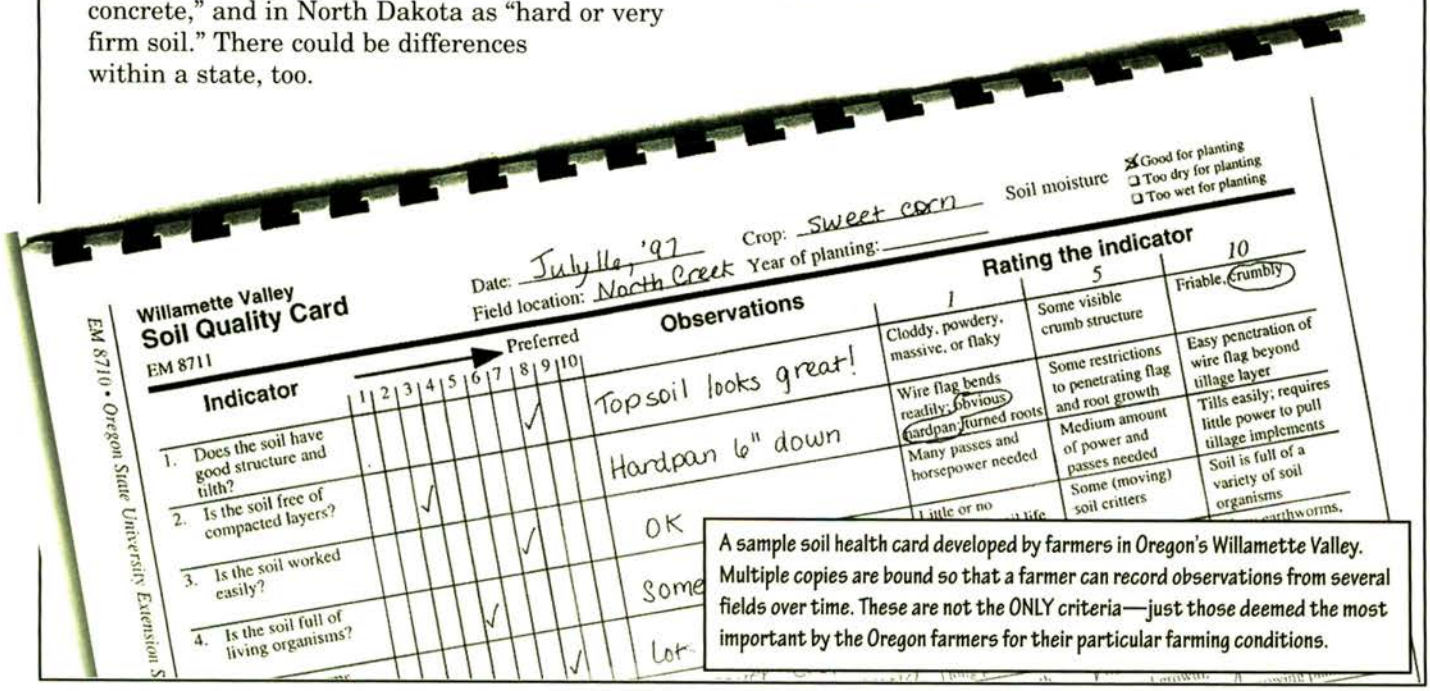
2. It is adapted to local conditions and needs. Cards developed in different regions across the country may use similar indicators, but they differ in important ways because crops, soils, and cultures vary. For example, Maryland farmers include pH and erosion on their indicator table but North Dakota farmers decided not to. Both groups included soil tilth as an indicator, but poor tilth in Maryland was defined as "looks dead, like brick or concrete," and in North Dakota as "hard or very firm soil." There could be differences within a state, too.

Farmers in about 10 states have developed cards by using the Soil Quality Card Design Guide. The guide describes a step-by-step process for leading farmers through the process of identifying soil quality indicators and developing a Soil Health Card. The endproduct is a region-specific, user- friendly, do-it-yourself tool to assess soil quality.

By participating in such a gathering, farmers will have generated valuable discussion about soil quality. Typically, the meetings are facilitated by Natural Resources Conservation Service (NRCS) or Extension employees with technical soils training. This is an opportunity for these technical specialists and farmers to learn how the other understands soil.

The Design Guide and samples of soil health cards from around the country are available on the NRCS Soil Quality Institute web site (http://www.statlab.iastate.edu/survey/SQI/sqihome.shtml). For more information or to order a Design Guide, contact Ann Lewandowski by telephone at 612-624-6765, or by email at alewand@soils.umn.edu.

Ann Lewandowski is a geographer for the NRCS Soil Quality Institute. She writes and edits soil quality information for distribution to NRCS personnel and land managers around the country. Her office is at the University of Minnesota.



A sample soil health card developed by farmers in Oregon's Willamette Valley. Multiple copies are bound so that a farmer can record observations from several fields over time. These are not the ONLY criteria—just those deemed the most important by the Oregon farmers for their particular farming conditions.

Research

Monitoring the Economics of Sustainable Farm Management

by Gigi DiGiacomo

Gigi DiGiacomo, a consultant in economics, works with Sustainable Farming Systems Project farm families to look at whole farm and enterprise viability over time. The team is interested in calculating ecological enhancement and family goals as well as more traditional economic measures.

Rapidly changing commodity prices, farm input costs, and government policies can easily lead to short-sighted farm management decisions that are based on immediate market and policy conditions at the expense of long-term goals. While management adjustments are often necessary during a given production year, it is also essential to step back and take a look at how the farm business performs over time. With this insight, development of a long-range plan can help a family move toward its personal as well as farm business goals.

A handful of farmers participating in the Sustainable Farming Systems (SFS) Project are doing just that. They hope that by monitoring at the whole farm level, they can learn whether it is possible to manage for ecological enhancement while maintaining or improving farm income. These families recognize the need for multi-year economic monitoring in order to build a sustainable farm business. The six families from the Sand Creek (south central Minn.) and Chippewa River (western Minn.) watersheds currently operate diversified crop and livestock farms and are engaged in alternative farm management practices such as rotational grazing, minimum tillage, and/or organic crop production.

Economic monitoring includes goal setting, record keeping, and analysis that can be used in whole farm planning.

As a group, their management philosophy is based on diversification, environmental stewardship, and personal family goals. Even so, profitability is important to them, too. The families share several economic and whole farm goals including risk management, debt reduction, increased use of family labor, and the desire to build a beautiful and healthy farm landscape.

Based on their goals, team members are exploring how production and marketing diversification reduce price and income-related risks from year to year. At the same time, they are taking a hard look at economic performance within individual enterprises: the difference, for example, between the viability of laying hens versus turkeys. In the words of a farm team member, "enterprise monitoring becomes especially important when the operation is diversified.

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■ *Cows on Snow, Continued from page 2*

5. Animal impact in spring or fall was beneficial if the duration is short and the rest period is long.

In November of this year, Lentz noted:

1. Beef cow economics will not pay for silos, concrete feeding systems, and shelters. The low-input economics of over-wintering make sense.
2. I haven't had a vet bill for two years. I had a mild outbreak of winter dysentery in 1997, but the animals survived it without medicines, special care, or confinement.
3. Shelter is a necessity in Minnesota winters. This valley farm is ideal, with steep hills and terraces or timber for shelter during severe storms.
4. Early June grazing is important to control cool season grasses and dandelions before the warm season grasses really start growing. The prairie area was grazed three times this year. I am beginning to think that the most sustainable grass-based systems would have warm and cool season grasses.

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A 5-acre pasture planted in warm season native grasses shown in July after limited grazing and long rest periods allowed optimum species establishment.