Internship Report

An Overview of Natural Resources Conservation
*Through the Benton Soil And Water Conservation District*

By *Fran Lacroix*

For AREC 406-410 (Project/Internship)
Spring 2013
# Table of Contents

Introduction .................................................................................................................. 3

Overview of the Benton SWCD .................................................................................. 3
  History ....................................................................................................................... 3
  Funding, Structure, and Jurisdiction .......................................................................... 5

Objective 1: Learn how the Benton SWCD and other agencies, such as the NRCS, coordinate, develop, and implement programs ................................................. 6
  Oregon Natural Resources Conservation Service ..................................................... 6
  US Fish and Wildlife Service ................................................................................... 7
  Benton County .......................................................................................................... 7
  Watershed Councils ................................................................................................. 7
  Benton County OSU Extension Service .................................................................... 8
  Public Schools ........................................................................................................... 8
  Farm Bureau ............................................................................................................ 8
  Greenbelt Land Trust .............................................................................................. 9
  Oregon Invasive Species Council ......................................................................... 9
  Oregon Watershed Enhancement Board ................................................................. 10
  Cascade Pacific Resource Conservation and Development ......................... 10
  Oregon Society of Soil Scientists ...................................................................... 10
  Other Partners ....................................................................................................... 10

Objective 2: Evaluate and present activities or programs developed through the SWCD to make information, support, and research available to the community .................. 11
  School Projects ....................................................................................................... 11
  Training and Workshops ....................................................................................... 14
  Soil Quality Lab ...................................................................................................... 16
  Information ............................................................................................................ 17
  Tools and equipment Lending ................................................................................ 17

Objective 3: Gain experience in the data collection process involved in soil quality analysis, testing, and research .............................................................. 18
  PMC Research and Sampling ............................................................................... 18
  Soil Quality Lab ................................................................................................... 19

Objective 4: Gain proficiency in the cost benefit analysis process ............................ 21
  Introduction ............................................................................................................ 21
  About Cover Crops ................................................................................................. 21
  About the Cost Benefit Analysis Process .............................................................. 22
  Objectives and Methods ....................................................................................... 23
  Challenges ............................................................................................................ 23
  Costs ....................................................................................................................... 24
  Benefits .................................................................................................................. 25
  Calculating Net Profit .......................................................................................... 27
  Net Social Benefit ............................................................................................... 28
  Recommendations .............................................................................................. 28

Conclusion ................................................................................................................. 29

References ................................................................................................................. 30
Introduction

This report is a review of my internship at the Benton Soil and Water Conservation District (SWCD), which took place between April 1st and June 1st 2013. The Benton SWCD is located at 456 SW Monroe Avenue, Suite 110, Corvallis, OR 97330. Its phone number is 541-753-7208. My supervisor was Teresa Matteson, Education and Outreach Director and Soil Quality Project Manager. I also worked with Heath Keirstead, Education Coordinator, and Crystal Durbecq, Stewardship Coordinator and Invasive Species Specialist. I was involved with many project and activities, including teaching soil science basics to middle school students, writing the Urban Creek Tour brochure, invasive weed spotting and training, as well as soil testing and sampling with the Soil Quality Lab. This report is an overview of natural resources conservation processes I experienced with the Benton SWCD. I learned what the Benton SWCD is and how it operates. I gained a better understanding of how the district cooperates with other organizations and the types of projects that are implemented to serve the community and protect natural resources.

Overview of the Benton SWCD

The Benton Soil and Water Conservation District (SWCD) is one of more than 3,000 districts in the United States and one of 45 offices in Oregon (Benton SWCDa). These districts are legally defined as subdivisions of state government, although they function as local units (Benton SWCDa). Depending on the state, they are also known as Land Conservation Departments (Wisconsin), Natural Resources Conservation Districts (Arizona), Natural Resources Districts (Nebraska), Resource Conservation Districts (California), and Soil Conservation Districts (Idaho, North Dakota, Utah, Maryland, New Jersey, Puerto Rico, and Tennessee). They coordinate assistance from all available sources, public and private, as well as local, state, and federal, in order “to develop locally driven solutions to natural resources concerns (NACD).”

History

The history of the conservation districts is closely tied to that of the Natural Resources Conservation Service (NRCS). Soil quality concerns grew during the
1920s, as Hugh Hammond Bennett, soil surveyor for the USDA, observed how soil erosion by water and wind could significantly diminish the ability of the land “to sustain agricultural productivity (NRCSa).” His 1928 publication “Soil Erosion: A National Menace” was influential in raising awareness in soil quality issues.

In 1932, the Dust Bowl further emphasized the need for soil conservation. Following a long drought in the Great Plains, the region experienced a widespread crop failure and the soil became exposed to blowing winds and eroded. Fine soil particle were swept over a large part of the country, reaching south to Texas and east to New York. The storms “blotted out the sun and swallowed the countryside (NACD).” The same year, in the midst of the Great Depression, Franklin D. Roosevelt was elected President and conservation of soil and water became a priority in the New Deal administration (NRCSa).

The National Industrial Recovery Act was passed in June 1933 and included provisions and funds for soil erosion issues. With these funds, the Soil Erosion Service (SES) was created as a branch of the Department of Interior, with Bennett as its Chief in September 1933. In 1935, Bennett testified to Congress and urged for the creation of a soil conservation agency. The Soil Conservation Act was then passed in April 1935, creating the Soil Conservation Service (SCS), which replaced the SES, as a branch of the United Department of Agriculture (USDA). The program expanded nationwide, supported by labor provided by the Civilian Conservation Corps (CCC), the Civil Works Administration (CWA), and the Works Progress Administration (WPA). Technical experts conducted research in order to better understand the erosion process and “develop effective conservation practices (NRCSa).” As part of the Federal Crop Insurance Reform and Department of Agriculture Reorganization Act of 1994, the SCS was renamed Natural Resources Conservation Service (NRCS), to better reflect the scope of its mission.

The Soil Conservation Service was originally designed to connect federal actions with the “active, voluntary support from landowners,” in order to ensure the “success of conservation on private land (NACD).” However, the SCS had difficulties reaching these landowners, as its actions were often centralized and often lacked consistent presence in local communities. In 1937, Roosevelt proposed the creation of local conservation districts that would be run by landowners (NACD). These districts would fill the gap between federal and state programs and local communities by connecting landowners. The USDA created a framework for cooperation by drafting the Standard State Soil Conservation District Law, which was sent to the governors of all states. In August 1937, North Carolina opened the first district in the Brown Creek Watershed (NRCSa).
Funding, Structure, and Jurisdiction

Conservation districts were originally planned to operate solely with the help of volunteers. This concept had to be adapted because it was relatively unsuccessful. As it was difficult to find enough people to commit to coordinating efforts, the districts created six paid positions, supported by grants, donations, and occasionally, a tax base. The board of director is composed of seven volunteers, elected to represent five geographical zones and as to at-large directors. There are also three volunteer associate directors.

The Benton SWCD receives grants from the NRCS, Farm Service Agency (USDA), Oregon Watershed Enhancement Board (OWEB), Oregon Department of Agriculture (ODA), and other organizations, as well 0.30$ from each of Benton County's taxpayers. Such a tax base is unusual for an SWCD and is a very valuable asset, as grants can be difficult to obtain. Projects to which funds will be allocated are discussed at monthly meetings and budget hearings. The Benton SWCD monthly meeting takes place the first Monday of every month.

County limits usually mark the jurisdiction boundaries of the SWCD. Within this range, the SWCD primarily works on private lands, but also extensively cooperates with other property owners, such as the city, non-profit organizations, such as the Greenbelt Land Trust, as well as state and federal land. While the SWCD does not have the power to work on public land, it can collaborate on public projects. Since environmental issues do not stop at county limits, the Benton SWCD also works closely with other counties' SWCDs. They implement joint projects, share information and results, or refer contacts to each other.
Objective 1: Learn how the Benton SWCD and other agencies, such as the NRCS, coordinate, develop, and implement programs.

In order to accomplish its conservation goals and implement new programs, the Benton SWCD collaborates with many organizations. This section describes the role of these partners and how they coordinate with the SWCD.

Oregon Natural Resources Conservation Service

The Benton SWCD collaborates very closely with the Oregon NRCS, and especially with Tom Snyder, resource conservationist at the Tangent NRCS, and Annie Young-Matthews, agronomist at the Corvallis Plant Material Center. The NRCS works primarily with private landowners. As a part of the USDA, the NRCS helps administering the Food, Conservation, and Energy Act, also called the 2008 Farm Bill. The act builds on the 1985, 1996, and 2002 Farm Bills, creating new goals and simplifying existing programs (NRCSb). It provides conservations opportunities for farmers and ranchers, such as Conservation Innovation Grants (GIG) and Environmental Quality Incentives Programs (EQIP).

Tom Snyder has been the District Conservationist for Benton County since 2005, and is based at the Tangent NRCS. He often works from the Benton SWCD offices on Thursday mornings. This allows him to efficiently communicate with his SWCD collaborators and creates a continuous link between the two agencies. He is responsible for working with partners “to determine how Federal Farm Bill Dollars are utilized” in the county. He has recently distributed funding for improving the Fender’s Blue Butterfly’s habitat and restoring Oak Woodland Habitat. (Benton SWCDa) While his jurisdiction is limited to working on private lands, with landowners, his projects are often adjacent to similar programs on public lands.

Tom Snyder and SWCD employees meet potential landowners and partners and mutually refer them to each other. They allocate projects between the SWCD and the local NRCS branch, depending on which one is the most suitable and most likely to succeed.

Another important resource made available by the Oregon NRCS is the Field Office Technical Guides (FOTG). This set of documents is published online, through the eFOTG. Field Office Technical Guides are localized, in order to apply to the geographical area for which they are prepared. They can include databases, computer programs, and other electronic-based materials, such as transmittals, cost
data, maps, laws, and erosion prediction tools. Some of the information included in the Benton County FOTG file was used in the Cover Crops Cost Benefit Analysis.

**US Fish and Wildlife Service**

While the US Fish and Wildlife Service (USFWS) and the SWCD do not typically work on the same land, as the USFWS works primarily on federal lands, they collaborate by exchanging information and volunteers. SWCD volunteers and employees occasionally organize weed pulling sessions or other labor-intensive tasks on federal land. This allows them to learn about common issues and benefit from each other’s help, resources, and knowledge. They also collaborate to organize events to raise public awareness, such as tours and workshops.

**Benton County**

The SWCD provides resources and knowledge on natural resources, such as weeds, to the County, in order to facilitate public work and protect the environment. A recent example of such collaboration is the weed identification at the wetland mitigation project near Bald Hill. A mitigation zone replaces habitat lost by new developments, such as a new road. Crystal Durbecq, invasive weed specialist, and Heath Keirstead, education coordinator, put flags on a Wetland mitigation project, close to Bald Hill, in order to help County workers to identify native and invasive species, when they spray the area.

**Watershed Councils**

Watershed councils (WC) are locally organized, voluntary, non-regulatory groups “established to improve the conditions of watersheds in their local area.” (Network of Oregon Watershed Councils) The 1995 Oregon Legislature contributed to the establishment of the councils through House Bill 3441, by clarifying that a council is “a local government decision, with no state approval required. The councils represent the interests of their basin, by establishing partnerships with private, local, state, and federal stakeholders. They plan watershed protection and holistic restoration strategies, from headwater to mouth (Network of Oregon Watershed Councils). Council members collaborate to “identify issues, promote cooperative solutions, focus resources, and agree on goals (Network of Oregon Watershed Councils).” In Benton County, the SWCD works with the Mary's River WC, Alsea WC, Long Tom WC, and Luckiamute WC.
Benton County OSU Extension Service

The Benton County OSU Extension Service’s mission is to convey research-based knowledge to the local community (OSU Extension a). Its goals are to strengthen the local economy and improve community health. OSU Extension faculty works with business people, farmers, foresters, youth, and community leaders to solve local issues and foster progress through gardening, small farms, food, and youth programs (OSU Extension a).

The Extension Service collaborates closely with the SWCD. It hosts the Soil Quality Network webpage, a program developed by Teresa Matteson through the SWCD. It runs 4-H Youth Development programs, out of school youth activities in which any student enrolled in kindergarten through 12th grade can participate. The SWCD often participates in discovery days organized by the 4-H Wildlife Stewards (OSU Extension b). The Extension Service has also developed the Small Farms network, a valuable tool through which the SWCD can connect with small farmers and landowners. The Small Farms network provides information, education, resources, and opportunities to “farmers, agriculture professionals, food policy advocates, students, and managers of farmers markets (OSU Extension d).”

Public Schools

An important part of the SWCD work is to promote natural resources preservation in the community. By collaborating with Benton County public schools, the SWCD can reach students to raise an interest in conservation programs. SWCD representatives, such as Crystal Durbecq, invasive weed specialist, Heath Keirstead, education coordinator, and Teresa Matteson, outreach director, are often presents at school field days, to teach students about soil and watershed properties, erosion, invasive species, and ways to help to protect the environment.

Farm Bureau

The Oregon Farm Bureau is a voluntary and nonprofit organization representing the interests of the state’s farmers, growers, and ranchers in the public and policy making (Oregon Farm Bureau). It promotes “educational improvement, economic opportunity, and social advancement” for its members (Oregon Farm Bureau). The organization was first established in 1919, and its membership now counts more than 60,000 Oregon families (Oregon Farm Bureau).
Farm Bureau meetings are a good way for the SWCD to meet influential landowners. Teresa Matteson attends monthly meetings of the local chapter, on the third Wednesday of every month. Farmers discuss new legislation and concerns that could impact their work. They also talk about local projects, such as their booth at the local county fairs, rodeos, and auctions.

Greenbelt Land Trust

The Greenbelt Land Trust (GLT) was founded in 1989 to provide Corvallis residents with easy access to nearby natural areas (GLTb). Today, GLT owns 376 acres that staff and volunteers are “actively restoring and using for educational opportunities (GLTb).” They also work with landowners as well as private and governmental organizations to protect over 1800 acres of farmland, forest, meadowland, and riparian areas in the Mid-Willamette Valley.

The SWCD primarily collaborates with the Greenbelt Land Trust to reach the community and raise public awareness on current issues, such as invasive species management and wildlife habitat protection. Speakers from both organizations work together at workshops and demonstrations to inform the public. The land owned by Greenbelt, at Bald Hill, is a good place to organize demonstrations, showcasing examples of native and invasive plant species, management efforts, wildlife habitat, and human/wildlife cohabitation.

Oregon Invasive Species Council

The Oregon Invasive Species Council is a branch of the Oregon State government. Its purpose is to “conduct a coordinated and comprehensive effort to keep invasive species out of Oregon and to eliminate, reduce, or mitigate the impacts of invasive species already established in Oregon (OISC).”

The Oregon Invasive Species Council provides expertise and advices on invasive and native plants species to the SWCD. Members from the council occasionally attend SWCD workshops and events. Members from both organizations share their strategies and ideas to better control weeds’ invasion.
Oregon Watershed Enhancement Board

Oregon Watershed Enhancement Board (OWEB) is a state agency that provides grants to help Oregon landowners to protect local streams, rivers, wetlands, and natural areas (OWEB). In order to support the implementation of the Oregon Plan for Salmon and Watersheds, OWEB offers $100,000 per biennium through Benton SWCD. The funds are distributed to landowners, with a maximum of $10,000, to implement projects that will benefit “water quality, water quantity, and fish and wildlife (Benton SWCDa).”

Cascade Pacific Resource Conservation and Development

Cascade Pacific Resource Conservation and Development helps the Benton SWCD identify funding sources for projects and programs, and provides key grant administration services (Benton SWCDa).” The organization is part of non-profit Resource Conservation and Development Areas (RC&Ds). This national program was created within the USDA more than 40 years ago to respond to the needs of rural communities through regional projects (Cascade Pacific RC&D).

Oregon Society of Soil Scientists

Oregon Society of Soil Scientists (OSSS) is also in contact with the SWCD, as Teresa Matteson serves as the organization’s president. OSSS jointly organized the Soil Quality Network conference. The OSSS’s mission is to advance the knowledge of soil science and promote public awareness of soil conservation issues (OSSS). Members of the society include soil scientists, students studying soils, or anyone else interested in soil science and conservation (OSSS).

Other Partners

The Benton SWCD also maintains contacts and channels with other organizations and agencies. Benton SWCD staff occasionally communicates with members of the Institute for Applied Ecology and the Corvallis Environmental Center. The Oregon Department of Agriculture (ODA) is a major source of funding for the district’s operations and activities. The U.S Forest Service, Department of Environmental Quality, Oregon Department of Fish and Wildlife, Environmental Protection Agency, and other government agencies sometimes share their expertise or participate in SWCD events.
The Stream Stewards program often participates in SWCD events, as speakers, to share their work with the community and recruit new volunteers. The program aims at encouraging Corvallis citizens’ care for local streams. Volunteers monitor water and stream insects and participate in stream and wetland restoration work. No experience is required to join. The city of Corvallis provides all necessary trainings, equipment, and support.

Local news channels are also another useful tools for the SWCD. They write articles on events and initiatives in which the SWCD is involved. These articles promote the community awareness of the SWCD’s existence and mission. Local newspapers that have written about SWCD events include the Corvallis Advocate and the Gazette Times.

**Objective 2: Evaluate and present activities or programs developed through the SWCD to make information, support, and research available to the community.**

**School Projects**

The SWCD participate in field days organized by local public school and OSU Extension Service 4-H.

**4H-Wildlife Stewards.** Jefferson Elementary School is a 4-H member school with a 4-H Wildlife Stewards program. Trained students, parents, and educators help to preserve wildlife habitat on school grounds and on the portion of Dixon Creek between Circle and Kings Boulevard (OSU Extension c). The project has served as a community model for urban stream enhancement.

The stream is a great learning opportunity and elementary schools students use it as an outdoor classroom and research site to study plants and animals. They have been involved with mapping, plant and tree identification, fish inventory, measuring creek velocity, drawing, and writing poetry (OSU Extension c).

Armed with shovels and clippers, they remove invasive plants, pick up litter, and add wood chips to the trail. Litter removal prevents animals from being harmed and reduces chemical leakages into the environment. Their volunteer work also
benefits the community, as many neighborhood residents enjoy walking on this trail. The students learn about plants, animals, and their habitat (OSU Extension c).

The school also organizes a spring 4-H Wildlife Stewards Youth Summit, where students visit several activity stations where they can learn about weeds, fossils, insects, animals, and many other topics. Volunteers work with parents and teachers to create hand-on, inquiry based learning activities, such as scavenger hunts, displays, and small art projects (OSU Extension c).

**Outdoor School.** The Benton SWCD has been participating in the Camp Tadmor Outdoor School, held at Camp Tadmor, a summer camp near Lebanon. This Forest Camp is held every spring. About 250 students, from more than 5 Oregon School districts spend 5 days at the camp to learn about the environment and conservation processes (US Forest Service Pacific Northwest Research Station). The SWCD holds the Soil Station, which teaches about physical, chemical, and biological soil properties.

The soil station is held at the camp for a day. There are six rotations of students, three before and three after lunch break. Each rotation each divided into groups of three to six students depending on the number of mentors available, usually four to six. The mentors teach the students about erosion, demonstrating how wind and water can transport soil particles from one location to another. They talk about soil aggregation and the impact of compaction on plant growth and water retention. To show the impact of soil compaction, students insert wide metal rings one inch into the soil and pour about two cups of water inside the ring. They can then record the time it takes for the water to soak into the soil and compare the infiltration rate between compacted and un-compacted spots. The students also experiment soil texture by pulling samples from the soil with an auger and testing for the percent of sand, silt, and clay in the soil.

**Evergreen Field Day.** The Marys River Watershed Council organizes the Evergreen Field Day. The event is held at Evergreen Creek Farm, a Greenbelt Land Trust Property. About 140 eighth graders from Philomath Middle School spend a day at the farm to learn about wildlife, soil, trees, and other topics on natural resources (GLTa).

The soil station had four rotations of students, two before and two after lunch break. The mentors mostly taught the same information presented at the Tadmor Outdoor School, including soil compaction, erosion, and texture. They also related the soil characteristics to the history of the field. It was a logging site in the 1920s. The tree
slashes were burnt and the hot roots baked the soil. Pieces of charcoal and terra cota (baked soil) are still present in soil today. The site was used for grazing for many years during the 1950s, resulting in high compaction at the time. The mentors explained the importance of grazing rotation, in order to minimize the impact of the animals on good soil aggregation. More recently, the field has been left fallow, with plenty of organic matter to improve soil quality and reduce compaction. High organic matter content also tends to make the soil darker colored.

The field is also home to voles, moles, and goffers and students learned how to recognize the different kinds of holes their make. They also used the auger to sample different areas in the field. There is a wetland at the bottom of the hill where siderophores can be observed when the moisture content is high. Siderophores are low molecular mass molecules that can be produced by bacteria, yeast, and fungi. They bind to iron from the environment, giving a red color to the soil.

The students learned about the Munsell color system and how soil scientist use it to classify soil colors, by hue, value, and chroma. Albert H. Munsell (1858-1918) was an artist who created a system to numerically describe colors. The classification facilitates communication between artists and scientists, and was adopted by the USDA as the official color system for soil research in the 1930s (NRCSd). The students also used the auger to dig for water pockets in the soil, about 1 meter deep (~40 inches).

*Philomath High School Compost Project.* The SWCD contributed to the creation of the Philomath High School Compost Project. In 2004, the Environmental Protection Agency (EPA) awarded the Benton County Health Department (BCHD) an Environmental Justice Grant (Benton SWCDc). Its goal was to raise high school students’ awareness of local environmental issues. BCHD recruited juniors to implement a compost research project. They selected professionals in the community to serve as their mentors, designed a study, and wrote literature reviews. They used their results as the foundations of their senior project presentation in 2007.

The students worked with Teresa Matteson to develop a randomized sampling process. They took samples with sterile equipment from 16 sections, every two weeks, from 4 randomly selected areas. They then performed experiments in the school’s laboratory to obtain data on the quality of the compost and the “potential for composting to reduce environmental harm (Benton SWCDc).”
**Monroe Weed Spotters.** Heath Keirstead supervises the Monroe Weed Spotting team. The Teen Weed Spotters are a group of students from Monroe High School. They learn how to identify invasive plant species and volunteer to remove them (Benton SWCD b). They also practice using GPS mapping, data collection, and teach elementary school students about weeds during the 4-H Wildlife Stewards Summit.

**Corvallis High School.** Dixon Creek enhances Corvallis High School’s environment while providing students with hands-on educational and service-learning possibilities. In 2005, CHS was renovated and several new features were added, including a bioswale. The swale is a vegetated ditch that cleans and slows stormwater runoff from the parking lot, preserving the creek’s water quality. It is also filled with native plants, adding beauty and wildlife habitat to school.

In May 2008, students volunteered with the SOLV Down By The Riverside project to remove invasive Himalayan blackberry from the banks of the creek and plant native plants next to the bioswale.

**Training and Workshops**

The Benton SWCD regularly organizes opportunities for landowners, farmers, gardeners, researchers, students, and community members to learn about sustainable soil management practices.

**Soil Quality Network Winter Meeting.** The Soil Quality Network (SQN), hosted by the OSU Extension Small Farms Program, and the Oregon Society of Soil Scientists (OSSS) organized a 2-day winter meeting on February 28th and March 1st 2013 (OSU Extension e). The event was held at McMenamins Edgefield in Troutdale, near Dabney State Park, which was used for field demonstrations. Soil quality stakeholders come together to coordinate their efforts and make new contacts. They learn about soil processes, ethics, and assessment methods.

Teresa Matteson spoke on behalf of the Soil Quality Network and contributed to the event preparation. Guest speakers included Ron Raney (NRCS) who explained how to estimate soil moisture by soil and appearance, and Graham Shepherd (BioAgriNomics Ltd., New Zealand), who talked about visual soil assessment and the impact of soil quality on water quality and quantity (OSU Extension e). There were also two soil pits prepared by the OSSS, where guests explored the geomorphology of the park. Finally, speakers presented current soil conservation initiatives and contributors.
Cover Crop and Soil Health Workshop. On May 2nd 2013, Teresa Matteson organized the Cover Crop and Soil Health Workshop at the Corvallis Plant Materials Center (NRCS). The morning session was held in the indoor workshop (Oregon Tilth). Guests were distributed documents and brochures, including a soil quality assessment card (OSU Extension f). The afternoon session was held throughout the PMC fields, where speakers showed how to use soil testing and sampling tools.

Nick Andrews, senior instructor from the Department of Horticulture and OSU Small Farms Extension Agent, explained how cover crops could improve soil health and how to choose cover crops to reach the desired nutrients (Oregon Tilth). Audrey Eldridge (Department of Environmental Quality) discussed the impact of soil pollution on human health. Don Wirth (Saddle Butte Ag.) described his experience with cover crops and discussed potential benefits (Oregon Tilth). Eric Shumaker (Wilbur-Ellis) explained what tools are used in precision agriculture (Oregon Tilth). Ron Raney (NRCS) and Teresa Matteson talked about aggregate stability, water infiltration, and soil sample collection (Oregon Tilth). Finally, Annie Young-Mathews (NRCS) described the PMC methods, the cover crop trials, mixes used, seeding rates, and weed suppression (Oregon Tilth).

Weed Spotters. Weed Spotters training session teach community members how to recognize invasive weeds and how to control their spread. Heath Keirstead manages the program, where she teaches, along with Crystal Durbecq. Each attendee receives an information packet, with fact sheets for the most noxious weeds, along with a weed brush, to keep seeds off their shoes. The instructors use Power Point presentations and live or dried specimens of each weed.

The sessions are occasionally organized in partnership with Greenbelt Land Trust (GLT). Elizabeth Records, Conservation/Stewardship Coordinator, was present during the most recent session, on May 18th 2013. She gave a lecture on weeds and invited the audience to become volunteer naturalists for GLT. Volunteer naturalists “maintain a friendly presence on Bald Hill Farm throughout the summer” and provide “informal outreach and natural history education for visitors (GLTc).” Matt Blakely-Smith, Willamette Restoration Manager at GLT, was also present and took the trainees on a tour of Bald Hill. He showed how to recognize weeds and explained their impact on native plants diversity and wildlife health.

Urban Creek Tours. The annual Urban Creek Tours take Corvallis’ community members along a local urban stream to demonstrate the impact of human development on the riparian ecosystem. Past-featured streams include Dixon Creek, Newton Creek, and Dunawi Creek. These Urban Creek Tours encourage community
members to take action and protect our local urban streams. They learn about ways to enhance their stream and detrimental actions. The tours usually last 3 to 5 hours and attendees can choose to bicycle or to take the trolley to move from one stop to the other.

The 2013 tour was held at Dixon Creek on June 1st. The Dixon Creek Watershed arises in the Northwest hills of Corvallis and encompasses 2,712 acres. A watershed is a bounded hydrologic system, within all living things are inextricably linked. The watershed is a habitat for many wildlife species and helps us to meet our water needs.

Human influences can negatively impact the watershed by inducing habitat loss for aquatic and riparian species, decreased water quality, faster water flows, increased potential for flooding, bank erosion, and the introduction of non-native plants and wildlife. The tour’s stop included the headwaters of Dixon Creek, the Jefferson Elementary School Trail, the Beca Rain Gardens, the Corvallis High School Bioswale, and the confluence of Dixon Creek with the Willamette River. At each stop, volunteers presented their projects, how they helped the streams, and ways the tour attendees could get involved. At the last stop, Karen Hans, fish biologist at the Oregon Department of Fish and Wildlife) shared the life of local fish species and how urban development can impact their health and species survival. She had also caught live fishes in a bucket, for guests to observe.

**Native Plant Sale.** The Native Plant sale is an annual event, organized every February, during which the District distributes tree and shrub seedlings at low cost to “encourage the use of native vegetation for erosion control, windbreaks, landscaping, and wildlife habitat (Benton SWCD d).” Those interested can fill out an mail-in order form available online, to request the plants they would like to purchase (Benton SWCD d). The order deadline for 2013 was on January 31st. The pick-up day was held on February 16th. An overstock sale followed on February 17th, for which no order forms were needed (Benton SWCD d). Since 2007, Alice Fairfield, who was an avid fan for many years, coordinates the sale (Benton SWCDA).

**Soil Quality Lab**

Teresa Matteson created the Soil Quality Lab (SQL) in 2009, thanks to a NRCS Conservation Innovation Grant. The lab is located in CROP 143, the crops and soil science building on the Oregon State University campus. The lab provides soil testing services to landowners who wish to better understand the physical,
chemical, and biological composition of their soil. The CROP lab tests for physical soil characteristics. For chemical testing, the soil samples are crushed and taken to another laboratory, in ALS. The lab currently runs with the help of students volunteers. Students can also collaborate with the lab to conduct research projects (more details on this topic in part 5).

**Information**

The SWCD diffuses information to the community in a variety of ways. The office has a brochure area, with publications on a variety of topics, such as invasive weeds, watershed enhancement, endangered species, upcoming events, agricultural safety, and other relevant information on conservation and agriculture.

The SWCD also publishes a quarterly newsletter, informing readers on upcoming events, initiatives, and accomplishments. It also introduces new staff and board member, as well as new programs and grants. An annual report is also produced at the end of the year, reviewing major past news and achievements as well as a financial report. The newsletters are both printed and distributed through the SWCD listserv.

**Tools and equipment Lending**

The Benton SWCD lends a variety of resources to the community for watershed enhancement and other natural resources conservation and education projects. Some of the items landowners, volunteers, and other community members can borrow include tree-planting equipment, a seed drill, nose pump weed wrenches, stream simulator, soil quality test kit, soil sampling equipment, and teaching resources (Benton SWCD a).
**Objective 3:** Gain experience in the data collection process involved in soil quality analysis, testing, and research.

**PMC Research and Sampling**

The Corvallis Plant Materials Center (PMC) was established in 1957 and operates on 58 acres of land owned by Oregon State University. The PMC provides plant solutions for northwestern California, Western Oregon, and Western Washington. Its primary mission is to “develop new technology in plant propagation and establishment, seed production, revegetation, restoration, and erosion control, and to develop new plant sources for use in riparian areas, wetlands, and uplands (NRCS e).”

The Corvallis PMC is currently participating in a national soil health study. The project is planned over three years. The study's goals include:
- Document the effects of cover crop species composition on changes in soil health.
- Determine optimum seeding rates for cover crop mixes to affect soil health and demonstrate the use of cover crops in rotation with a commodity crop (Haney).

In order to collect, analyze, and interpret data, the PMC employs standardized methods and conventions. A few of these techniques are described below.

**Plot Design.** The PMC plots are organized into 40 plots, 10 per row. Each plot was randomly assigned to a treatment plan. There are 4 seed mixes (Haney):  
- control – no cover crop, commodity crop  
- rye, crimson clover  
- rye, crimson clover, hairy vetch, radish  
- rye, crimson clover, hairy vetch, radish, oats, *Brassica sp.*

Each mix is seeded at 3 seeding rates, 20, 40, and 60 seed/ft². Each combination has 4 replications (Haney). The cover crops are cut at the end of spring and left on the ground to decompose. The commodity crop, corn is then planted in June, and harvested in August.

**Biomass Sampling.** Biomass Sampling consists of inserting a sampling frame in a plot, and then clipping all the plants contained within the frame (Haney). For the plots that were planted with radishes, the roots are taken out of the ground and put
into a separate bag. All the clippings are then taken to the workshop, where each species of plant is separated, put into labeled bags. The weeds are also inspected and each new species is recorded. The bags are then weighted and their weighs are recorded in a datasheet. The samples are then dried and weighted again (Haney).

**Other Methods.** Biomass sampling is the only method I experienced while volunteering at the PMC. Other methods were also briefly described to me. All collection and analysis method are also described in a field guide. The guide provides instructions to collect soil moisture and temperature, as well as soil penetration resistance. The PMC researchers also visually assess the kinds of weeds and pests present on the plots. The PMC also records the commodity crop yield per plot and cover crops bulk density. Finally, photos of the overall condition of the plots and sampling procedures are taken at each sampling, for later reference.

**Soil Quality Lab**

The Soil Quality Lab (SQL) offers soil quality testing services to farmers and landowners. The lab collects and analyses the soil samples to create a soil report card that landowners can use to better understand the needs of their fields and adapt their management practices accordingly. In addition, the lab is used for OSU research, conducted by students. All collected and analyzed samples are recorded into a database. The sampling and testing practices are based on guidelines published by Cornell University.

**Sample Collection and Preparation.** In order to collect a sample from a field, the field agents draw an imaginary M on the field. They then collect 2 samples at each 5 points on the M. It is also recommended to avoid collecting from any spot that look different from the rest of the field, such as a muddy puddle or an especially dry hilltop. Agents dig a round hole about 6-8 inches into the ground and take a slice of soil from one of the least disturbed side. Each field sample includes a total of 10 slices of soil (2 at each point on the M) (Cornell University CALS a).

Back at the lab, the samples are sieved through 8mm sieves. They are mixed to ensure uniformity, put into gallon back and labeled with the name of the farm, date, field name, and a SQL ID number. The bags are weighed and weighs are recorded into a datasheet, along with all other observations on the sampled field, such as the weigh of rocks, the appearance of the soil. Certain past management
practices, such as field burning, are also noteworthy because they can impact the results of the tests.

The sample bags are put into a refrigerator, in order to preserve the moisture. These bags of soil will later provide growing for the Mycorrhizae study (see below). Smaller samples are also taken from the large bags and dried in an oven. These smaller samples will then be used for the soil quality testing.

**Texture Testing – Separation by Sedimentation.** Texture is the percent of sand, silt, and clay in the soil. In order to determine the texture of a sample, the soil is crushed with a rolling pin and passed through a 2mm sieve. Technicians then put 40 grams of crushed soil into a labeled bottle, to which a solution of sodium hexametaphosphate and distilled water is added. The bottles are then put on a shaker, which will shake the sample for a couple of days. After the waiting period, the content of the bottle is poured into cylinders and the temperature of each is recorded. The technicians then shake the liquid in the cylinder, drop in a hydrometer after 40 seconds (the time the sand takes to settle at the bottom of the cylinder), and record its height in the liquid. The cylinder is then left untouched for two hours (the time the silt takes to settle at the bottom of the cylinder), the hydrometer is dropped again, and its height recorded. This type of analysis depends on Stokes’ Law (UW ESRM 410). The percent of sand, silt, and clay can then be calculated, and the soil is classified according to its texture.

**Other Tests.** Soil texture is the only test I have directly experienced this spring. More tests will be conducted over the summer, including aggregate stability, pH, calcium, magnesium, potassium, phosphorus, and organic matter.

**OSU Research Crop and Soil Science Graduate Research.** While I was volunteering at the Soil Quality Lab, I helped sampling fields for a graduate research project, conducted by Natalie Allen, graduate student in Crop and Soil Sciences. Her research’s goal is to identify soil attributes that favorite plant association with ectomycorrhizae. Mycorrhizae is a symbiotic relationship between a fungus and the roots of a vascular plants. In order to collect data for her research, we sampled 30 fields from about 15 farms. We avoided plots that had been planted with crops that do not have an association with the fungus. Such crops include members of the brassica family, such as broccoli, cabbage, and kale, the Ericaceae family, such as blueberries, as well as beets, mustard, spinach, and orchids (The Organic Gardener’s Pantry). The samples were collected, prepared, and tested according to the Soil Quality Lab’s methods.
Laboratory Safety. During my work at the Soil Quality Lab, I designed a laboratory safety sheet (see appendix) to pin on the wall. Such checklists are useful to remind workers of general rules that can protect their health, including wearing protective clothing and equipment when handling hazardous chemicals or dust. The sheet also provides chemical and sample handling tips. Certain recommendations advise how to properly respond in case of emergence, such as a chemical spill. Lab technicians are also required to read the Material Safety Data Sheets (MSDS) for all chemicals present in the lab at least once, prior to first use. Finally, one of the main advices I got from my work at the lab was to always communicate with coworkers and ask questions when unsure. This is a very good way to avoid miscommunications and reduce stress.

Objective 4: Gain proficiency in the cost benefit analysis process.

Introduction

During my internship at the Benton Soil and Water Conservation District, I worked on a Cost Benefit Analysis (CBA) of cover crops. I was given the task to identify potential costs and benefits of cover crops use. I then developed a short guide proposing ways to quantify these factors. Data collected from the Corvallis Plant Material Center will later be used, with the help of this guide, to estimate the net profit or loss of various cover crop treatments.

Such an analysis is beneficial for several reasons. It is a way for farmers to better understand how much using cover crops on their field could actually cost. This allows for better decision-making and financial planning. Understanding the actual cost to farmers can help policy makers identify ways cover crops can reduce externalities. By using cost data, conservation organizations, such as the Benton SWCD, can also better demonstrate the potential of cover crops use and convince farmers to adopt the practice.

About Cover Crops

Cover crops are crops grown to protect and enrich the soil in between planting seasons. They are beneficial to soil quality in a variety of ways. They speed up infiltration of excess surface water, relieve compaction and improve structure of overtilled soil, add organic matter that encourages beneficial soil microbial life, and enhance nutrient cycling (Clark).
Choosing which cover crops to use depend on the management goals of each landowner. The first step is to understand the needs of the soil, based on soil testing results and the choice of commodity crop to be planted during the next season. Landowners also need to know when they will be able to plant the cover crop, and how long it can stay in the field until the landowner need to plant the next commodity crop. Planting a diverse mix of cover crops can generate cumulative benefits, as each plant has varying properties.

The Department of Agriculture and Life Science of Cornell University has made available a Cover Crops Decision Tool, in order to help farmer to choose the crops that would benefit their soil the most. It provides recommendation for a variety of goals, including reducing weeds, improve soil aggregation and nitrogen fixation, or reduce compaction (CU CALS b).

**About the Cost Benefit Analysis Process**

A cost benefit analysis estimates the “equivalent money value of the benefits and costs” of a project (Watkins). There should be a common unit of measurement, which is commonly money. The analysis should also represent the consumers or producers as revealed by their actual behaviors. This information can usually be obtained from past choices. By studying how consumers have been deciding, we can design a model that includes their actual preferences. In other words, a value should not be estimated based on what planners think it is worth, but on what consumers, think it is worth, or their willingness to pay (Watkins). Conducting a cost benefit analysis can lead better decision-making by providing a better understanding of the value of a project. It also gives tangible information that allows for better financial planning and more efficient and profitable outcomes.

When performing a CBA, one of the first steps is to clearly define each scenario. The goal of the analysis is to assess the results with and without the project. In the case of the PMC, there are 9 different treatments and one control. The treatments plots have been planted with 3 different cover crop mixes and 3 seeding rates, while the treatment plot has been left bare.
There are also several steps to follow in the research process, including designing a study, collecting data, and evaluating the results:

- **Step 1**: Determine a question of interest (also called a research question). This is often a hypothesis the researcher has.
- **Step 2**: Determine the best way to collect data to answer the question of interest (a survey sample, observational study, or experiment).
- **Step 3**: Collect and record the data.
- **Step 4**: “Explore” the data. That is, take an initial look at the data with graphical displays and/or summary statistics to give you an idea of what the data “show”.
- **Step 5**: Do a formal analysis of the data. The results of the formal analysis provide scientific support to the answer to the question of interest.
- **Step 6**: Based on the evidence from step 5 the exploratory analysis in step 4, answer the question of interest.
- **Step 7**: Elaborate on the results and refine the question of interest to start a new analysis.

**Objectives and Methods**

The objective of this guide is to provide landowners, policy planners, and conservationists with an approach to evaluate potential costs and benefits, both to private parties and society, of using cover crops.

The information for this guide was collected through interviews with local farmers, Benton and NRCS staff, as well as readings of books and websites on cover crops and cost benefit analysis. A cost benefit analysis on till, conducted by John Williams and Dan Long, researchers at the Columbia Plateau Conservation Center (USDA-ARS) was used a model for the design. Spreadsheets and cost data provided by Hal Gordon and Sophia Glenn, economists at the Portland NRCS, were also served as examples.

**Challenges**

Quantifying soil quality factors can be challenging for several reasons. Soil quality relies on many biological, physical, and chemical processes that are highly correlated with each other. There may increase the risk of double counting. It is also difficult to create a standard model that would apply to any property, because soil types, land uses, and management practices vary widely from one field to another. The underlying science of cover crops can also include fairly technical information,
which can be difficult to grasp for people without an extensive background in crops and soil science. When conducting soil quality research, there are many unpredictable factors, such as climate, that can make the results uncertain. It is also important to remember that the Plant Material Center is not a typical farm, but a government project. The cost incurred at the PMC to plant the cover crops may significantly vary from those that would be incurred in most commercial farms. Therefore, the final results of the cost benefits analysis should be interpreted with care, as the estimations are not fully accurate.

Costs

**Seeds.** The cost of seeds can be retrieved from seed dealers. Landowners can estimate the cost of seeds based on quotes or by past bills provided by their seed provider. If a provider has not yet been chosen, they can also use prices provided by major companies, such as Cover Crops Solutions. The Cornell Cover Crops Decision Tools also provides a list of seed prices as of 2007. Although a bit outdated, these costs may still be accurate enough for our analysis.

In the case of the PMC, the seed company donated the seeds to the NRCS. Since most farmers would need to purchase the seeds, it may be more realistic to include how much the seeds would have cost to the PMC in the study.

**Machinery and Tools.** The cost of machinery and tools will vary based on field size and seeding methods. In most cases, the seeds will be planted with a seeder or seed drill. The Benton SWCD rents seed drills for $5.00/acre (Benton SWCD a). It requires a small tractor to pull it across the field. This requires gas, which can be estimated by the gas mileage of the tractor used with the seeder. Smaller hand held pushed seeders can also be used. Most of them also have engines that require gas to function. In the case of hand seeding, no machinery is required, but the process still requires labor. As the PMC owns a seeder, the final analysis will include the cost of gas and, if feasible, the depreciation of the seeder.

**Labor.** The cost of labor can be estimated in various ways. In the case of the PMC, we can estimate how much time was spent on taking care of the crops and multiply by an hourly rate. The hourly rate may be based off of the salary of the NRCS staff. However, this may not be very representative of labor that would actually be incurred by an average farmer. A better way may be to determine an hourly rate based on average farm salaries in the county, state, or nation.
Termination. Before planting the next commodity crop, the cover crops must be trimmed, turned, or flattened. The debris are then left on the field to compost, releasing nutrients. This process usually requires the use of a mower and rototiller. Turning can also be performed manually, with shovels or garden forks. In both cases, the cost of the tools or gas used for the machinery may be included in the total costs.

Another potential cost for some farmers may be the removal of invasive cover crops. Certain crops tend to colonize the field and are hard to remove. In this case, they may take hand pulling and herbicides to remove, which would incur supplies and labor costs. Although these costs are not usually planned before planting, they are worth mentioning, as they could potentially be costly. Choosing the right cover crops can often prevent this issue.

Benefits

Increased Yield. Cover crops can enhance soil health by speeding infiltration of excess water, reducing compaction, adding organic matter that favors beneficial soil microbial life, and enhancing nutrient cycling (Clark). All of this can lead to better plant growth, and potentially, an increased yield.

There does not appear to be an easy way to estimate a potential increased yield prior to planting. The PMC will be seeding its commodity crop at the end of June 2013 and harvesting at the end of August. The yield for each treatment will be calculated. In the future, any statistically significant difference between the treatments and control plots could become a base estimation for landowners to use when conducting their cost benefit analysis.

Increased Fertility / Decreased Fertilizer Use. Cover crops can add nitrogen and other chemicals, such as phosphorus, to the soil by scavenging and mining soil nutrients (Clark). Legume cover crops also convert nitrogen gas from the atmosphere into soil nitrogen that can be used by plants. Commodity crops grown in fields subsequently can absorb at least 30 to 60 percent of the nitrogen that was produced by the cover crop (Clark). This reduces the amount of nitrogen fertilizer needed to enrich the soil and boost plant growth.

The PMC will test the soil in order to assess how much nitrogen and phosphorus have been added to the soil by the cover crops. The amount of fertilizer saved can be estimated by calculating the amount of fertilizer that would have been
needed to enrich the soil to the same levels. Fertilizer costs are available through agricultural products providers’ websites. The OSU Extension Cover Crops Calculator can also calculate the nutrient value (in $) of elements added by various cover crops.

**Increased Water Retention / Decreased Watering.** Cover crops can conserve soil moisture. Residues from terminated cover crops increase water infiltration and reduce evaporation (Clark). Lightly incorporated cover crops trap surface water and add organic matter to increase infiltration in the root zone (Clark). Timely termination of the cover crops can also avoid the opposite impact of water, by preventing excessive soil moisture (Clark).

The PMC has been monitoring water moisture in each plot. In order to estimate the savings from decreased watering, we could multiply the amount of water that would be needed to reach similar moisture levels by a flat water cost, obtained from the water service bill or through the city or county water service.

**Weed Reduction / Decreased Herbicide Use.** Cover crops are an effective way to control weeds. They smother and outcompete weeds for water and nutrients, their leaves or residues alter the frequency of light waves and change the soil surface temperature, preventing weed growth (Clark). Certain cover crops’ roots release compounds that have natural herbicidal effects (Clark). By preventing the spread of weeds, cover crops can reduce the amount of herbicide that would need to be used.

The PMC regularly conducts biological assessments on the plots to compare weed types and quantities. We can compare the control plots with the treatments and estimate the difference. We could then assess how much herbicide would have been needed to reach similar weed profiles. The costs can then simply be based on current herbicide prices.

**Increased Pest Resistance / Decreased Pesticide Use.** Cover crops can control the spread of pests in variety of ways. They host beneficial microbial life that discourages diseases and create an inhospitable environment for many soilborne diseases (Clark). They can encourage beneficial insect predators and parasites that can reduce insect damages. Finally, they produce compounds that reduce nematode pest populations and encourage beneficial nematode species (Clark).

The PMC will be conducting biological assessments to compare the insects and pests present on each plot. Based on the results, it may be possible to estimate the difference in beneficial insects and harmful pests between the various
treatments and control crops. We could then estimate what types and quantities of pesticides would have been used to reach the same pest and insect profiles. The cost of pesticides can then easily be obtained through agricultural products providers.

**Increased organic matter.** Some farmers protect and enrich their soils with methods other than cover crops, such as leaves or straw. Planting cover crops would eliminate the need for these other methods. The amount of money saved by not using other soil enrichment methods could also be included in the benefits.

**Erosion control.** Cover crops can hold soil in place, reduce crusting, and protect against erosion by wind and water. They also improve soil infiltration, which reduce runoffs that can carry away soil. By preventing erosion, cover crops can soil replacement costs or other erosion control costs.

There are two ways we could evaluate the benefits from reduced erosion. The first one is to calculate the soil erosion factor, RUSLE, and the weight of soil that would be lost on the field without an erosion control method (MSU IWR). We can then use soil prices to estimate how much it would cost to replace the soil on the field by bringing in new soil. Another way would be to obtain evaluate the cost of implementing another erosion control method, such as leaving the fields fallow, ceasing tillage, creating a grassed waterway, lined channels, or drop structure, Terracing, leaving crop residues, or adding organic matter, such as leaves or straw (Alberta Agriculture and Rural Development). Such quotes can be obtained by companies who provide some of these services, or if all the work can be performed by the farm's staff, by counting the costs of labor, machinery, tools, and supplies.

**Calculating Net Profit**

Once as much data has been collected, it can be entered into the spreadsheet. The net profit or loss is then calculated by subtracting all the costs from all the benefits. Ideally, the project could be worthwhile if one of the following applies (Watkins):
- The net profit is positive
- The discounted present value of the benefits exceeds the discounted present value of the costs
- The ratio of the present value of the benefits to the present value of the costs is greater than 1.

However, despite a net loss, a project may still be viable if the net loss is within a certain range, which will vary based on the type of project.
Social Benefits

Certain benefits of cover crops will not be directly returned to individual landowners, but rather to society or the surrounding community. The positive effects of cover crops on soil quality extend beyond the fields they are planted in. Cover crops can reduce the need for fertilizer and pesticides, which can lower the amount of agricultural runoffs on wildlife habitat, riparian areas, and rivers. By slowing erosion and runoff, cover crops reduce nonpoint source pollution caused by sediments, nutrients, and agricultural chemicals (Clark). By absorbing excess nitrogen, they can also prevent nitrogen leaching to groundwater (Clark). This means cleaner water, for human consumption and stream health. Moreover, as the country experienced with the Dust Bowl, the impact of erosion do not stop at property boundaries, but affect society at large by reducing land productivity and food supply, as well as air and water quality. Less chemical applications can also help to safeguard the health of farm neighbors, workers, and the local community.

Pollution and erosion are negative externalities. Individual landowners are rarely deemed responsible for the damages and do not provide compensation to society. Instead, entire communities, through cleanup or damage costs, pay for these externalities. As cover crops can reduce such externalities, they can eventually decrease their cost to society.

This may have implications in policy-making, as the use of cover crops is often subsidized. The research, such as the PMC, and advocacy programs, such as workshops organized by the SWCD, on cover crops use also have cost to government agencies, and by extension to taxpayers. By showing that the money spent to improve field management practices may come back to society in the form of lower externality costs, we could facilitate conservation efforts. For example, by showing that money given to soil quality improvement programs is not lost, funding may be easier to obtain. It may also be easier to show tax payers why they should allocate funds to their local conservation organizations, such as the Benton SWCD, because ultimately, the money may come back to them, in the form of improve quality of life and environment.

Recommendations

The next step in the analysis will be to collect soil quality data from the Plant Material Center, as well as cost data from the Field Office Technical Guide. The information will then be evaluated and methods adjusted to better fit the data. The
net profit or loss for each treatment and control plot will be calculated and the results will be assessed and compared. Cost benefit analyses often follow a sequential approach. Once results are obtained, the model is reevaluated and refined to add more details and improve accuracy.

It is also important to note that a cost benefit analysis, despite all efforts to ensure precision, is often not fully accurate. The results are a useful tool to make decisions, but should be used with caution. Even with an analysis showing positive results, a project may not actually be profitable. Similarly, an analysis showing losses does not necessarily signify that the project is not viable. Decisions should be based on the cost benefit analysis results, as well as a good understanding of the project’s social and environmental impacts beyond an individual field.

**Conclusion**

During my internship at the Benton Soil and Water Conservation District, I learned how to collect and test soil samples, recognize weeds, and teach children about soil properties, issues, and wildlife habitat. I now understand how the SWCD coordinates with other agencies to protect environmental quality through community programs. Environmental conservation initiatives involve a lot of networking and time spent understanding opposing views, and gaining the trust of other stakeholders. My project on cover crops helped me to realize that cost benefit analyses do not have one right or wrong answer. The results must be placed within their context and we must look beyond what the numbers tell us. In the future, I would like to gain more technical skills, such as computer programming, to create models with appealing visual designs and create new tools to facilitate decision-making.
References


http://www.hort.cornell.edu/bjorkman/lab/covercrops/.

GLTa (Greenbelt Land Trust), "Spring Planting...." Accessed June 12, 2013.

GLTb (Greenbelt Land Trust), "Volunteer." Accessed June 12, 2013.


Haney, Rick. *Effect of Mixed Species Cover Crops on Soil Health*. Plant Material Center (PMC), 2012.


http://www.nacdnet.org/about/districts.

http://oregonwatersheds.org/.

NRCSa, "75 Years Helping People Help the Land: A Brief History of NRCS." Accessed June 12, 2013.
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/about/history/?cid=nrcs143_021392.


