AN ABSTRACT OF THE THESIS OF

Irene Rolston for the degree of Master of Arts in Applied Anthropology presented on April 11, 2006.
Title: Who's Afraid of a Little Nitrate? Discovering Impediments and Incentives in following Best Management Practices Related to Water Quality within the Southern Willamette Valley Groundwater Management Area.

Abstract approved:

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Thesis summarizes interviews with growers residing within the Groundwater Management Area (GWMA) in the Southern Willamette Valley of Oregon. Informal and semi-structured interviews were used to identify perceived impediments and incentives perceived by local farmers in following best management practices related to water quality. Results from the interviews were coded into four major themes: economics, sources of information, technology and perception of risk. The four themes illustrate how growers determine which best management practices to incorporate based on risks that have been either amplified or attenuated. Therefore, it is vital that recommendations for voluntary actions in reducing nitrate leaching into groundwater supplies must take into account risk perceptions that are based on economic viability.

Who's Afraid of a Little Nitrate? Discovering Impediments and Incentives in following Best Management Practices Related to Water Quality within the Southern Willamette Valley Groundwater Management Area

by
Irene Rolston

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APPROVED:

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Chair of the Department of Anthropology

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Irene Rolston, Author

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DEDICATION

In the memory of my father, Howard Jay Bush, Jr.,
who taught me to respect Mother Earth.

Who's Afraid of a Little Nitrate? Discovering Impediments and Incentives in following Best Management Practices Related to Water Quality within the Southern Willamette Valley Groundwater Management Area.

Chapter One

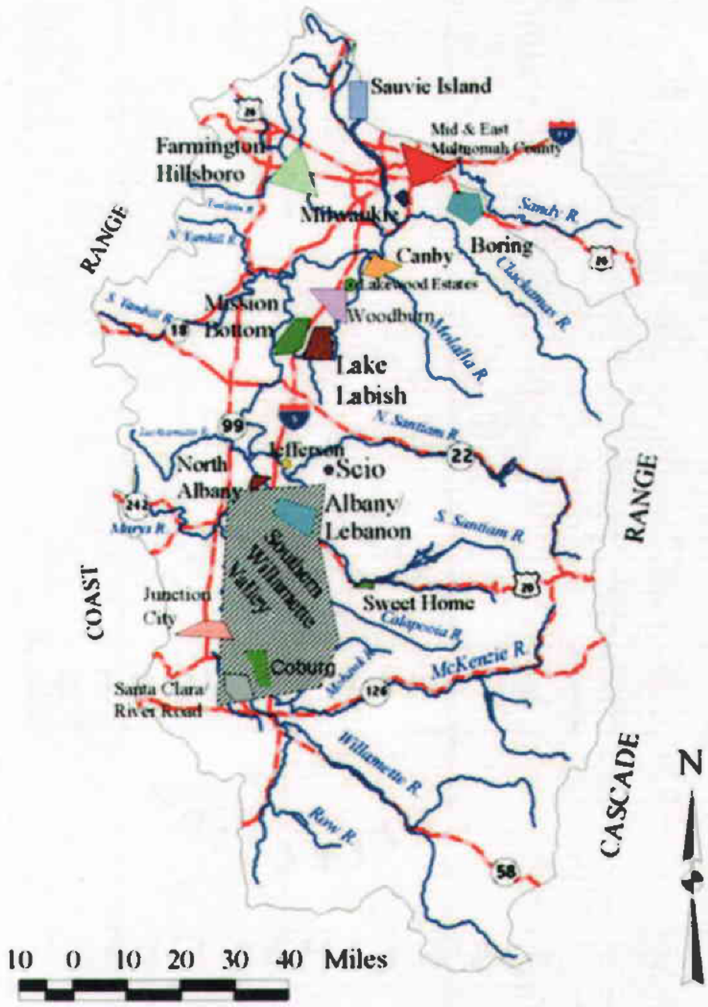
Introduction

On May 10, 2004, the Oregon Department of Environmental Quality (DEQ) declared a Groundwater Management Area (GWMA) in the Southern Willamette Valley (See Maps 1 and 2). In the State of Oregon; the "law requires that DEQ declare a groundwater management area when there is confirmation of nitrate contamination in the groundwater above 7.0 milligrams per liter (mg/L) and the suspected sources of nitrate are not facilities with permits, such as landfills or incinerators" (Fact Sheet 2004:1). One of the likely nonpoint sources of this nitrate contamination is from the use of chemical fertilizers on agricultural lands. Other nonpoint sources include leaky septic systems, manure storage facilities, fertilized lawns and food processing waste (SWiG Update 2003).

> Nitrate Standards
>
> Public water supply standard for nitrate is 10 mg/L* (EPA Fact Sheet 2006:1).
>
> ORS 468B.180 states that if nitrate levels are at 70% of EPA standards (7.0 mg/L), DEQ must declare a GWMA (Oregon Revised Statutes 2003).
>
> *There are no standards for private wells

Due to population growth trends in the Southern Willamette Valley (See Appendix A for Mid/ Southern Valley Population figures), dependence on groundwater for drinking water and irrigation is increasing. Most drinking water comes from shallow wells in the area. Health risks associated with consuming water with high levels of nitrate include: methemoglobinemia or "blue baby syndrome," a condition where nitrate interferes with the blood's capacity to carry oxygen (OHS 2001; Alvira et al. 2003; Almasri and Kaluarachchi 2004;

Causapé et al. 2004; Gardner and Vogel 2005); enlargement of the thyroid gland and increased sperm mortality (Alvira et al. 2003); stomach cancer in adults (Almasri and Kaluarachchi 2004); and non-Hodgkin's lymphoma (Gardner and Vogel 2005). The populations considered to have the highest risk are infants and pregnant or nursing women. Because most of their food is in liquid form, infants receive the greatest exposure from drinking water.

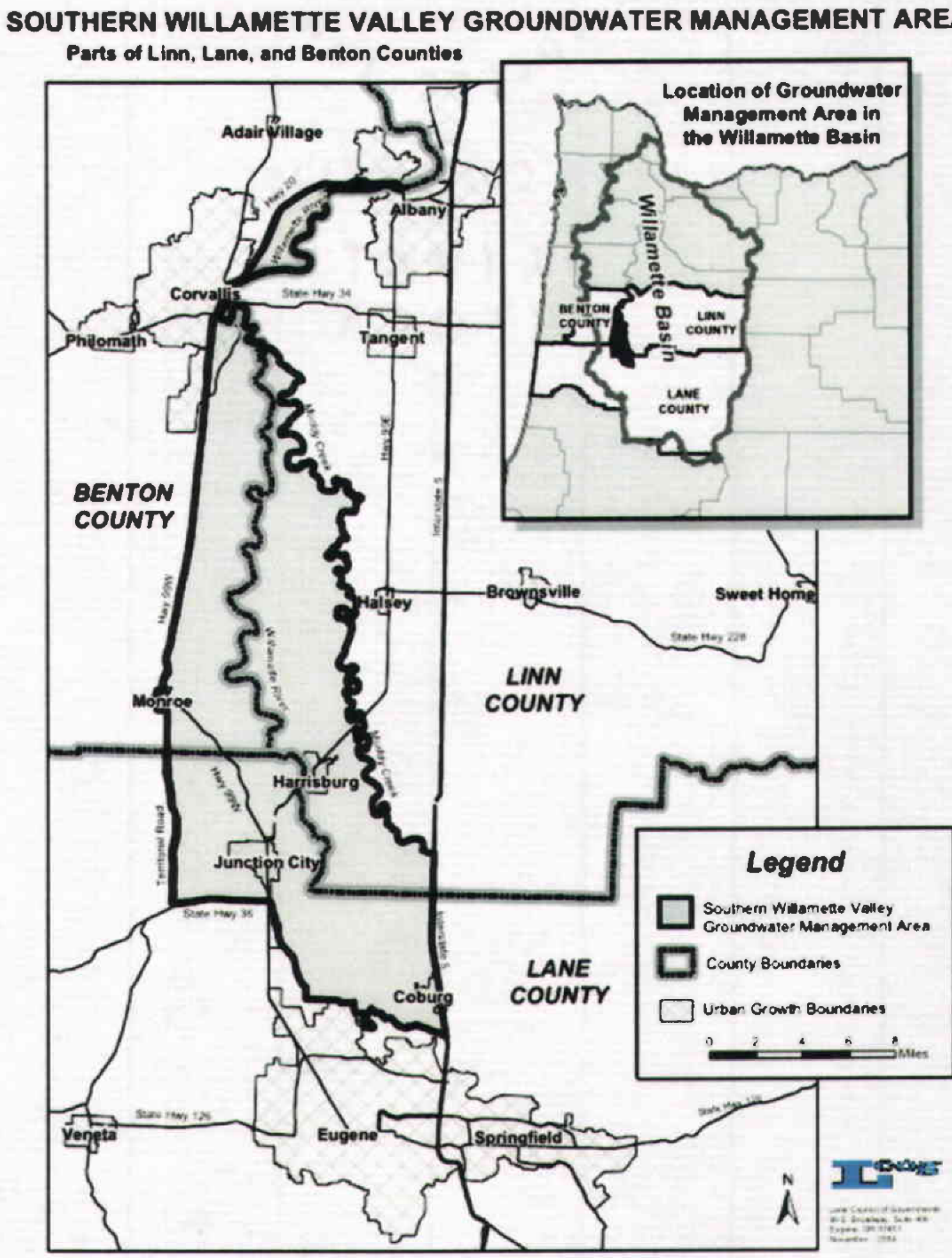


Map 1. Groundwater Quality Study Areas in the Willamette Basin, Oregon (Hinkle 1997).

Now that a GWMA has been declared, "DEQ, Department of Agriculture, Water Resource Department, Department of Human Services and other state agencies are required to focus efforts on the development of an *Action Plan* to restore groundwater quality" (Fact Sheet 2004:1). But restoring groundwater quality is not a simple endeavor, either physically or politically. For example, removing nitrate from water cannot be accomplished by boiling the water. In fact, boiling actually concentrates the nitrate. Residents who live in the Southern Willamette Valley have only two options for eliminating nitrates from their drinking water: 1) installing a water treatment unit that uses ion exchange, distillation or reverse osmosis or 2) using bottled water (OHS 2001).

In response to the GWMA, the Southern Willamette Valley Groundwater Management Committee was formed to consider potential actions to decrease nitrate in the groundwater. Officials from DEQ, Lane Council of Governments (LCOG) and Oregon State University (OSU) Extension Service support committee meetings, and its members include representatives from various backgrounds such as county officials, private business owners, environmentalists and farmers (See Appendix B for complete list of committee members). Recommendations made by the committee will be instituted on a voluntary basis, rather than regulatory, and will be accompanied by outreach educational opportunities for residents within the affected area.

As an educational component for the GWMA committee to consider, the study for my thesis involved conducting an anthropological characterization of the farming community to discover what types of changes farmers would be willing to incorporate



Map 2. Southern Willamette Valley Groundwater Management Are Location and Boundaries (Powers 2006).

in their farming methods and to make recommendations to the GWMA committee. Specifically, understanding what farmers perceive as barriers to following Best Management Practices (BMPs) related to water quality, as recommended by Oregon State University Extension Service, would enable the GWMA committee to make appropriate voluntary actions that would most likely be incorporated into local farming practices.

Questions considered in this study include: What would cause farmers to change their current practices in an effort to reduce nitrate levels in the groundwater? Are they aware of the environmental and health risks associated with consuming drinking water with elevated nitrate levels (above DEQ's standard)? If they are, how have they responded?

Due to the GWMA in the Southern Willamette Valley, its associated committee must consider several issues in devising programs that may encourage modifications in farming practices. Issues under consideration are: perceptions of governmental intervention, pollution control, natural resource protection and public health hazards, as well as how communities view the natural environment, including the various value and belief systems within the local community and their perception of risk and public resource management.

What follows is a presentation of a contemporary environmental issue that calls for action from various communities-of-interest and stakeholders, as well as from governmental agencies. In considering these actions, "…it is important to recognize how these strategies and their effects on flows of power shape human subjects, their interests, and their agency" (Agrawal 2003:258). Anthropological theories can be applied to show how the continuing study of culture is necessary and acts to enhance future studies on environmental protection and natural resource management.

In Chapter Two, a brief account of agricultural development in the Willamette Valley is provided and shows how agriculture is related to capitalism and its ever expanding markets. Under this influence, emerging technologies, such as chemical fertilizers that promote crop production are seen as methods of increasing capital. By the latter part of the 20th century, water quality studies began to show that nitrogen in fertilizers could reach groundwater in a process known as leaching, where nitrogen not utilized by the crop percolates through the soil, eventually reaching underground aquifers. A few contemporary nitrate studies will be examined, along with rationality for further research in cultural studies that examine responses to such environmental issues.

Chapter Three introduces the theoretical background that will be used as an explanation of what was revealed in the interviews with local growers. Utilizing contemporary ecological anthropology, I was able to analyze information gleaned from interviews with primary sources. Specifically, I use cultural theory to examine cultural biases associated with social organizations defined by Douglas and Wildavsky (1982) and Dake (1992) to explain why farmers hold particular perceptions of risk. How these perceptions work to either amplify or attenuate risk is articulated using the Social Amplification of Risk Framework (SARF), as developed by Kasperson et al. (1988, 2003).

Chapter Four discusses the anthropological methods that were used in conducting the research, via participant observations of GWMA committee meetings and interviews with growers, as well as the major themes (Economics, Technology, Sources of Information and Risk Perception) that arose in the interviews. In addition, demographics of the participants will be provided (acreage farmed, crops, etc.). Combining textual analysis of primary sources and secondary sources will be used to conceptualize the story of Southern Willamette Valley growers.

The results from participant observations of the GWMA committee meetings and the grower interviews, discussed as four major themes, along with direct passages of transcribed interviews, will be shown in Chapter Five, in an effort to illustrate the stresses faced by local farmers. Economic trends in commodity markets have placed tremendous pressure on growers, especially those who were previously growing row crops (vegetables) for the now defunct Agripac cannery. New technologies, such as Global Positioning System (GPS) units installed on farming equipment, promise fine-tuning of fertilizer and irrigation practices, as farmers work to keep their expenses to a minimum. Also discussed are sources that farmers use to gain information, such as local extension agents and company representatives (field men), who share the latest study results from agricultural institutional experiments. Lastly, perception of risk associated with using groundwater as drinking water is used as a springboard to launch into a discussion of cultural theory and the social amplification of risk.

Chapter Six discusses the implications of participatory decision-making from the perspective of the GWMA committee and its makeup of various representatives from the communities-of-interest.

In addition, the chapter broadens the discussion of risk perception, bridging definitions of social organizations with common cultural biases within each and is used as an explanation of why growers share similar perceptions of risk. The Social Amplification of Risk Framework (SARF) is then used to show how these perceptions are either amplified or attenuated, causing secondary effects that further reinforce the concept of risk perception.

Chapter Seven's conclusion will offer recommendations for the GWMA action committee, as well as to risk communicators and regulatory agencies in general, based on evidence presented in this study. Broadening the scope of understanding particular social organizations and their cultural biases is conducive in "knowing your audience," and will bridge the gap that sometimes exists between governmental agencies and their constituents.

Chapter Two

Historical Background

Choosing a historical point in time to begin this thesis is difficult. The transformation of the American west is a story that has been told from various perspectives and includes tales of great expansion of capital markets, development of land, allocation of water, and the loss of indigenous cultures that had previously occupied the landscape. Using William G. Robbins' eloquent history of Oregon as a guideline, I will begin where native indigenous people began to fade from the land, losing much of their population to diseases brought by Euro-Americans, in addition to governmental policies of forced removal and oppression.

After Lewis and Clark's Corps of Discovery claimed a passage to the Pacific Northwest in 1805-06, many settlers made their way beyond the Rockies and Cascades, ultimately setting roots in the Willamette Valley, south of the Columbia River, and bounded on the west by the Coastal Range. Documenting the practice of native burning, which cleared the valley of heavy undergrowth and allowed native grasses to flourish, many newcomers reported great expanses of potential pastureland for domesticated herds and easy access to open areas for agricultural activities (Robbins 1997).

As early as 1811, Ross Cox reported to populations east of the Oregon Territory that the climate of the Willamette Valley was mild and "possesses a rich and luxuriant soil," yielding an abundance of fruits and roots (quoted in Robbins 1997:53). Alexander Ross claimed that the Willamette Valley was "the most favorable spot for agriculture" (quoted in Robbins 1997:53). Reports such as these opened the imagination of settlers further east, who began to visualize themselves in a land of natural bounty: "…Indian-maintained open landscapes became plausible farm sites for future settlers" (Robbins 1997:56). By the 1830s, increasing numbers of agriculturally minded people made their trek west.

By 1842, settlers brought with them practices of wheat production and subsequently produced 31,698 bushels of wheat on 6,284 acres of "improved land." As more acres were tilled into production of commodities, typically wheat, the landscape was altered to accommodate market demands: "It was the link between agriculture and the market, the shift from subsistence and barter to commercial operations, that set in motion the wholesale transformation of the Willamette Valley" (Robbins 1997:82). Wheat production continued to increase: 200,000 bushels in 1850; 660,081 bushels in 1860; and 2,086,826 bushels in 1870 (Robbins 1997).

Technological advances in machinery, such as mowing machines, threshers and wheat separators, helped to keep production high and labor costs low (Young 1982). But the biggest enhancement to agricultural growth in the Willamette Valley came when railroads began to cross Oregon, from east to west and north to south: "The rail lines built during the 1870s and 1880s were an entrepreneur's dream" (Robbins 1997:110). Not only did the railroads open distant markets, they also delivered the latest laborsaving farm equipment.

Waterways were also developed to help transportation of agricultural products. Dams were constructed to control flooding and store water for irrigation during the typically dry summer months. Draining ditches altered the landscape as well, making more acreage available for crop production.

At the same time, congressional support promoted the spread of family farms. Passing a series of acts, such as the Homestead Act of 1862, which offered free land to those willing to adopt the farming lifestyle, the federal government stepped up efforts to provide useful agricultural information to farmers, along with new and valuable seeds and plants (Kirkendall 1996). For example, the United States Department of Agriculture (USDA) was established in 1862; the Morrill Act (1862) funded state agricultural ("land-grant") colleges, such as the Oregon Agricultural College in Corvallis; the Hatch Act (1887) established agricultural experiment stations for conducting ongoing scientific research; and the Smith-Lever Act (1914) created the Cooperative Extension Service as a means to disseminate research results to farmers. According to Robbins, "Those legislative initiatives contributed to an explosion in scientific and technical innovation in American agriculture" (2004:83). For example, the extension service brought scientific information to farmers, including information on the best ways to manage fertilizer applications and irrigation. As a result, land-grant university research and extension service reinforced a transition from multi-crop general farming to specialized commodity production, a trend that continues today (Hobbs 1995; Davidson 1990).

Additionally, advancing technologies such as tractors reduced labor intensity while making use of land for crop production that previously had been held for pasture and grazing (Robbins 2004; Young 1982). Laborsaving technologies also meant that farmers could operate larger farms and increase their profits accordingly (Kirkendall 1996; Davidson 1990).

Despite governmental support and advances in machinery, some farmers went into bankruptcy during the depression era of the 1930s. The New Deal relief programs were put in place to enable the success of farms, however "it did not give them (small farmers) as much help as it did to large commercial farmers" (Kirkendall 1996:102). For instance, continued developments in new technologies, including machinery, new plants and seeds, and chemical fertilizers, insecticides and herbicides allowed farmers to work larger farms and produce many more commodities (Kirkendall 1996).

Shortly after the second world war, the State of Oregon encouraged population growth, boasting of natural resources that beckoned returning service men and women seeking new futures and fortunes. The Willamette Valley's climate and soil conditions continued to promise abundances of agricultural crops and attracted "back-to-the-landers" to settle in its fertile land. As a result, Oregon's population has more than doubled during the second half of the 20th century, from 1,521, 341 as reported in 1950 to 3,421, 399 in 2000, with approximately 70% of the population residing in the Willamette Valley. Covering 11,250 square miles, the Willamette Valley now contains Oregon's three largest cities: Portland, Salem, and Eugene. (Robbins 2004).

As farm production grew in the Willamette Valley, new markets were sought for commodities that ranged from grain (wheat), to vegetables and fruits, to specialty seeds, particularly grass seed (See Appendix C for list of Oregon's 2004 commodity values). As the main transportation routes, rail and ship, evolved into major veins with which to export products to newly established markets outside of the state, farmers could concentrate on increasing production of their crops (Robbins 1997; Kirkendall 1996; Oakerson 2003).

Finding the best ways to promote crop production became a capitalistic endeavor. Capitalism, seen as a mode of production, worked to find ever increasing ways to grow more and more crops with less and less labor (Robbins 1997; Edel 1973; Young 1982). Due to technological advances in agriculture, farmers were able to cultivate larger and larger tracts of land. Consequently, family farming transformed over time into agribusinesses with heavy investments in the latest machinery, chemicals, seeds and plants (Kirkendall 1996; Robbins 1997, 2004).

Now in the role of entrepreneurs, growers became closely associated with business people and were expected to behave as such (McMichael 2003; Kirkendall 1996). Encouraged by agricultural colleges to define themselves as business people, farmers were expected to "behave like the folks who ran businesses in the towns and cities because they needed a constant flow of credit to invest in the new technology, operate and enlarge their farms, and needed to persuade creditors that they operated in accord with good business principles" (Kirkendall 1996:104).

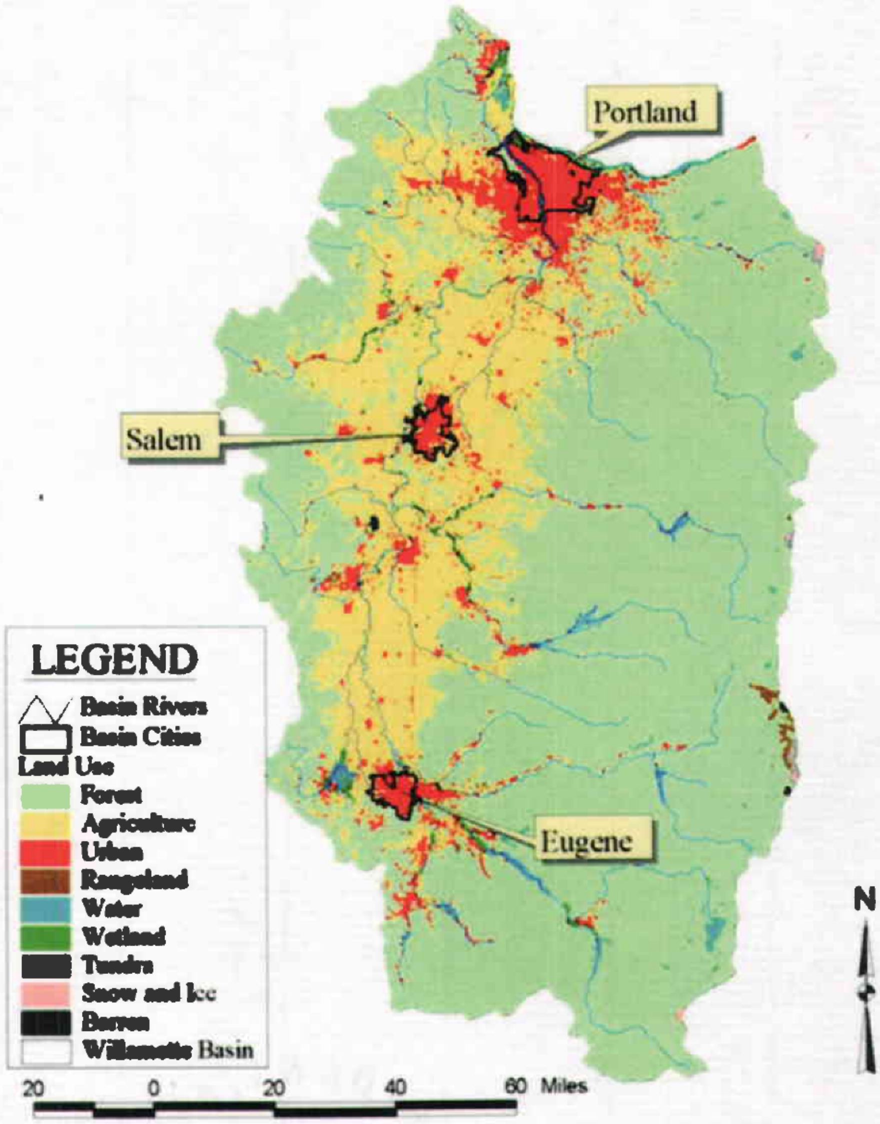
Post World War II mentality reinforced the idea of man over nature, presenting a strong belief in man-made products that would enhance or replace what nature was lacking. Practices, such as crop rotation and adding soil nutrients, meant that farmers no longer had to worry about over-exhausting the land. Backed by scientific evidence and presented with corporate products, growers were reassured that their crops would be a success.

In an effort to ensure the success of farms, extension services advised farmers on best management practices (BMPs), based on results from experiment stations located at the state college:

> The research and education programs of the USDA and the agricultural colleges also contributed, conducting the basic research, encouraging farmers to purchase and trust in new technologies, and training people for work on modern farms and for jobs in the off-farm parts of the agricultural system, including the colleges themselves and the corporations that built the new technologies, processed, and marketed the abundant products (Kirkendall 1996:102).

Of course, other variables, such as weather and climate were still a cause for concern (McMichael 2003).

Viewing the natural world as capital, the cultural imperative of the post World War II age was to use that capital for self-advancement, with "a conviction that the social order should promote the accumulation of personal wealth" (Robbins 1997:190). In conjunction with this imperative, federal research and marketing supports transitioned the Willamette Valley seed crop industry into one of dominancy. For example, in 1940, 11,000 acres were planted to grass seed; 100,000 acres in 1950, and by the early 1980s, about 300,000 acres were in grass seed production, which equates to 32% of the total valley cropland (Robbins 2004) (See Map 3 for Land Use in 2004).



Map 3. Land Use in the Willamette Basin, Oregon (Oregon State Service Center for Geographic Information Systems; Pacific Northwest Ecosystem Research Consortium).

Other crops grown include vegetables and fruits. Invested in local food processing plants, farmer cooperatives were formed in an effort to retain profits locally. As early as 1915, Eugene Fruit Growers began canning vegetables and after a number of consolidations with smaller canning operations, eventually transitioned into the large vegetable processor, Agripac (Jacobs 1990). According to the USDA, the benefits of farmers' cooperatives include:

1. Fulfilling the need for, or replacement of, a marketing service not available;
2. Improvement of growers' bargaining position with buyers;
3. Facilitating economies of scale in handling and processing grower-member products;
4. Providing better servicing for large buyers by pooling smaller quantities of product into larger lots for more economical sourcing and shipment; and
5. Reducing price risk for the individual grower by spreading that risk over a larger number of units.

Though initially successful at unifying and protecting farmers, the number of farmer cooperatives has steadily declined since the 1930s: "From 1930 to 1987, the number of farms in the United States fell about 65 percent, and fruit and vegetable cooperative membership fell by just under 70 percent" (Jacobs 1990:9). Most responsible for the decline in cooperatives has been the attempt to gain in larger-scale economies, mergers and consolidations of local associations (Hobbs 1995; Bonanno and Constance 2003; Buttel 2003).

Armed with science, however, the agricultural community and its affiliates continued basing decisions on information procured from policymakers, scientists, and industry leaders. A variety of new chemicals became available after the war, and with the urging of agricultural officials, "farmers sprayed an increasing volume of pesticides, herbicides and fertilizers on their fields and orchards, practices that would pose some of the more controversial and persisting human health issues in all of modern agriculture" (Robbins 2004:113) (See Appendix D for U.S. 2002 Census of Agriculture by state). Commodity commissions lobbied congressional representatives, in hopes of influencing regulation of agricultural practices (Hobbs 1995). Of particular concern were "environmental challenges to conventional farming practices" (Robbins 2004:85).

In recent years, inputs such as fertilizer, pesticides and herbicides applied to Willamette Valley agricultural crops (See Table 1) have come under close scrutiny of leading environmental agencies (e.g. Department of Environmental Quality and U.S. Geological Survey).

Table 1. Estimated total acreages, estimated nitrogen application rates, and 3 most heavily used pesticides for the 12 highest acreage Willamette Basin crops and pasture and rangeland (Hinkle 1997).

[Estimated total acreage for crops from Anderson et al. (1996), as calculated from data of Rinehold and Witt (1989); 1987 data. Estimated total acreage for pasture and rangeland calculated from data of U.S. Bureau of the Census (1989) (estimated acreage for pasture and rangeland not given in Rinehold and Witt (1989)); 1987 data. Estimated nitrogen application rate from J. Hart, Oregon State University, Department of Crop and Soil Science, written commun., 1995; estimates for 1995 growing season. --, crop or cover not typically grown under conditions indicated; application rate estimates based on an assumption of typical precipitation amounts and patterns; estimated typical range given in appropriate column; where available, estimated typical range followed by estimated average in brackets. Three most heavily used pesticides (based on mass of active ingredient used per year) calculated from data of Rinehold and Witt (1989); 1987 data; listed in order of use, beginning with most heavily used compound; compounds analyzed in this study in bold type; (NA), data not available]

Crop or cover	Estimated total acreage	Estimated nitrogen application rate (pounds N per acre per year) for crop or cover that is:		Three most heavily used pesticides
		Irrigated	Nonirrigated	
Grass seed	290,000	--	120–250 [150–160]	Maneb, **diuron, atrazine**
Wheat	170,000	--	60–180 [120]	**Diuron**, diclofop-methyl, **MCPA**
Other hay	150,000	100–350 [150]	50–150 [75]	(NA)
Oats	62,000	--	0–80 [50–60]	**Diuron, MCPA**, carboxin
Clover/vetch seed	50,000	--	0–30	**Diuron**, methoxychlor, metaldehyde
Sweet corn	35,000	160–220 [200]	--	**Atrazine, alachlor, metolachlor**
Alfalfa hay	26,000	0	0	**Diuron, pronamide, EPTC**
Filberts	25,000	--	0–180 [140–150]	Copper, **2,4-D, carbaryl**
Snap beans	21,000	60–150 [100]	--	**EPTC, dinoseb**, vinclozolin
Mint	17,000	200–400 [350]	--	**Fonofos, terbacil, chlorpyrifos**
Silage corn	17,000	100–400 [200]	--	**Atrazine, alachlor, fonofos**
Christmas trees	16,000	--	[a]0–180	**Atrazine, chlorothalonil**, hexazinone
Pasture and rangeland	180,000	50–200 [75]	0–60 [50]	**2,4-D, dicamba, [b]glyphosate**

[a]Nitrogen usually applied in last 2 years of a 7-year growth cycle.
[b]Analyses performed only for urban Land-Use-Study samples.

The State of Oregon's Groundwater Protection Act (1989), "mandates DEQ and other state agencies to conduct ongoing statewide groundwater quality monitoring and assessment" (DEQ 2004:9). Due to agricultural practices being identified as one of the nonpoint sources of ground and surface water pollution (Buttel 2003; Davidson 1990), contaminants must be accounted for if found above standard limits, as set by the Environmental Protection Agency (EPA) and the State of Oregon. As an outcome, there have been many studies done across the United States on the problem of elevated nitrate levels found in groundwater.[1]

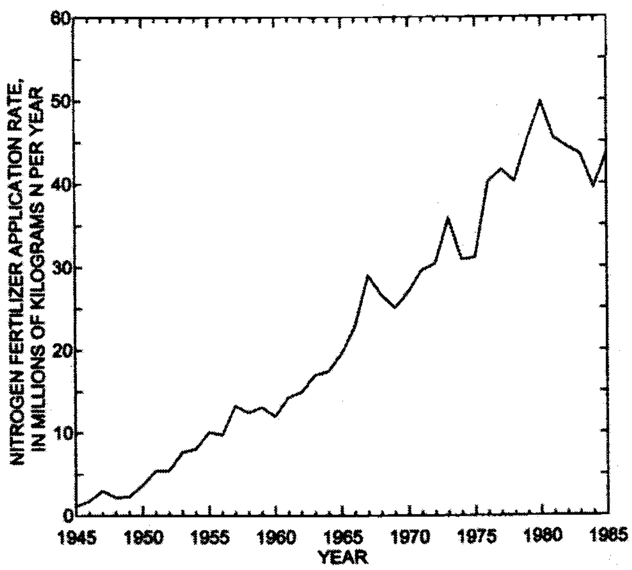
Nitrate Studies

Previous studies from around the United States (e.g. Whatcom County, WA, Raccoon River, IA, and Suwannee River Basin, FL), have cited agricultural practices as one of the major contributors of nonpoint source nitrate leaching (Johnson et al. 1991; Jackson-Smith 2003; Schilling and Zhang 2004; Gardner and Vogel 2005; Almasri and Kaluarachchi 2004; Causapé et al. 2004; Feaga et al. 2004; Selker and Rupp 2004). Schilling and Zhang state that due to an increase in usage of nitrogen fertilizers since the 1960s, "from less than 200,000 tons/year in early 1960s to nearly 1,000,000 tons/year in the 1990s" the odds of elevated nitrate levels in water sources has increased as well (2004: 306). Graph 1 shows the increasing level of nitrogen fertilizer used in the Willamette Basin over the second half of the 20th century (Hinkle 1997).

There are many factors that contribute to nitrate leaching, including soil type, soil organic matter content, nitrate residues in soil, soil physical/chemical properties, manure rotations, methods of irrigation, nitrogen dynamics in soil, types and amounts of fertilizers and manures applied and crop type (Almasri and Kaluarachchi 2004). In

[1] For a U.S. map of the probability of nitrate contamination, see USGS Scientific Investigations Map 2881 at http://pubs.usgs.gov/sim/2005/2881.

addition, precipitation has been identified as a major influence on nitrate leaching (Feaga et al. 2004; Almasri and Kaluarachchi 2004).



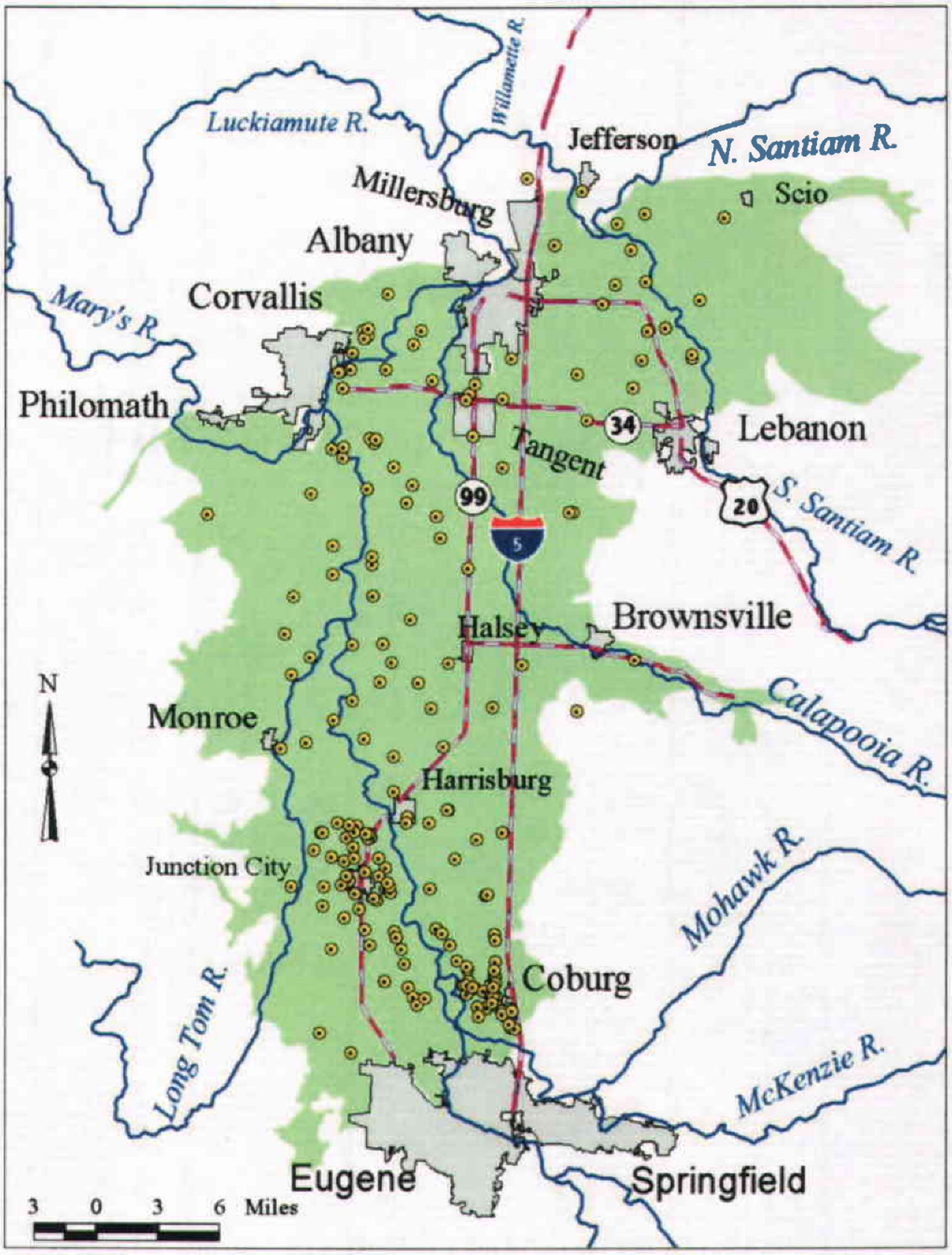
Graph 1. Nitrogen Fertilizer application rates for the Willamette Basin, Oregon, from 1945 through 1985 (Data from Alexander and Smith (1990), found in Hinkle 1997).

Consequently, several recommendations or "best management practices" have been made, including long-term monitoring programs to record parallels between seasonal variations (weather) and nitrate loading patterns, improved riparian zone management (Schilling and Zhang 2004), use of deep rooted crops that are able to retrieve nitrate from deep locations in the soil, applying nutrients in phase with crop demand, use of grass cover crops, adding a legume rotation, irrigation scheduling and maintenance (Almasri and Kaluarachchi 2004; Feaga et al 2004; Selker and Rupp 2004) and reuse of drainage water for irrigation in an effort to recycle nitrated water (Causapé et al. 2004).

Studies conducted by Oregon State University scientists have taken into account the uses of nitrogen fertilizers and their potential for leaching into underground aquifers (Feaga et al. 2004; Selker and Rupp 2004). Utilizing Passive Capillary Wick Samplers (PCAPS), researchers installed measurement devices beneath fields to capture water percolating under the root zone. Crops such as row vegetables, mint, certified organic vegetable crops, orchards and blueberries were monitored (four years under vegetable crops and five years under mint crops) from November 1993 to November 1997 and July 1998. The study found that nitrate concentrations were the highest in the summer months and decreased during the winter season, due to precipitation levels. The data proved that: "In regions of the Willamette Valley where high N (nitrogen) input crops are being intensively grown over large contiguous areas, aquifers used for drinking water supply can be expected to approach or exceed the 10 ppm drinking water standard with time unless nutrient management practices are modified" (Feaga et al. 2004:7). Maps 4 and 5 show the concentration of wells associated with elevated nitrate levels (DEQ 2004).

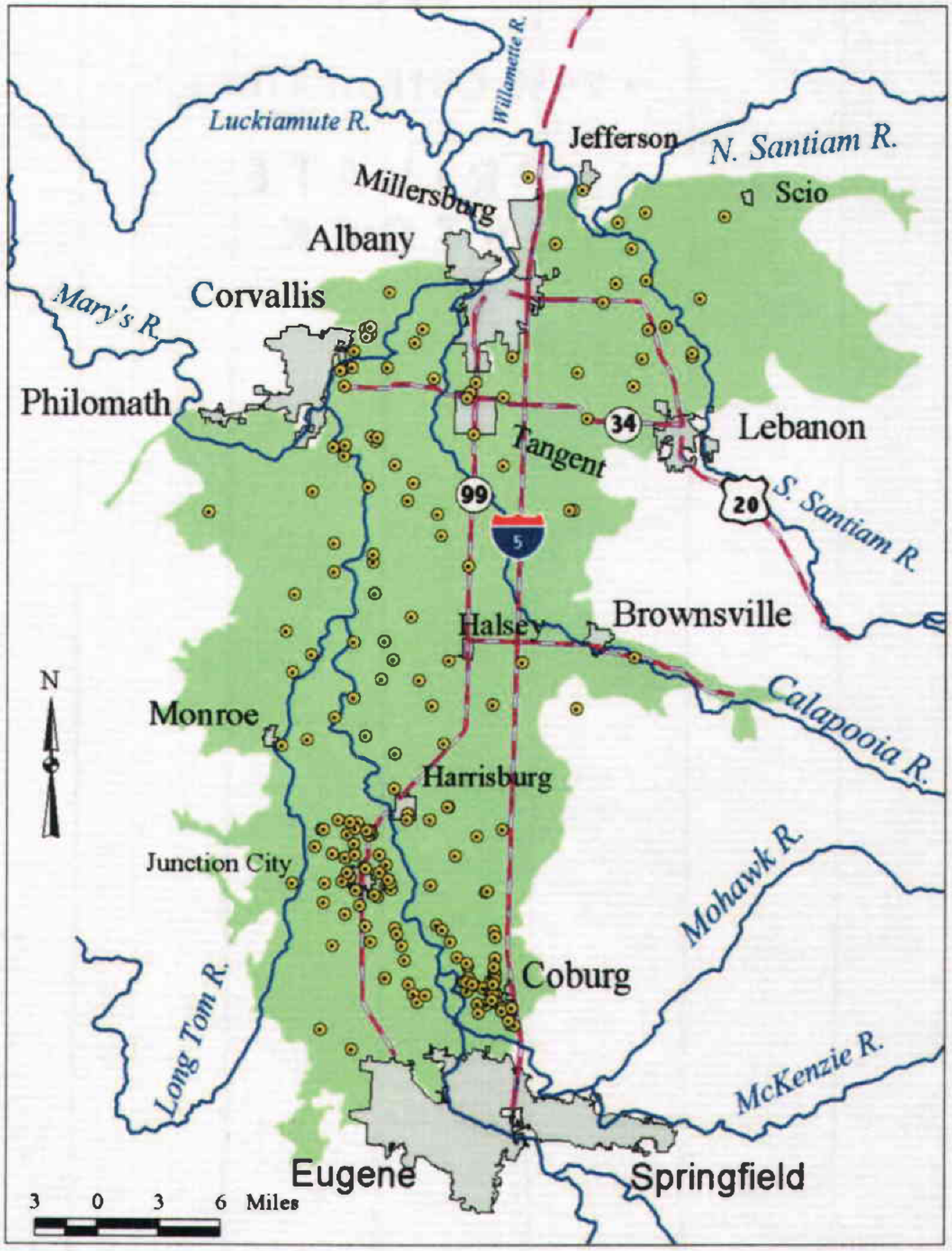
All of these studies focus on the geological aspect of elevated nitrate levels, but have not focused primarily on the cultural significance of the communities involved. Understanding the audience of strategic committees, put together to contemplate and design voluntary actions for community members, is of vital importance in understanding the needs and perspectives of the intended audience and permits holistic decision-making.

In her 2003 thesis, Gibson used the symbolic interactionist perspective to discover southern Willamette Valley grass seed farmers' worldview, which influences their decision-making processes and directly affects their behaviors and actions (Gibson 2003). Gathering qualitative data by interviewing local grass seed growers



Map 4. Southern Willamette Valley Wells With Nitrates Between 3 - 10 mg/L (DEQ 2004).

and by conducting a focus group, Gibson was able to identify variables that were linked to growers' decisions on whether to participate in land conservation programs



Map 5. Southern Willamette Valley Wells With Nitrate Over 10 mg/L (DEQ 2004).

supported by state and federal agencies. Her analysis found that in addition to economic concerns faced by growers, loss of control of owned land also played a significant role in participation rates.

Another study involving elevated nitrate levels found in water supplies in Florida's Suwannee River Basin, Alvira et al. (2003) interviewed stakeholders to reveal their perceptions "as a participatory and consensual way of problem solving regarding the nitrate pollution issue" (2003:3). Using informal, conversational interviews, the team of investigators spoke with members of the Suwannee River Partnership (SRP), that included representatives from the university, agriculture, state and federal agencies, local governments and related associations.

The SRP is similar in its makeup to that of the GWMA action committee. My study was designed specifically to discover what growers perceive as barriers to best management practices (BMPs) related to water quality in an effort to assess their fellowship in following the GWMA action committee's potential recommendations. Using anthropological techniques, such as participant observations and ethnographic interviews, my goal was to produce a record of local growers' concerns and biases toward following best management practices related to water quality (Puntenney 1995; Starrs 1996).

Chapter Three

Theoretical Perspectives

Environmental issues, once seen as solely technical and scientific problems, are now recognized to be societal problems. As a result, it is "impossible to leave out economic and political systems, (the) position of science and technology, and relationships between people" (Zweers and Boersema 1994:4). A society's norms and values reflect their ideology and worldview, which determine their actions with respect to nature, their views on their place in nature and their knowledge of nature (Zweers and Boersema 1994).

In an effort to study humans interacting with their environment, ecological anthropology "uses ecological methodologies to study interrelations between human groups and their environment" (Little 1999:254). Early ecological anthropologists, such as Julian Steward, Roy Rappaport and Marvin Harris, "examined the role of cultural practices and beliefs in enabling human populations to optimize their adaptations to their environments and in maintaining undergraded local and regional ecosystems" (Kottak 1999:23). Roy Rappaport believed that "general laws of biological ecology could be used to study human populations" and developed the idea that rituals acted as feedback mechanisms that bring ecosystems back to an equilibrium state (McGee and Warms 2004:286). Marvin Harris believed that a culture's infrastructure or "modes of production and reproduction," was the primary factor in cultivating behaviors and beliefs within a society (McGee and Warms 2004). Using the ecological materialist approach, for example, anthropologists observed how cultural institutions could be used to keep a balance between production and consumption of energy to the carrying capacity of the environment (McGee and Warms 2004). As a response, neofunctionalists "took the position that social organization and culture were functional adaptations which permitted populations to exploit their environment successfully without exceeding the carrying capacity of their ecological resources" (Herbert Applebaum as quoted in McGee and Warms 2004:284,285). For example, Porter (1965) believes that cultural adaptation models should allow for feedback, showing reciprocal energy flows that balance potentials for different subsistence uses.

These approaches, however, do not fully serve the needs of studying cultural responses to environmental degradation due to anthropocentric activities. According to Bennett (1973), Harris missed an important variable, one that shows "the innovative and high-want aspect of human behavior, which can exert severe pressure on all environments as a result of demands emerging out of the social system, and without regard for any currently existing ecosystemic properties" (1973:37). Vayda and McCay (1975) list four criticisms of ecological anthropology: 1) its overemphasis on energy, 2) its inability to explain cultural phenomena, 3) its preoccupation with static equilibria, and 4) its lack of clarity about the appropriate unit of analysis (1975:293). The authors argue that the unit of analysis should be on various forms of groups (in addition to individuals) in order to understand the consequences of adaptive strategies in regard to the "magnitude, persistence, and other characteristics of the hazards in question" (Vayda and McCay 1975:300).

Kottak claims that the ecological anthropology of the 1960s "was known for its functionalism, systems theory, and focus on negative feedback," and was criticized for "circular reasoning, preoccupation with stability rather than change and simple systems rather than complex ones," as well as the "assumption that adaptation is optimal" (1999:23). For instance, these original ecological anthropology studies relied on value-neutral cultural relativism, displaying natives as preserving their ecosystems and managing their resources (Kottak 1999). Rather than remaining neutral, the new environmental anthropology doesn't shy away from proposing and evaluating policy. It has become instrumental in devising "culturally informed and appropriate solutions" encompassing within its scope "problems and issues as environmental degradation, environmental racism, and the role of the media, NGOs, and various kinds of hazards in triggering ecological awareness, action and sustainability" (Kottak 1999:25).

In order to test ecological awareness and understand environmental values held by American culture, Kempton et al. (1995) used semi-structured interviews along with a survey instrument to decipher beliefs about the state of the environment by various social groups. Arguing that cultural models explain belief systems, Kempton et al. were able to show three belief systems that Americans use to define environmental values: 1) religion, 2) anthropocentric (human-centered), and 3) biocentric (living-thing-centered). Kempton states: "These beliefs partially determine which environmental issues people attend to and act upon, and what environmental policies they support" (Kempton et al 1995:12).

Central to this topic is how the participants perceive risk and how they view its harmful implications, which can determine what actions they are willing to take:

> Although the presence of an actual hazard increases risk perception, such perception does not arise inevitably through rational cost-benefit analysis of risk. Instead, risk perception emerges (or lags) in cultural, political,

> and economic contexts shaped by encounters among local ethnoecologies, imported ethnoecolgies (often spread by the media) and changing circumstance (including population growth, migration, and industrial expansion) (Kottak 1999:25).

What comes to the surface is how culture relates to not only defining risks, but deciding which risks will be singled out for prevention or avoidance and which will be ignored (Douglas and Wildavsky 1982; Slovic 1987; Renn et al. 1992; Dake 1992; Cutter 1993; Eiser 2001; Wildavsky and Dake 1990; Cvetkovich and Earl 1992; Morgan et al. 1992). Discussing the differences in responses to potential risks, Dake proposes that risk is used as "a rhetorical resource to defend particular worldviews" (1992:24).

In order to devise culturally informed and appropriate solutions, as suggested by Kottak, the analytical framework of cultural theory, as proposed by anthropologist Mary Douglas (1982), is a useful tool in uncovering varying degrees of risk perception within social organizations. Acknowledging risk as a social construction, Douglas asserts that competing cultures project different meanings on objects, events, situations and relationships (Dake 1992).

Cultural models shaped by social groups help to explain how people understand their world, how they reason and make decisions, and how cultural knowledge is patterned through society (Kempton et al. 1995). In the case of risk perception, many studies have been conducted to understand how people, when presented with potential life-altering risks, decide which risks that they will take action toward or ignore (seemingly by non-action) (Douglas and Wildavsky 1982; Wildavsky and Dake 1990; Dake 1992; Kasperson 1988, 2003; Slovic 1987; Renn et al. 1992;

Cutter 1993; Eiser 2001; Cvetkovich 1992; Brun 1994; Rosa 2003). Underlying this quest is, of course, a judgment that says humans will react in a particular manner, in this case, by taking action if presented with life threatening scenarios. The action is not stated openly; though it appears that by not taking action (a previously decided correct movement of some kind), actors are openly choosing to behave in a deviant manner. In other words, why would one not take "appropriate" action if faced with a life-threatening situation? Douglas and Wildavsky state that, "failing not to take all dangers into account is not behaving irrationally" (1982:72). However, it is not within the scope of this study to demonstrate "correct" action, but rather to show how and why people react to information that shows a potential adverse health affect.

Is the way that people respond to risk information based on their culturally defined social group? According to Douglas and Wildavsky (1982), it is. For example, Douglas and Wildavsky use cultural theory to define three different types of social organizations (Hierarchy, Individualistic, and Sectarian) that explain why particular groups are inherently risk-takers or are risk-adverse. By studying how individuals make choices, it become apparent that the institutions that make up their social environment act as screens, filtering their prospects and sometimes leading them to choose not to be aware (Douglas and Wildavsky 1982). I have summarized the three social organizations and their individual characteristics that the authors purport most individuals fall into (See Table 2).

Table 2. Adapted from *Risk and Culture* (Douglas and Wildavsky 1982).

Hierarchy	• Decision making collectivized, operate on fixed instructions • Everyone executes and no one decides policies • Policy issues are administrative problems • Demands of internal coalition concern of members • No one section or person can dominate for long • Individuals constantly made aware of limitations on their own possible achievements • Realism damps idealism • Selection of risks worth taking and avoiding is made by a process, not by a person • Problems are solved in sequence: best solution is realistically feasible • Individuals subscribe to common values: the organization and long term future, value tradition and rules, humans are rational enough to follow rational instructions. • Long time-span for decisions: no hurry, humans are more fallible than institutions, advocate remedies, people need good regulations • Shared fear that hierarchy may collapse: by maintaining hierarchy he is giving future generations the best possible protection • Hierarchist expects to be dead by the time any long run risk materializes • Hierarchical society put the maintenance of the whole system above individual survival, believes in sacrificing the few for the good of the whole

Table 2. Adapted from *Risk and Culture* (Douglas and Wildavsky 1982). (Continued)

Individualistic Market Oriented	• The individual is an entrepreneur seeking to optimize all transactions • Needs some measure of autonomy • Universally valuable right of fellow citizen, claim for everyone the rights freely to contract and freely to withdraw from contractual obligations (so long as publicly acceptable) • Refuses to give some individuals a hereditary or other right to exact privileges or to turn the free market into monopoly • Standardizing measures of costs and rewards • Monetarized economic system help calculations and separate the transactions • Able to terminate contracts when unprofitable, members have same sorts of problems • Know the need to keep up their own visibility, seeking credit, offering support to most desirable partners, screening out uncreditworthy colleagues • Introduce standard measures and get legislation to protect measures • Common values: exchange system and then a trust in quantification: expect the state to see fair play, protect contracts, protect the standard measures, and ratify decisive contests, personal success • Common fears: loss of resources in the market, preventing independence, threat to the exchange system. • Does not ignore or regret uncertainties; uncertainties are opportunities, attitude toward time is a response to competitive pressures (always short of time) • Ready to cut losses, cannot impose plan on the future, some are quicker, slower or luckier, he has to believe in luck, screens out and drops weak partners (as he is himself), not likely to believe in uniform human nature, some have more cleverness or luck • Rationality; rank objectives, choose the one with the highest value and go for it. • Individualist used to change, take on responsibility for long-term risks, so long as risk take collects rewards • Legislative interference with market transactions will prevent important new discoveries • Evolutionary faith that market will select the best and reject the worst • Feels confident that his activities will leave the future better off • Future-orientated; places bets on guessing right, does not mean explicit concern about the future • Risk portfolio does not carry heavy fixed liabilities for pensioners, widows, and orphans, • Holds people responsible for their own misfortunes, stupidity and neglect or bad luck explain their losses

Table 2. Adapted from *Risk and Culture* (Douglas and Wildavsky 1982). (Continued)

Sectarian	• Thoughts about the future: expect discontinuity, expect a different future and expect that it will be bad • Established society is incorrigibly evil, being both coercive and hierarchical, must not be imitated and cannot continue • Vested interest in bad news that society outside is polluted, thus impure • Need the future to be different and worse to turn criticism into warnings • More alert to long-term risks and low-probability risks • Wins adherents if he can threaten bigger dangers and associate with them to the corruption of the outside world • Political experience of stalemate and veto makes him dislike large-scale politics

From this, governmental bureaucracies typically fall into the hierarchy category, individual entrepreneurs would be seen as individualistic, and smaller egalitarian groups would be seen as sectarians.

Underlying the contention between public and private interests, these social organizations determine which risks its perspective members select for attention: "people who adhere to different forms of social organization are disposed to take (and avoid) different kinds of risk" (Douglas and Wildavsky 1982:9). Values and beliefs vary between the three social organizations and each base risk criteria on value systems that are reinforced within the group. For example, hierarchy social organizations believe that the maintenance of the top-down information structure is of the highest priority, for without it, disrespect of the social organization itself ensues (Douglas and Wildavsky 1982; Dake 1992; Wildavsky and Dake 1990).

Egalitarian views, typically found in small grass roots environmental groups, contradict both the Hierarchical and Individualistic social organizations, who tend to reflect individuals pursuing their own best interest in a "society that believes in the freedom of the commons" (Hardin 1968:1244). Hierarchists may see "coercive laws or taxing devices" as a way to control polluters of the commons (air and water), but egalitarian thinking chooses to involve group decision-making, rather than regulatory actions:

> Because egalitarians are inherently suspicious of the external "system," they resist external controls; because they value equality, they will impede a peer's progress rather than see him get ahead of the remainder of the group (Buck 1989:103).

Berkes (2005) believes that "tragedy of the commons" theory has moved beyond its formally "gloom and doom" predictions into an ideology that promotes resource users as fully capable of self-organization and self- regulation. Burke (2001) states that the "commons" literature, however, "fails to fully consider the effects of perception on resource use," claiming that if the role of perception is not recognized when formulating policy recommendations, the likely results will be severely misguided due to incorrect predictions.

Expanding upon Douglas and Wildavsky's cultural theory, Dake (1992) utilizes five cultural patterns of social organizations (Hierarchy, Individualists, Egalitarian, Fatalists, and Autonomy) and again offers cultural theory as a way to interpret risk perceptions, belief systems, and social relations (See Table 3). Culturally biased meanings of perceptions of risks account for qualitative analysis inferred by local actors, in this case, within the three social organizations:

> The main questions posed by the current controversies over risk show the inappropriateness of dividing the problem between objectively calculated physical risks and subjectively biased individual perceptions. Acceptable risk is a matter of judgment and nowadays judgments differ. Between private, subjective perception and public, physical science there lies culture, a middle area of shared beliefs and values. The present division of the subject that ignores culture is arbitrary and self-defeating (Douglas and Wildavsky 1982:194).

For example, during the 19th century, technological advances were seen as opportunities to be used to advance social economic well-being, and risk was "thought to be necessary for business enterprise" (Dake 1992:22).

Table 3: Adapted from *Myths of Nature: Culture and the Social Construction of Risk.* (Dake 1992).

Hierarchically	• Foster the myth that nature is "perverse or tolerant" • Nature is robust, but only up to a point • Sustainable development is the rational environmental strategy (policy takes advantage of the perceived resilience of nature, but respects "known" limits), limits of ecosystems can only be discovered by duly certified "experts" in these hierarchies • Compliance to regulations is supposed to flow up the ranks of long-lasting institutions, just as commands flow down. • Concern about loss of respect for authority and other forms of insubordination
Individualists	• Nature as "benign" • People need to be released of constraints (environmental regulations and enforcement sanctions) • Will place few limits on abundance for all, more than compensates for any hazards that are created in the process • Deregulation is the rational choice • Value decisions stemming from personal judgment rather than collective control • Viewed as social beings, generating and stabilizing a form of social relations • Creating social sanctions that defend their freedom to bid and bargain in self-regulated networks with few prescriptions • More highly correlated with economic issues
Egalitarian	• Prescriptions do not vary by rank and station, espouse the myth that nature is "fragile" • View that nature is ephemeral justifies precautionary principles of environmental management • Critical of the procedural rationality associated with hierarchy, prefer approaches to risk policies that foster equality of outcomes • Frame risk-related issues in ethical terms (allows them to focus on the social and political dimensions of technologies) • Criticize the institutions responsible for risk management, calls for strict preservation of the environment • Perceived the dangers associated with most technologies as great, and their attendant benefits as small
Fatalists	• High levels of prescription • Minimal collective participation, see nature as "capricious" • May have been excluded from the other ways of organizing social life: those who cannot compete successfully in markets, cannot meet the minimum social standards of bounded and stratified groups, and who cannot muster the time, energy or resources required for political participation • May simply want to be free from disempowerment of influence from well-wishers, construct a cultural bias that rationalizes isolation and resignation to stringent controls on their behavior; "why bother" • Lack the self-regulation of individualists and the groups solidarity of hierarchical or egalitarian collectivists • Desire the right to be left alone, stay out of harm's way, or not, as they choose
Autonomy	• A largely asocial way of life

Attitudes toward risk that developed in the 20th century, however, began to interpret risks differently, especially when worded as "environmental risks," typically seen as potential threats to human health and became a salient social issue: "In recent decades, many people have wondered whether the overwhelming successes in agriculture, manufacturing, and the like are now creating more problems than they are solving" (Dake 1992:22).

Defining social relations as one of five patterns, Dake (1992) contends that cultural biases within these groups either amplify or attenuate perceptions of risk, ultimately reinforcing the shared representations of that group: "among all possible risks, those selected for worry or dismissal serve—sometimes intentionally, often not—to strengthen one of these cultures and weaken the others" (Dake 1992:28). Worldviews not only reflect social attitudes and policy preferences, but also personality traits and personal values. The way one sees the world is interdependent upon their social relations, which "provide powerful cultural lenses, magnifying one danger, obscuring another threat, selecting others for minimal attention or even disregard" (Dake 1992:33).

Cultural theory explains why social organizations reproduce individual beliefs, seen as cultural biases, but does not explain how these beliefs are intermingled with action choices. Kasperson et al. (1988) has developed the Social Amplification of Risk Framework (SARF) to understand how this process works: "Social amplification provides a corrective mechanism by which society acts to bring the technical assessment of risk more in line with a fuller determination of risk" (Kasperson et al. 1988:179).

As explained by Kasperson et al. (1988), SARF is based on communications theory where "amplification denotes the process of intensifying or attenuating signals during the transmission of information from an information source, to intermediate transmitters and finally to a receiver" (1988:180). This process can be used to "analyze the ways in which various social agents generate, receive, interpret, and pass on risk signals" (Kasperson et al. 2003:15). Slovic (1987) initially proposed a model of impact for unfortunate events, where the initial event (e.g. accident, a discovery of pollution, sabotage, product tampering) is seen as a "signal" that is analogous to a stone being dropped into a pond, with rippling effects that spread throughout society. Kasperson et al. (1988, 2003) reformulated this model into SARF (See Diagram 1).

Risk signals can be images, signs, and symbols that interact with psychological, social, institutional and cultural process. In the first stage of the framework, Individuals or social organizations see specific characteristics of the signals and "interpret them according to their perceptions and mental schemes" (Renn et al. 1992:140). As the interpretations are turned into messages, they then get communicated with other individuals and social organizations, who then collect and respond to information and act as amplification stations (i.e. individuals, groups, or institutions): "Amplification differs among individuals in their roles as private citizens, and in their roles as employees or members of social groups and public institutions" (Renn et al. 1992:140). Amplification stations can also include scientists who conduct and communicate risk assessments, risk management agencies, news

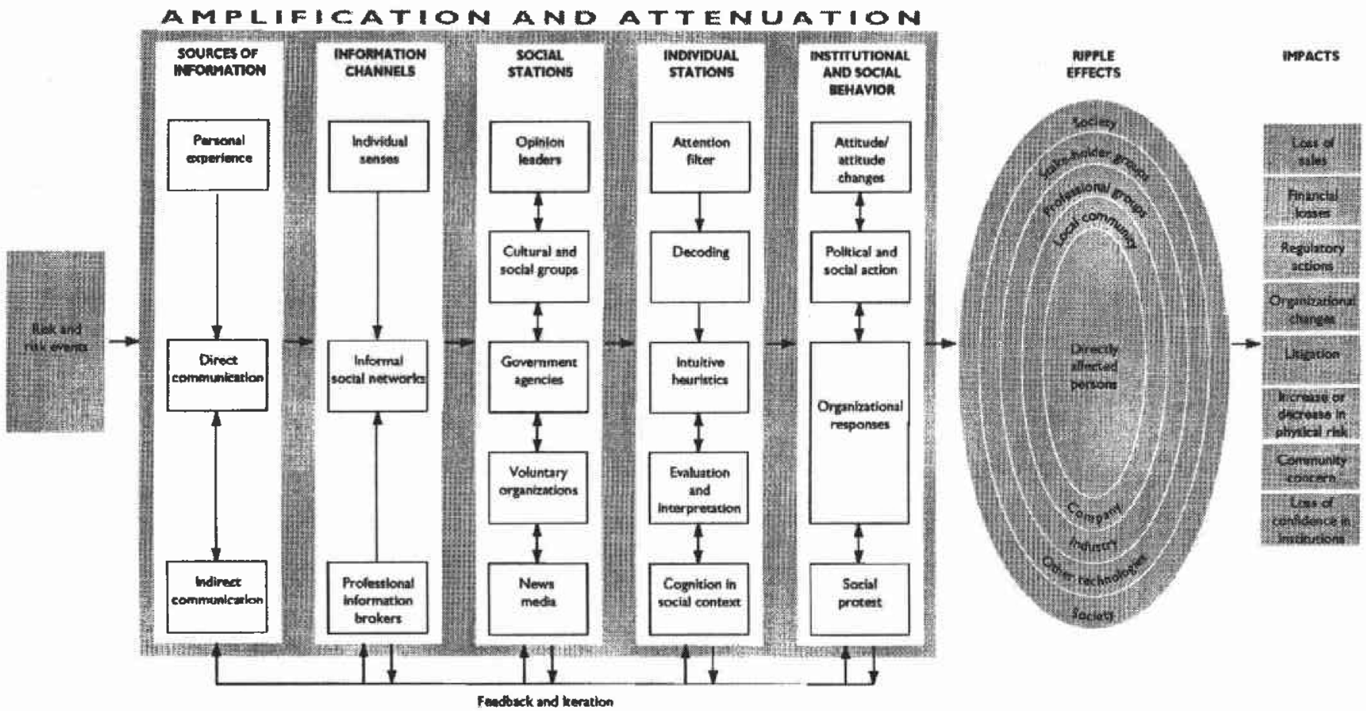


Diagram 1. Social Amplification of Risk Framework (Kasperson et al. 2003).

media, activist social organizations, opinion leaders, networks of peers, friends and family members, and public agencies (Kasperson et al. 1988). Influences such as the institutional structure, functions and culture can affect the amplification or attenuation of risks for social stations, whereas heuristics, qualitative aspects of the risks, prior attitudes, blame and trust influence individual stations (See Table 4) (Kasperson et al. 2003).

The second stage of the framework, *Ripple Effects,* encompasses any secondary effects from the initial amplification process and can produce effects such as "market impacts, demands for regulatory constraints, litigation, community opposition, loss of credibility and trust, stigmatization of the product, facility or community, and investor flight" (Kasperson et al. 2003:16). These secondary impacts are then perceived by social organizations or individuals and are amplified or attenuated again, and may produce third-order impacts. As the ripples spread outward, the first groups encountered are those directly affected by the event or the first group to be notified. Secondly, the next higher institutional level is reached and there is a possibility of reaching other parts of industry or other social groups with similar problems. Eventually, the larger society is reached and can cause multiple impacts (as suggested above).

Renn et al. (1992) support the social construction of risk, as well as incorporate the objective property of risk. The social amplification of risk theory avoids total cultural relativism (socially constructed risk) as well as technological determinism (strictly science-based data). Using the social amplification of risk as a conceptual

Table 4. Steps in Individual Perception of Information (Renn et al. 1992).

Steps	Description
1. Passing through attention filters	Selecting and further processing signals from the environment, other individuals, and the media
2. Decoding of signals	Deciphering the meaning of the signals (investigating factual content, sources of information, explicit or implicit inferences, value statements, overt and hidden intentions of information sources and transmitters, and cues to assign credibility of information and information source)
3. Drawing inferences	Arriving at conclusions about the allegedly revealed intentions of the source and the transmitter, employing intuitive heuristics (common sense reasoning) for generalizing the information received, and using symbolic cues for judging the seriousness of the information
4. Comparing the decoded messages with other messages	Analyzing the meaning of the message in the light of related messages from other sources or previous experience
5. Evaluating messages	Rating the importance, persuasiveness, and potential for personal involvement on the basis of the perceived accuracy of the message, the potential effect on one's personal life, the perceived consistency with existing beliefs (to avoid social alienation), and personal value commitments
6. Forming specific beliefs	Generating or changing beliefs about the subject of the message or to reassert previously held beliefs
7. Rationalizing belief system	Sorting and reinterpreting beliefs in order to minimize cognitive dissonance
8. Forming a propensity to take corresponding actions	Generating intentions for future actions that are in accordance with the belief system

framework, Kasperson et al. (1988, 2003) work to systematically link risk assessments (technical) with psychological, sociological and cultural perspectives of risk perception and risk-related behavior. The authors argue that based upon one's membership to a social organization, the readiness to interpret defined risks (technical assessment) and take or ignore actions is heavily influenced by cues gained from friends, family, co-workers, etc. These information sources are then amplified and cause secondary effects, again either amplifying or attenuating cognized models of the risk at hand (Slovic 1987; Kasperson et al. 1988; Renn et al. 1992). The metaphor of amplification or attenuation of information signals shows how belief systems, values and worldviews are constantly reinforced and dependent upon identifying with co-members of social organizations.

It is important for promoters and regulators of health and safety to understand the various ways that people think about and respond to risk (Slovic 1987). By acting within social organizations, people emphasize certain risks and downplay others as a way of controlling and maintaining their organization (Douglas and Wildavsky 1982; Slovic 1987; Dake 1992).

Discovering what motivates communities or individuals to take action as a response to risk will be most challenging for the GWMA committee. According to Kottak:

> "…people won't act to preserve the environment (regardless of what environmentalists and policy makers tell them to do) if they perceive no threat to it. They must also have some good reason (for example, preserving irrigation water or a tax incentive) for taking action to reduce the environmental threat. They also need the means and power to do so. Risk perception per se does not guarantee environmental organization and action" (Kottak 1999:29).

In this study, I will use cultural theory (Douglas and Wildavsky 1982; Dake 1992) and SARF (Kasperson et al. 1988, 2003) to interpret interviews conducted with local area farmers, in an effort to explain their expressions of risk as related to water quality. Do farmers perceive elevated nitrate levels in the groundwater as a hazard for public health? Does their view of risks determine the extent to which they will incorporate changes in their current practices of fertilizing and irrigating? Before answering these questions, I think it is important to define the term "risk," and how it will be incorporated in this study.

Definition of Risk

Various definitions have been given to the term "risks." Some authors differentiate between "hazard" and "risk." For example, Cutter defines technological hazards as "the interaction between technology, society and the environment" and risk as "the measure of likelihood of occurrence of the hazard" (1993:2). Cvetkovich and Earle claim that technical hazard assessors assume that "for any given hazard there is one true risk, usually defined on the basis of the probability and the severity of negative outcomes, and that it can be accurately assessed" (1992:5). By defining risk as the "probability that exposure to a hazard will produce a particular negative outcome," Eiser claims that it does not fully capture what risk means or "how it is subjectively interpreted by the public" (2001:111). Brun questions the various definitions of risk, finding that "most of our subjects in general expressed that risk has to do with both the severity of an event and the uncertainty associated with it," and finds that people "expressed a very *individualistic* risk perspective" (1994:298). The National Research Council adopted a more inclusive process for risk characterization, by stating that "a risk characterization must address what the interested and affected parties believe to be at risk in the particular situation, and it must incorporate their perspectives and specialized knowledge" (1996:3).

For my study, I have chosen to use Eugene A. Rosa's definition of risk, which states: "Risk is a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain" (2003:56). I believe, as the author does, that this definition is broad enough to include three elements found in most risk discourse: 1) the notion that risk expresses some state of reality of human concern or interest, 2) some outcome is possible; an outcome can occur, and 3) the notion of uncertainty (Rosa 2003). In my mind, this definition includes an "objective" reality of the risk, that it exists in the real world outside of human consciousness, that even if humans were not exposed, the risk would affect the environment negatively or in some way, [2] while incorporating "subjective" events, such as the social construction and interpretation of risk and the perception of risks by individuals as members of social organizations.

Understanding the cultural biases based on identity with particular social organizations opens the door for explaining why particular actors make particular decisions, especially when faced with potential health risks. My analysis of interviews conducted with growers located within the Southern Willamette Valley GWMA places farmers within the Individualistic social organization, as described by Douglas, Wildavsky and Dake. As market-oriented individuals, farmers tend to amplify risks to

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[2] According to Causapé et al. (2004:88), "the enrichment of waters with nutrients (nitrogen and phosphorus) stimulates the growth of aquatic vegetation which, when it decomposes, depletes the oxygen dissolved in the water causing eutrophication of the water bodies."

their businesses, sometimes at the cost of attenuating potential health risks. My intention for this thesis is that it will acknowledge particular worldviews based on social organizations allowing for a more informed process of determining recommendations of voluntary actions for the GWMA action committee, as well as frame the underlying causes for conflicting interests between social organizations. Additionally, SARF will be used as a means to examine how risks are perpetuated within social organizations.

Chapter Four

Methods

I utilized two anthropological techniques in order to gain an emic perspective of southern Willamette Valley growers and their perceptions of risk. I applied participant observation while attending the GWMA committee meetings to: a) educate myself about the GWMA, b) to observe a participatory committee working on an environmental issue and c) in order to understand what types of issues the GWMA committee would face. As a participant, I was expected to present the results from my interviews with local growers to the committee in an effort to influence the committee's choices in the final action plan's voluntary recommendations for the agricultural community.

The second technique that I used was informal and semi-structured interviews with local area growers as a means of gaining an understanding of their current farming practices and whether they had incorporated BMPs (as recommended by OSU Extension Services) into their practices, specifically those pertaining to lowering nitrate leaching. Attempting to demonstrate what farmers perceived as barriers or incentives in following BMPs, I asked a series of questions that I thought would reveal what practices growers were currently using. Interestingly, what I found at the base of perceived barriers and incentives was risk perception, particularly risk perceptions based on consuming groundwater that may contain nitrate levels above DEQ standards.

In the next two sections, I will further explain the methods that I employed, both participant observation at the GWMA committee meetings and informal and semi-structured interviews with the growers.

Participant Observation

I attended the GWMA committee's monthly meetings, beginning in the fall of 2004 until the time of this writing. Utilizing participant observation techniques, I observed the action committee's process and gained insights into the variety of issues they are facing in formulating recommendations for the communities within the GWMA (these will be discussed more fully in Chapter five).

Each meeting was scheduled for two hours on the last Thursday of each month and typically took place in Harrisburg. Through various presentations, the committee was educated on the background of the GWMA, as well as introduced to a variety of topics to consider when making the final plan (e.g. municipal water treatments, septic systems, etc.). The objective for providing such information was to inform committee members on possible recommendations to the nitrate issue.

In order to expedite the action committee's progress, GWMA committee members were divided into subcommittees or working groups (Agriculture, Commercial/Industrial, Public Drinking Water Systems, and Residential) and were assigned the task of writing a report of goals and actions based on those meetings. Each final draft report was presented to the entire committee for approval. The final action plan report will incorporate all subcommittee reports into one consolidated report for DEQ and for a public presentation.

I attended the Agriculture Subcommittee meetings, facilitated by an ODA representative. In addition to a few of the committee members, local growers were also encouraged to attend and provide input to the meetings. The six meetings were approximately two hours in length and held at various locations, including the home of a local grass seed farmer. Again, by using participant observation, I was able to hear the concerns of local growers. I also made contact with a couple of farmers serving on the committee who provided me with their views and a farm tour.[3]

My study was designed as an educational component for the GWMA committee to consider when choosing what types of voluntary actions to incorporate for local growers in the final action plan. In December of 2005, I made a presentation of my results to the full GWMA committee. I believe that the conclusions that I reached and shared with the committee will enable them to make better-informed recommendations for the nitrate issue, specifically those tailored for local area growers. The interviewing methods I used in order to access growers' perceptions will be examined next.

Semi-Structured Interviews

Oregon State University Extension Service was responsible for providing potential participants. Initially, I received a list of 10 growers who had been involved in a study conducted by OSU Extension Service, in an effort to understand the process of nitrate leaching (Feaga et al. 2004). These growers allowed OSU Extension Service to install Passive Capillary Wick Samplers (PCAPS) underneath their fields. The PCAPS captured water as it filtered through the soil, so that scientists could measure

[3] These farmers were not included in the formal interview process in an effort to avoid conflict of interests.

the amount of nitrogen escaping the reaches of plant roots. Due to their cooperation throughout this study, and their continued involvement with OSU Extension Service agents, the Extension Service felt that these growers would be willing to participate in this study.

I contacted the list of potential participants by phone to see if they would be interested in participating in this study. Four of them declined to participate and I was unable to contact one of them by phone. Reasons for declining to participate included time constraints, disinterest and even distrust. Of the nine that I contacted, five agreed to be interviewed. I explained the Informed Consent Document to them over the phone (and at the first meeting), in addition to the basis of this study. At a later date, I received contact information for an additional ten growers from OSU Extension Service that were not involved in Feaga's study, but whose farms are located within the GWMA. I was able to reach three of them and they agreed to be interviewed.

The amount of acreage the participants use for crop production varied from 40 to 3,000 acres. Some had previously grown vegetable and mint crops and most grew grass seed as a predominant crop. Two farmers were first generation farmers, meaning they had purchased the land for themselves; one was a second-generation farmer, having inherited the farm from his parents; and five were third generation farmers whose grandparents had purchased the original land (See Table 5).

Table 5: List of Informants

Farmers (pseudonyms)	Acreage	Crops	Generation
Tim	3,000	Vegetables, peppermint, grass seed, filberts	3rd
Al and Sally	60	Vegetables and Orchard	2nd
Harry	Undisclosed	Grass seed	3rd
Frank	500	Grass seed and Orchard	3rd
Walt	900	Vegetables, peppermint, grass seed	3rd
Mike	300	Vegetables, specialty seeds, grass seed	3rd
Bill	50	Grass seed	1st
Todd (no longer farming)	40	Organic vegetables	1st

At first, I met with three farmers to conduct informal interviews, discussing various aspects of their farms and their current crop production and practices. Afterwards, we scheduled semi-structured interviews for a future date. It was during the initial informal interviews that I conceived of open-ended questions that would be used for the semi-structured interviews for all of the participants (See Appendix E for complete list of questions used). Semi-structured interviews allow the participant to expand on any topic that they feel is relevant, yet follows a preconceived set of interview questions (Bernard 2002). Of the remaining five farmers, the informal interview was not scheduled and only the semi-structured interview was conducted. In part, this was due to the timing of the study, which was conducted in mid-May 2005. Participants indicated that their availability for further interviews would not be possible for the next several months (the growing season). OSU Extension Service also indicated that preliminary results were expected by the end of June 2005.

Initially, the study was proposed as a way to discover whether growers within the GWMA were utilizing any of the recommended ways, as suggested by OSU

Extension Service agents and related publications, to lower the risk of nitrate leaching into the groundwater. I also wanted to find out how farmers knew when to fertilize and irrigate and in what amounts, as well as what they use to calculate those decisions. I often heard the term "Best Management Practices" used in the OSU Extension Service literature and wanted to know what this meant to growers. In addition, I was curious about the level of awareness they had of the GWMA and their reputed role in attributing to this issue. Ultimately, I wondered whether they chose to use groundwater as drinking water and, if so, whether they felt safe in doing so.

Each semi-structured interview lasted approximately two to three hours and were audio taped and transcribed for further analysis. Participants agreed to the audio taping and four indicated that they would prefer that a pseudonym be used to keep their identity confidential. Due to the small size of the sample of informants, I decided to keep all names confidential in order to guarantee confidentiality of the few who chose to be identified by pseudonym.

After transcribing the audio taped interviews, grounded theory was used to identify categories and concepts that emerge from the text and to link concepts into substantive and formal theories (Bernard 2002). Textual analysis of the transcribed interviews revealed reoccurring words that related to significant events that appeared over and over. Common themes that I identified and coded were:

- Economics
- Information Sources
- Technology
- Risk Perception

I used my own coding system to determine which themes were most prevalent. These four themes appeared in all the interviews that I conducted and show the many choices that farmers consider in their business practices. In the following chapter, I will expand upon each theme in more detail.

Chapter Five

Results: Participant Observation

Attending the monthly GWMA committee meetings, I observed the proceedings and learned a great deal, not only about the nitrate issue, but also how a committee made up of varied-interested members is conducted. The goals of the committee include:

1. To engage and involve all groups and citizens concerned with GWMA plans or programs by disseminating information about the project, soliciting input and encouraging actions that will protect the groundwater resource;

2. To encourage both a short and long term commitment from federal, state, and local agencies to support efforts to reduce nitrate and protect the aquifer from other potential contaminates;

3. To maintain traditional and/or locally appropriate land uses while preserving and enhancing the health of the aquifer. Emphasis should be on the development of specific voluntary strategies that avoid leaching nitrate to groundwater; and

4. To rescind the declaration of the GWMA by reaching and sustaining nitrate levels of less than 7 mg/L throughout the region (meeting notes).

Some of the difficulties that I saw in identifying goals and strategies lay in determining whether recommendations were realistic and what parties would be responsible for implementing them. Committee members were careful to keep any strategies they proposed as voluntary-based and within the scope of the committee's jurisdiction.

After the first few meetings, I began to appreciate the effort that it takes to get individuals to commit their time and energy to a committee such as the GWMA. The individuals act as representatives for their interests, such as county commissioners, private business people, and city officials. In the role of interest representatives, the members, I imagine, must feel that their time and efforts are spent on a worthy cause.

Due to the complexity of the nitrate issue, members of the committee needed to be "brought up to speed" before formulating an action plan. Agencies supporting the committee (DEQ, Lane Council of Governments (LCOG), Oregon Department of Agriculture (ODA) and OSU Extension Service) provided speakers and educational information for the committee members.[4] For example, Gary Whitney from the Oregon Economic and Community Development discussed financing options for municipal water system formation and improvements; Ken Vanderford, City of Eugene's Residuals Supervisor presented how their wastewater facility manages solid and liquid wastes; Rick Partipilo from Linn County Environmental Health gave an outline of septic system regulations and design; and Barbara Rich with DEQ in Deschutes County elaborated on her study of alternate septic system technologies and the resulting planning and regulatory issues.

The committee members were asked by the supporting agencies to form working groups or subcommittees (Agriculture, Residential, Public Drinking Water, and Commercial and Industrial) in an effort to expedite drafting a master action plan. Each representative member joined the group that they felt would best represent their interests. Each group submitted a written report for the entire committee including specific goals and potential actions in meeting the identified goals. All four action plans will be incorporated into a single action plan that will be presented to the leading agency, in this case the DEQ, and to the public.

[4] For a list of agendas and meeting notes, see GWMA website: http://groundwater.oregonstate.edu/willamette/.

The supporting agencies continually asked committee members what they wanted (i.e., types of information) and how they (the agencies) could be of service. For example, LCOG helped the committee in the early stages to set up ground rules on how the committee would conduct meetings and how they would reach an agreement between members. OSU Extension Service supplied various speakers and student researchers to present topics related to the GWMA (including this study). DEQ brought in specialists, as well as information from the other two GWMAs located in Oregon.

OSU Extension Service decided to fund a study for the committee that would ask growers about their perceptions on following BMPs related to water quality in an effort to discover what recommendations would be realistic for the agricultural community. Rather than spending resources on formulating an action plan that would include suggestions to improve water quality that growers would vehemently oppose or completely ignore, I was asked to uncover any cultural biases that growers may have in order to assist the committee in creating voluntary actions that would most likely be incorporated into growers' practices, specifically in the area of fertilizer usage. I needed to understand what practices farmers were currently using as a means of figuring out what modifications, if any, they would be willing to make. In addition, I wanted to find out if growers were aware of the GWMA declaration, and if so, whether they saw this as a threat to their health.

In the following section, I delve into the four general themes that surfaced in the interviews that I conducted with my participants. The themes reveal what growers base their fertilizer decisions on, as well as their perceptions of risk, which directly correlate to any modifications that they may be willing to integrate.

Results: Semi-structured Interviews

The four themes that emerged from the analysis of the transcribed interviews are as follows: Economics, Information Sources, Technology, and Risk Perception. These themes surfaced throughout the eight interviews and provide valuable insight into the daily life of farmers.

This data can be used when considering management of resources, in this case water quality, and strategic plans that incorporate the reality of the many variables that farmers consider when making decisions that may affect natural resources. As I consider each theme in detail, direct quotations will be used to show exactly what was said in addition to the implicated meaning behind the spoken word.

Economics

During the informal interviews, it was brought to my attention that the Agripac cannery located in Eugene, OR had closed its doors in the late 90s-early 2000. My informants indicated that this directly affected what they were presently growing. Having contracts with Agripac to grow vegetable crops, typically known as row crops, for many years, farmers were acclimated to practices necessary to ensure a quality crop. Practices included fertilizer and irrigation techniques, pest management, when to contract labor, and proper crop rotations, to name a few. Growers also timed their operations accordingly and owned machinery and equipment that facilitated row crops.

After suffering financial hardships beginning in the late 1980s, Agripac began a slow economic decline that ended in bankruptcy in 1998. This greatly impacted local growers, as one grower expressed:

"South of Monroe and Halsey, from there south it's made a major impact. The biggest share of the Agripac growers, that's what Eugene was...Agripac, they had plants in Eugene and Salem. The growers down at this end of the valley were previously growing for Eugene Fruit Growers, which was the predecessor of Agripac. Well, that's about the only company that we grew for down here, we were pretty specific and so, when we went to Agripac that was the only company that we grew vegetables for, so when Agripac went out of business our farms had a major impact cause we didn't have anybody else we were growing for. Some of the people farther north, they had at least two, maybe three different vegetables processors that they were growing for, so the impact on them was a lot less than it was on this end of the valley" (Harry).

The struggles that these growers faced at that time was echoed in all of the interviews. One grower indicated that a few of his neighbors' agribusinesses could not overcome the hardships and ended up either retiring or finding other employment, oftentimes leasing their land to other farmers for crop production:

"So, anyway, after they just hung on as long as they could and it finally got to the point, this farm here they called us in March of whatever year it was, in fact, I was on vacation, my dad called me and said they had called and the bank wouldn't loan then anymore money, so they couldn't, they were just, they couldn't fertilize or do anything. So, dad says, 'Do we want to take it on?' And I says, 'Yeah, lets go ahead and do it.' So we took it on" (Walt).

Some of the growers that I interviewed were directly impacted, like "Harry" while others felt the impact indirectly:

"I know that did affect us. The cannery growers going out. That probably made less people buying from our farmers coop, you know, fertilizers. So the cannery growers may have impacted the business of the farmer's coop, so when the farmer's coop went out, which impacted our supplies. So instead of going to West Eugene to get our chemicals, now we have to go to Harrisburg. It didn't dry up the source of materials, it just meant that we have to drive maybe 30 miles round trip farther" (Sally).

"All our field men are gone" (Al).

"Wilco still have field guys, but not as specialized as we did have. There was one person who was specialized in our kind of crops. There's not a lot of orchards and stuff grown so I don't think their efforts go into that as much. Wilco serves a lot of grass seed farmers and that kind of farming, so I think their main emphasis is knowing those kind of crops" (Sally).

Without a local market for their produce, farmers scrambled to find an economically viable crop:

"There's a few who went to specialty crops, you know vegetable seeds and specialty crops, but that's a pretty limited market, so the small portion of their acreage went to that sort of thing, but the biggest portion ended up as grass seed or something like that. Commodities" (Harry).

"Before we always had 50 acres of beans and 100 or something acres of sweet corn, but being that Agripac closed in Eugene and Salem why we didn't have that option, so now we're raising grasses" (Frank).

Grass seed has been grown successfully in the Willamette Valley for generations and accommodates a worldwide market. Several varieties of grass seed, such as Tall Fescue and Annual and Perennial Rye Grass, are grown and processed locally for such uses as pasture forage, lawns, golf courses, etc. (See www.ryegrass.com/Perennial_rye_broch.pdf for more uses of grasses). As row crop growers converted into grass seed growers, the market for grass seed was impacted for several years:

"And in turn, all of this (went) into grass, which floods the market and since that point and time, this is all cleared out. In other words all the problems, a lot of the problems have ended. But what it did it brought in all this extra production in grass, which put more pressure on the grass industry. I mean you can only grow x many acres of this stuff. So all these surpluses started building up, which drove the price down and it's just a vicious cycle" (Walt).

"They went into (grass seed)*...and what it did, it didn't just affect them, it affected all of us because they...and they were forced to do something, but because they were into the tall fescue, it brought the price for tall fescue down and it didn't just bring it down for them, it brought the whole Willamette Valley tall fescue price down. And probably*

rye grass to a certain extent too. It's not their fault, I mean. You'll go broke if you don't grow something. That's the reality" (Bill).

The transition from row crops to grass seed did not happen overnight and it was not smooth. For those farmers who were already successful grass seed growers, leasing more acreage was a fairly benign endeavor. However, for the cannery growers, their crop choices relied upon outside interests. For example, AgriBio Tech (ABT) contracted with several of the former row crop growers, who thought they had found their way into another viable market, only to experience the bankruptcy of that company (Russo 2001; Martinis 2001):

"I don't know if you heard the word ABT come up or...well, a few years back there was, when these guys lost their vegetable contracts, well, they went to different seed companies and started planting grass seed. There was a company that came in, an individual, I think that he was out of Las Vegas, anyway, an individual came into the valley here and he had this grandiose plan of buying out all of these seed companies and then forming a big company and controlling the grass seed markets. So, these guys were growing crops for 2 or 3 different seed companies who got bought out by this individual and then he went bankrupt, this company went bankrupt. So, they were growing these crops with nowhere to go with them and they got hung out to dry. They couldn't get their money; they couldn't sell the seed. They couldn't do anything cause it got tied up in the courts, litigation and they couldn't sell the seed cause the court wouldn't let them sell it" (Walt).

In June 2004, Washington State legislation updated The Commission Merchants Act, Chapter 20.01 RCW, by requiring businesses to be licensed and bonded with Department of Agriculture, in an effort to protect farmers from "fraud and other unscrupulous business practices," after farmers in that state went unpaid for seed totaling $5.4 million that they had sold to ABT (WSDA Seed Program 2004:1). In February 2005, a $14.87 million dollar judgment against a former ABT executive was entered, but even if the collection is successful, Willamette Valley Grass Seed Farmers will be lucky to receive 12 cents on the dollar (Wolfe 2005):

"And there were some varieties that these guys were growing for ABT that were once the court released that seed, it flooded the market, it became a mess, it just snowballed and it affected everybody. I don't think that there was an individual in the valley here that wasn't affected by all that. Cause it was just a snowball affect. You may have had a contract for fescue, from a reputable good company that you'd been growing with, but when all this seed got dumped on the market the price it just, it forced the price down. And so, these companies they come to you and say, "Hey, we can only pay you 35 cents a pound instead of 55 or whatever." And so it affects everybody when that happens" (Walt).

The loss of the Agripac cannery had severe implications for the Southern Willamette Valley Growers, both row crop growers and grass seed growers. Though farmers expressed that these disruptions have subsided over the past five years, they have become cautious of their economic investments (See Appendix F for Benton, Lane and Linn County Profiles). Another crop that has declined in the Southern Willamette Valley is peppermint.

Willamette Valley peppermint was once prized for its unique minty flavor. Growers related to me that peppermint growers typically had distilleries that they used to process the peppermint leaves into oil, which would then be sold to various companies. Partially due to the stagnation of the price of peppermint, some growers have opted not to continue producing this crop. In addition, the international market has opened the door to buying peppermint oil from other countries, such as India, Ukraine and China. One former grower and one current grower of peppermint indicated to me that companies who use peppermint have found a way to mix peppermint oil purchased internationally with Willamette Valley peppermint oil in order to produce an adequate quality of peppermint oil:

"...the advancement in technology is what caused it. Quite a bit of the domestic oil, they can crack it now and get, not real good sweet chewing gum, but mouthwash and stuff like that, why they can crack it and get number 2 oil...And they (China) found out they can crack it too, so they're furnishing the oil now to Walmart. So they sell number 2 oil from China, that's replaced the Willamette Valley oil" (Mike).

"Just there are other parts of the U.S. that will do it cheaper, better plus there's a whole bunch coming in from overseas. Huge amounts. Even the people we grow for are buying overseas. Same way with peppermint, the oil. You used to see peppermint all over the place. Everybody had a distillery, I'd say a third of what it was 20 years ago. It's the same thing, huge amounts from China and India...There's an over supply. They're finding out that they can get almost the same quality oil that people grow other places. The Willamette Valley has the highest quality oil in the world and so, they take our oil and blend it with something that comes from the mid-west or Madras or Yakima to make a good quality. So they do need our oil, but not as much as they used to. They can get oil from Ukraine that's on the same latitude that we are so it grows the same kind of oil for a tenth as much. This world market, it's hurting us" (Tim).

According to the United States Department of Agriculture (statistics), the number of acres used for peppermint production has declined in the past decade (See Table 6). The price for peppermint has also dropped over the same time period, from a high of $15.50 per pound in 1995 to a low of $11.80 in 2001. The production of peppermint reached its peak in 1995 totaling 3750 thousand pounds and dropped to its all time low over the past decade in 2004 to 2115 thousand pounds. Total value of peppermint as a crop went from a high of $58,125 thousand in 1995 to a low of $27,718 thousand in 2001.

Total acreage of peppermint in the State of Oregon in 2004 was 23.5 thousand acres, with a total high of 50 thousand acres in 1995-96, illustrating that more than half of the acreage once delegated for peppermint crops are no longer used for that purpose:

Table 6. Production and Price of Peppermint in the State of Oregon. National Agricultural Statistics Service (2004).

Commodity	Year	State	Harvested	Yield	Production	Price per Unit	Value of production
Peppermint	1992	Oregon				14.40 dols / lb	48571 thousand dollars
Peppermint	1993	Oregon	43.2 thousand acres	60 pounds	2592 thousand lbs	14.30 dols / lb	37066 thousand dollars
Peppermint	1994	Oregon	44 thousand acres	73 pounds	3212 thousand lbs	15.80 dols / lb	50750 thousand dollars
Peppermint	1995	Oregon	50 thousand acres	75 pounds	3750 thousand lbs	15.50 dols / lb	58125 thousand dollars
Peppermint	1996	Oregon	50 thousand acres	73 pounds	3650 thousand lbs	15.30 dols / lb	55845 thousand dollars
Peppermint	1997	Oregon	48 thousand acres	73 pounds	3504 thousand lbs	15.30 dols / lb	53611 thousand dollars
Peppermint	1998	Oregon	42 thousand acres	79 pounds	3318 thousand lbs	13.70 dols / lb	45457 thousand dollars
Peppermint	1999	Oregon	40 thousand acres	69 pounds	2760 thousand lbs	13.00 dols / lb	35880 thousand dollars
Peppermint	2000	Oregon	33 thousand acres	77 pounds	2541 thousand lbs	12.70 dols / lb	32271 thousand dollars
Peppermint	2001	Oregon	27 thousand acres	87 pounds	2349 thousand lbs	11.80 dols / lb	27718 thousand dollars
Peppermint	2002	Oregon	25.5 thousand acres	91 pounds	2321 thousand lbs	13.00 dols / lb	30173 thousand dollars
Peppermint	2003	Oregon	25 thousand acres	95 pounds	2375 thousand lbs	13.10 dols / lb	31113 thousand dollars
Peppermint	2004	Oregon	23.5 thousand acres	90 pounds	2115 thousand lbs	13.20 dols / lb	27918 thousand dollars

"So, what happened with the mint world was, the companies have discovered that, yes the Willamette Valley has a unique flavor, but they can pretty much buy some mint oil from multiple locations around the world, mix them together and get essentially the same flavor and it's cheaper. Yes, you have to bring them together, but in the end, the total cost is less than the Willamette Valley, so the mint production is at least or probably, it might be 20% of what it was 10 or 15 years ago" (Todd).

Three informants explained that in order to get maximum yields, peppermint requires a high level of nitrogen fertilizer. The oil from peppermint is in the leaves, so farmers make an effort to produce as much of the foliage as possible:

"Peppermint is a high user of nitrogen. There's numerous studies that we've conducted through the ...Research Council to try and figure out the optimal amount of nitrogen, I mean if you go past a certain point and you think, well heck, 20 more pounds will be that much better..." (Tim).

"Well, the way the...the oil is in the leaves. The more you have leaves, the more oil you have. The leaves evaporate the oil to some degree, but in high enough temperatures, there is more production oil in the plant, so it's typically harvested when you have a lot of leaves and warm temperatures, so you can get as much oil as you can" (Todd).

The estimated average amount of fertilizer recommended for use on peppermint crops is 350 pounds per acre per year (200 to 225 pounds per acre as recommended by OSU Extension Service) (Selker and Rupp 2004); in comparison, the average amount of fertilizer recommended for grass seed crops is 150-160 pounds per acre per year (Hinkle 1997). In addition, studies have shown that grass seed crops are "scavengers" of nitrogen and tend to hold nitrogen to the soil surface (Feaga et al. 2004).

Row crops, particularly peppermint, allow nitrogen to escape the root zone and leach to deeper depths within the soil, where it then transforms into nitrate that is easily drained into the underground aquifer: "Vegetables are highly inefficient at using applied N because of their shallow rooting depths and relatively large distances between plants due to cultivation practices. Due to the relatively high economic value, low water-stress tolerance, and large N requirements of mint, it is a high risk crop for NO-3 leaching" (Feaga et al. 2004:1). Possibly the reduction in row crops and peppermint will lower the amount of nitrates leaching into the water supplies.

In addition, OSU Extension Service has provided many publications addressing practices that may help alleviate the nitrate-leaching problem (Feaga et al. 2004; Selker and Rupp 2004). Some of their recommendations include using winter cover crops rather than leaving fields fallow during that season, stem testing of crops to measure level of nitrogen reaching plant, and irrigation equipment maintenance.

The offered suggestions fall under the label "Best Management Practices" or BMPs. One of the questions I asked all participants was to define "Best Management Practices" without indicating any particular subject. The responses overwhelmingly implied that farmers' view BMPs as minimizing inputs and maximizing outputs or yields:

"Best management practices really boils down to being able to make a profit. Having...you can practice something, but if you're losing money, the bank will say, 'No, no.'...Like raising peppermint, you can raise peppermint, but unless you have a still it's not a good practice because by the time you try to get the stilling costs and the irrigation and the water, why then you're going down the rat hole" (Mike).

"We try to use best management practices to help us stay in business. It's like anyone in business, you try to use the best management the best input that you got to help stay in business, you know. I guess that's the way I look at it. I guess it's equalizing what you're spending versus what you're making and hopefully coming out ahead" (Harry).

"Well nowadays it (BMPs) seems to be keep your costs low enough and yet have crop so that you can have a margin at the end of the year. Some margin. It hasn't been good for us. It's been not good at all. Of course, you'll find out most of agriculture, unless they're very big growers or very specialized the margins haven't been there" (Frank).

The term "Best Management Practices," as used in the business and academic worlds, typically imply a notion of solution-based procedures that are recommended to overcome real or perceived problems. For example, OSU Extension Service produces publications on various agricultural subjects, such as BMPs as related to water quality, in which study results are explained and recommendations are offered. My initial assumption was that growers were well aware of BMPs and had already incorporated these into their practices, however, economic factors appear to be one barrier in using recommended BMPs. In asking growers to define BMPs, I thought that this would prompt them to list BMPs from the PCAPS study (Feaga et al 2004), but instead, I received a very different definition than I anticipated.

For farmers, BMPs not only need to be solution-oriented, but also economically-oriented. If growers do not see a recommendation as economically beneficial, they may not be willing to incorporate such practices. Though they see themselves as environmentally conscious and all variables are considered, making a profit is a priority.

Sources of Information

OSU Extension Service generates a multitude of publications for the farming community. One of their primary goals is to communicate studies that have been conducted along with the conclusions and recommendations to audiences that may find the information useful. In the case of nitrate leaching, OSU Extension Service has conducted many field studies, typically measuring nitrogen that is lost to crop absorption and timing of fertilizer applications that may help alleviate potential nitrate leaching. Getting this information out to growers is an ongoing task.

Participants to this study were asked what sources of information they utilized to make fertilizer and irrigation decisions. Many responded that they used information produced by OSU Extension Service, however, they oftentimes responded that they commonly receive information from "field men," or fertilizer company representatives:

"Wilco has a fertilizer man and 2 or 3 others in Monroe and one by Shedd. Anyway, they vary, but most of them…it's getting time for the grass seed to grow, why you think, I need to put some fertilizer on it and they'll print you out a little form put on 20 pounds or 40 pounds in March and in April you put on 40 more. Cause you don't want it all on or it will all rain out. You just want enough to make it grow and not leach out in the water" (Mike).

"They come out and look at your crops and if you've got a problem. If you see, 'Oh man, we got a really sick looking field.' They'll come out and they'll dig and see if you got some kind of bug or just their general knowledge, 'Oh yea. This is what it looks like at so and so's and that's what he had.' Then they'll give you like a prescription, you know 'Well, I would recommend you do this spray or throw some extra nutrient' that you might not have had. They were just advisors. They've gone to college and are in that everyday talking to the chemical reps, and the chemical reps tell them what new fangle-dangle products that come out. So they're kind of like your middle men, sort of" (Sally).

Fertilizer representatives come out to the farmers' property to make assessments and recommendations.[5] Companies such as Wilbur-Ellis, Wilco, SureCrop and Simplot employ field representatives who are responsible for interacting with local growers in an attempt to gain their confidence and their business. A couple of participants saw the potential conflict of interest between following recommendations to limit fertilizer and the field men's role as salesperson:

"They're just trying to sell a product, so whether they are on commission or not, they're still trying to sell a product, so you gotta take that and break it down and make your own conclusions. That's why it's always good to know what's been done as far as

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[5] For Wilbur-Ellis fertilizer specifications, see http://webprod.wecon.com/WECOWeb/WECO/branch_includes/pacific_northwest_fertilizer_specs.pdf

the research, you don't want to just take the consultant's word, which there is a lot of trust there" (Tim).

"...historically, a lot of farm supply companies would have their field men going out, on one level they were going out to try to sell product, but a lot of them have moved away from actually just trying to obviously sell their product, to coming up with, scouting fields and providing recommendations to growers and then that same company having an application service" (Todd).

In addition to providing fertilizer or pesticide recommendations, field men also communicate whether their company offers services, such as field testing (soil sampling), fertilizer application service, field mapping and yield monitoring. A couple of the farmers indicated that they do regular business with SureCrop, who not only sells fertilizer, but also provides multiple levels of data to the farmer:

"Sure Crop does a lot of services for us other than just the application. We have our field maps up here on the wall. They've done all our field mapping for us. We know each field. Each field has a number. They have all that information in their computer over there. Whenever they do an application on a field that goes into the computer system over there. They have our field records from, as long as they have been doing business with us practically, probably more specific in the last 10 years probably that they've been doing our applications, so if we need to go back 5 years and remember what crop we had in what field and what was put on it, we can go to them and they can poke the computer and give us full information: what day it was applied, where it was, and how much it was. So their expertise at what they are doing is more than just putting the material on the field for us. In our case, that works out really well. And when they send us a bill at the end of the month, we have each application that's printed out and we keep that in our records. We have the printouts on all our fields and what was put on and how much. So there's a lot of things involved in hiring this done that get more than just the applications. And then we have the fieldman. That's part of the cost. Some people say, 'Gee, it costs so much to get fertilizer put on by Sure Crop,' but there's a lot of things that they do for you that you're paying for. You don't pay the fieldman to come out and scout your fields. You pay Sure Crop for doing the applications after the (test) has been done, so you're paying for that through the applications, by buying the chemicals and applications from them" (Harry).

"What we're doing now, we go to this field in February or March, we determine what we're gonna plant a year in advance or pretty close to that. And we'll go to this field and SureCrop Farm Service; Mark will come in with his four-wheeler and soil sample. And he'll pull into the gate there and this map will come up on his laptop and he'll

punch in some numbers and he grid samples this, so it will tell him exactly where to drive and he'll take soil tests on this twenty...he'll like one, two, three, four and he'll grid sample this whole thing. Then he sends it to the lab, sends the samples to the lab, they'll analyze it all, they send him back a sheet with all the numbers on it, you know all the soil, your typical soil test thing. Then what he does is, he plugs it into the computer and the computer tells him exactly what his inputs need to be on this particular field: ph, lime, potash, phosphate, whatever. Then what we do is we'll go in and they'll come back with the lime buggy and it will tell them...then we put on variable rate, so there might be an area of the field that doesn't need any lime or one area that needs 5 tons to the acre, usually we don't go that high, 3's usually the max. So then they'll spread the lime the variable rate, so we'll put exactly the input that we need on that field where we need it. And then, the same, they'll come back in, that's what we're doing today, they're variable rating the potash and nitrogen, and so the spreader goes along and he's putting the chemical and the potash down, he's variable rating that across the field. So if you need to bump it up, it will put it heavy and then we'll work it" (Walt).

Both of these growers have found that by purchasing SureCrop's services, they are able to monitor their inputs and yields much more accurately, which may, in the long term, save them the expense of buying fertilizer when it isn't necessary. Also, they have a historical record of their farms, color-coded on large field maps that make the information readily accessible.

Other sources of information include *The Capital Press* (a statewide agriculture newspaper), mailings, farm magazines, grower meetings, Ag shows, grass seed coops, cleaning agencies, and others who have experience in farming.

Technology

Technological advances in agriculture, especially concerning machinery and equipment, have caused substantial changes in modern-day farming practices. Due to the advent of Global Positioning Systems (GPS), farmers are able to have their fields plotted and recorded digitally with the help of satellites. Soil sampling done across an entire field can be entered into a laptop computer and used to plot differences in measurements of soil nutrients. This gives the farmer data that can be entered into application equipment that is able to vary the amount of product (lime, phosphates, etc.) being added to the soil. The advantages are that inputs, such as fertilizers, can be added to areas of the field where it is needed most, and not added to areas that show an ample supply of nutrients. Yield monitoring works in very much the same way, where yields across different fields are measured during harvesting season and this information is used when nutrients are added; areas where the yield was lower would get more inputs and less is added to areas that had adequate yields.

A few of my informants described their usage of GPS units, either purchased for their own equipment or those that are used by fertilizer companies. They appeared to take great pride in their map diagrams that showed crop type and annual yields:

"When they get all the samples and they run the computer, he generates a thing on the computer and they download it onto a card and then they take it to the equipment and plug it in and it's all run off the satellite. So the satellite watching where the buggy is in the field, it has GPS coordinates and then on this card it's reading, 'Okay, I need a ton to the acre in this GPS coordinate.' And it will just lay it in there and then the gate or however it's working will just automatically, basically the driver just drives and everything else is done by the computer" (Walt).

"...we bought a combine here 2 years ago that has a GPS on it and it has yield monitor, so it tells us what our yields are on all our fields and Sure Crop comes to the combine and takes the chip out of the combine and that gives us a map of our fields, of what our yields are on the whole field. They've done a field mapping. Every field that we've run the combine over has a map. It maps every time you go around the field with the combine, the yield all the way around the field. That's kind of expensive, but it gives you a better idea of what you're doing and how your yields are going, the quality of your soils and so forth. We've been doing grid sampling every 2 acres or so, you pull a soil sample. If you've got a hundred acre field you'd probably go with a little larger area than that, maybe 5 acres. So you would have a soil sample out of all the various places in your field. And then they make a field map for you of this field. They have the equipment to go out and if this part of the field needs more of some particular product, that part of the field gets more fertilizer and the field down there doesn't need more fertilizer, they can put less on that end" (Harry).

These responses suggest that farmers are willing to go to the expense of purchasing equipment with GPS units on them and hire fertilizer companies that have machinery capable of varying the rate of input applied to the soil. This implies that growers are willing to invest up front what they view will end up saving them money over the course of time. Again, this theme relates to the economic viability of farmers who are committed to minimizing inputs (costs) and maximizing their yields (profit).

Farmers tend to talk about the technical advancements in farm equipment in response to questions pertaining to fertilizer/irrigation practices and that they have been monitoring yields and inputs with GPS technology over the past 10 years. However, few responded that these changes are a result of knowledge of nitrates leaching into the groundwater. In fact, the following theme that surfaced was whether farmers perceive nitrates in the groundwater as a risk to their health.

Risk Perception

The DEQ standard for nitrates in groundwater is 7 ppm (Oregon Revised Statutes 2003). When I asked participants whether they used groundwater as drinking water, all but one indicated that they did. One farmer said that they had switched to using bottled water almost exclusively for drinking water, stating that because they have grandchildren who visit them regularly, he and his wife had decided to use another source of drinking water for the entire family.

Of those who still use groundwater as drinking water, a few stated that due to their children being grown, they themselves were not overly worried about their drinking water:

"For us personally drinking it we've never worried about it. Maybe I should have, but we already had our kids by that time, so the pregnancy issue wasn't in my mind" (Sally).

"...we aren't going to have babies anymore, maybe I don't want to have blue babies. There hasn't been a case of blue babies yet. That's 10ppm, above 10ppm, you have a chance of getting one, but no one has had one. It would probably take 20ppm before you got 'em, but 10ppm is safety" (Mike).

In addition, they said that they have their drinking water "tested" though it was not conclusive whether they have it checked for nitrates:

"Every once in a while they have those free water testing things, you take a sample in just to see if your water is healthy. I was curious, cause I live right, I have an acre and a half and my well is 50 feet from the first grass seed field and I just wondered about all the chemicals. It was fine...I just wanted to be sure that I didn't have a problem because a lot of these places in the country there is a little more distance, but I just happen to live on a little strip of land and it's literally only, at the most, 50 feet to the edge of the field. And I was wondering about nitrates. It was fine" (Bill).

Some participants claimed that their drinking water had shown high levels of nitrates in the past (slightly above or at the EPA standard), but because of various changes, the nitrate level had dropped:

"This used to be a peppermint field. We moved in our house...let's see my well was, I think 15 feet...anyway, and we were growing mint here and we were dumping, that was before we started keeping track of our nitrogen, we were just pouring the nitrogen to it and my well was right next to that field. I don't know why, for some reason I checked one time and it was at 10ppm, which is the threshold and so, which was a little high, so we were trying to figure out, at that time...didn't know why. Then we kind of figure...well that's real gravelly soil down there, so we figured that the nitrates were leaching down through from the peppermint. Anyway, we don't have peppermint there, I've put in a new well, it's at 35 feet I think, the best I could go before I hit clay. Since then, it's cleared right up. I don't even...it was below 5 the last time I checked. It was dropping fast" (Walt).

A few participants indicated that the "nitrate problem" was not in their immediate area, stating that due to distance in miles they felt that their drinking water was safe:

"…the area here and the area that we get our water, where we farm at the other places, the areas closer to where we are have had no problems, so we don't worry about it I guess. Coburg is a problem, but we are outside of Coburg by about 5 miles and probably as the crow flies, 4 miles. There hasn't been any problems where the wells have been tested over here" (Harry).

All of these responses suggest that, for one reason or another, these particular farmers believe that they do not have a problem with their well or that they have resolved the issue. Problematic of these views is that nitrate levels can fluctuate tremendously over the course of a year (See Selker and Rupp 2004). Due to this variance, it is difficult to pinpoint where the exact source of nitrate is and whether it has cleared out of the water system entirely. Also, due to the natural movement of underground water, it is very difficult to claim any natural boundaries. All of these participants reside within the declared GWMA, which was determined by the testing of various wells within the area.

When specifically asked if they themselves had any concerns over the health risks associated with consuming water with elevated levels of nitrates, most indicated that they did not feel overly concerned, however, they showed mixed emotions, as the following shows:

"I'd say, it would have to be opinion cause I'm not into the science of that, I don't know. Apparently there is some risk to their health, but I don't know at what level it becomes a risk. That's not my expertise. It's a concern though; yes I am concerned about it. It's not that I don't care" (Harry).

"I think that anytime you're told something bad you will try and correct it" (Sally).

"Yea, I mean you don't want to ruin everything" (Al).

"Yea, you don't want to be the guinea pig that says 'Hey, I guess they were right.' Twenty years from now, 'I guess I should have listened.' Maybe I will be saying that, who knows?" (Sally).

"I'm not overly concerned, but it's kind of foolish to just stick your head in the sand and think that nothing is gonna happen" (Bill).

It appears that growers within the GWMA are aware of the nitrate levels, have received some information on the potential risks involved with drinking water that contains elevated levels of nitrates, and have taken some actions to clarify whether their water source is a "problem," based on that data. However, they also appear not to have extensive information on the behavior of nitrates in groundwater, how fluctuations are common and depend upon seasonality (rainfall) and water movement (Feaga et al. 2004). One informant indicated that he believes that the nitrate levels are dropping off from a previous era of high nitrogen fertilizer usage, stating that federal agencies should have been measuring for nitrates more than 10 years ago, so that they would have some comparisons.

Growers are also aware of other potential nonpoint sources for nitrate leaching, typically pointing to possible leaky septic systems, however, none outright denied agricultural activities as influencing the level of nitrates. Rather, they see themselves as having made successful changes in nitrogen usage and believe that these accommodations are satisfactory. Other recommendations for controlling nitrate leaching have been published by OSU Extension Service, such as growing winter cover crops and replacing worn irrigation valves. Participants did not indicate whether they were using any of these suggestions or whether they had been made aware of them.

In the following chapter, I will further discuss the idea of risk perception, initially by summarizing the four major themes, then turn to cultural theory (Douglas and Wildavsky 1982, Dake and Wildavsky 1992) to explain why farmers exhibit particular cultural biases, and explain how the perception of risk operates utilizing the SARF (Kasperson et al. 1988, 2003).

Chapter Six

Discussion: GWMA Committee

While attending the GWMA committee meetings, I observed that the information presented to the members, via documentation and speakers, was primarily based on the geological and physical aspects of nitrate leaching. Outside of my presentation, none of the others was based on culture. Though "science-based" data is important, ultimately culture will decide what, if anything, is changed. Cultural biases play a central role in determining actions. How the nitrate issue is perceived and whether proposed recommendations are adopted, what educational platforms and materials are used, and how and what measurements will be calculated to assess the master action plan, all depend upon the values and beliefs of the people involved and their associated social organizations.

The GWMA committee is designed to bring various parties-of-interest to the table and involve them in the decision making process. As a participatory committee, each member represents a particular field (e.g. county commissioner, mayors, realtors, private businesses, farmers, etc.). One question that arises is how closely the members represent the greater GWMA community. Specifically, how representative are the two farmers on the committee for the rest of the growers within the GWMA? Both are seasoned committee members, having involvement in various councils and other interest groups. They bring to the table a rich cultural history of southern Willamette Valley growers and have been successfully farming for generations; however, they do have a vested interest in the outcome of the committee's action plan (though no more than other members) and have worked closely with OSU over the years. I believe that they, like all of my informants, tend to be more open to information that comes from the university and Extension Service specifically, but am not sure about growers who chose not to work with OSU. In other words, growers who do not regularly work with OSU may not be as willing to incorporate the voluntary recommendations, as formulated by the GWMA committee. At this time, I am unsure of how much contact these two growers have with growers not associated with the Extension Service.

This begs the question of how the committee or its funding agency will inform that particular population (as well as the rest of the GWMA community), a question that confronts the committee as a whole. There have been many discussions of how to accomplish this, as well as which media to use and how it will be funded. Will the recommendations decided upon by the committee affect growers' decisions? This remains to be seen; however, as pointed out earlier, the themes that were discussed should provide some guidance on what type of actions are most likely to be used—those that take into consideration the cultural biases of the Individualistic cultural pattern, specifically those related to economics and risk perception.

The perception of risk directly influences the environmental values of society, and the social organizations as outlined by cultural theory can be used to predict the behaviors of these social organizations. If people view that environmental problems must be fixed, then the values of society will influence which environmental problems are amplified and which are attenuated. If high levels of nitrates in the drinking water continue to be seen as a problem, then it can be expected that the perception of risk has determined that value.

Consequently, the sources of funding will determine what risks will be amplified or attenuated, as those with financial backing can set the agenda. Promoting values based on cultural biases and perception of risk, social organizations that can ante up the most funding will decide which issues become salient, while the weakest politically will have their values undermined. Those in power will determine the "correct" course of action, while those without will continue to struggle, possibly forming movements that advance their political agenda.

It is important to consider culture in studying any environmental issue. Ethnographic studies may be seen as "non-technical" data, yet they can provide insightful information that is very relevant in contemporary environmental problems: "Resource management information is usually focused on the resource itself and not on the users" (Buck 1989:114). Social organizations and the cultural biases that are relative to each offer the best information on the probabilities of what actions will be incorporated and which will be rejected.

As can be seen from the results chapter, the farmers that I interviewed are concerned with remaining economically viable. As business owners and operators, they are in a position to make decisions based on gaining marginal returns from their investments. Using Douglas and Wildavsky's (1982) and Dake's (1992) cultural theory, this places the farmers in the role of entrepreneurs, who fall into the social organization of Individualistic or the market-orientated group. Assessing the conditions of these social actors, one can see that the data collected from the informants relates to shared values of optimizing all transactions, the need of autonomy when choosing to contract or withdraw from contracts, expectations of the state to make sure that contracts facilitate fair play and appear highly sensitive to economic issues (See Tables 1 & 2 in Chapter 3).

The sources of information that farmers use is also directly related to issues of economics such as finding the best way to maximize outputs while minimizing inputs, as well as learning about the latest recommendations on fertilizers, pesticides and herbicides, and irrigation techniques in order to increase crop production or at least ensure a high yield for the amount of acres tilled. Publications, such as *The Capital Press*, OSU Extension Service literature, and various corporation advertisements and catalogs, all encourage values of enterprise. As business people, the farmers also use each other to discuss salient issues, oftentimes attending farmer meetings or becoming members of local commodity commissions. All of these sources reiterate the Individualistic social organization and its assumed cultural biases and should be used as a means to communicate the committee's action plan to the agricultural community.

Technologies also reinforce entrepreneur identity, who view risks as opportunities, in this case trying various "recipes" of inputs as an experiment in measuring its affect on yields. In addition, the use of GPS units or third-party high tech corporations facilitate the idea that technology offers opportunities or better ways of running the business. Underlying these choices, however, the farmer remains in control, as can be seen by the interviews, ultimately making the final decisions on any practices that take place on their farm. Both technology and sources of information, along with the words of the farmers themselves, show that growers seek out "science-based" information when making business decisions. This is also true when deciding whether to pay attention to a potential risk or choosing to ignore it.

The social organization of Individualistic shows general cultural biases of members in this group and explains why growers' perceptions of risk tend to be based on whether they truly feel that their individual health is being threatened or not, in this case, using groundwater for drinking water despite being located within a GWMA. The interviews illustrate that some of these farmers have had their individual wells "tested" and base their concern on EPA and DEQ standards (10 ppm and 7 ppm respectively), reflecting scientific measures. However, due to the constant fluctuation of nitrate levels, what proves to be a "safe" level in one moment in time may change within the overall climatic cycle, possibly within just a few months (Feaga et al. 2004).

This raises a couple of questions: How is risk perception cycled? Is there a way to explain how different social organizations determine their level of risk perception? In an effort to show how risk perceptions are generated and either maintained or changed, Kasperson et al. (1988) introduced the concept of the Social Amplification of Risk Framework (SARF). Since its origination, the framework has been applied to various studies (e.g. Renn et al. 1992; Rosa 2003) to help explain how risk signals, as received by various cultural groups, either get amplified, resulting in salient issues that receive more focused attention, or attenuated and placed at the peripheral margins of society.

Social Amplification of Risk Framework (SARF)

A run through the Social Amplification of Risk Framework with my findings is illustrated in Diagram #2. Using the announcement of high levels of nitrates (between 3 and 10 mg/L) detected in 11% of wells tested between 2000-2002 (DEQ 2004) as an

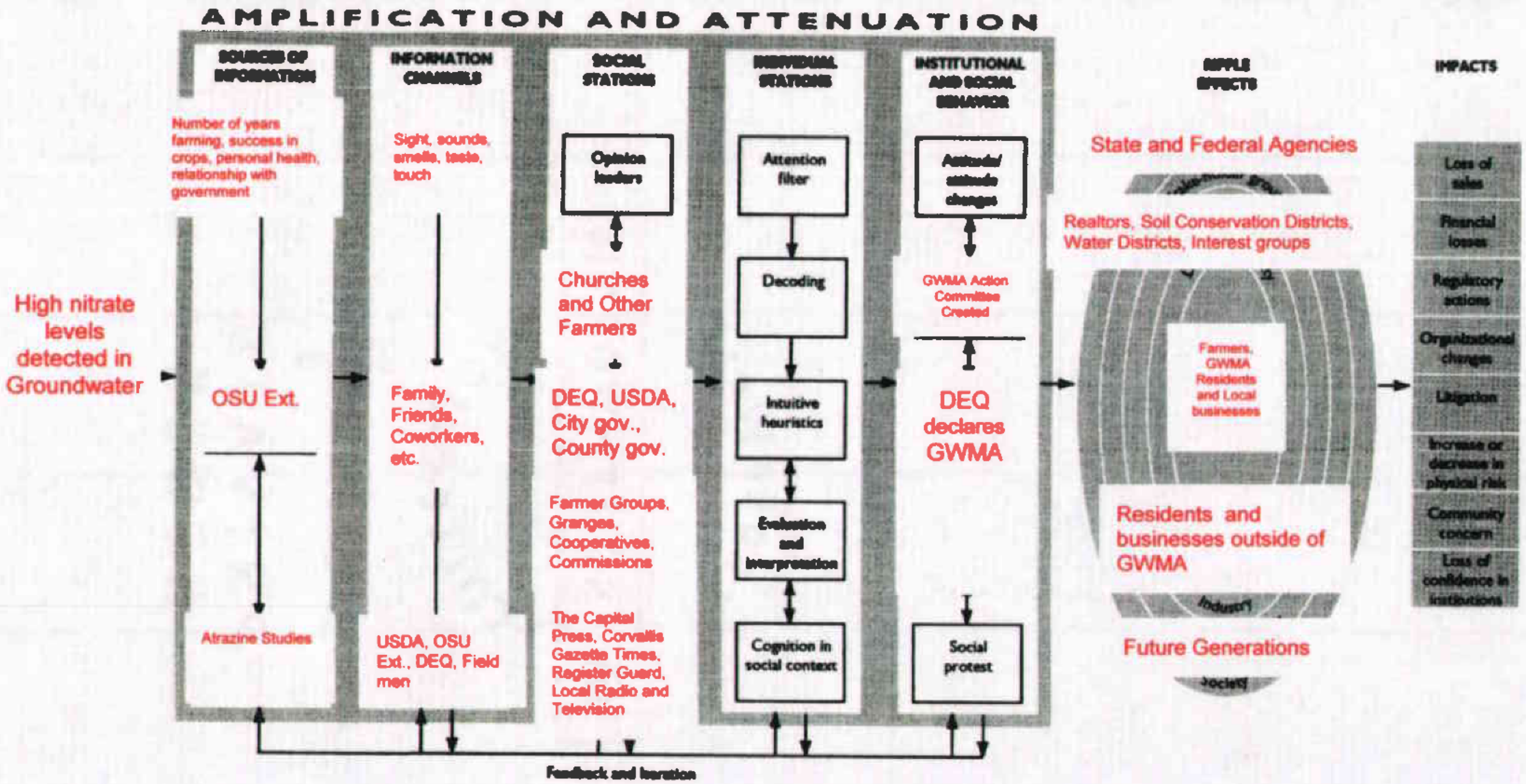

Diagram 2. Social Amplification of Risk Framework (Kasperson et al. 2003).

initial risk signal, it can be shown how this played out. *Sources of Information* includes farmers' personal experience (years farming, success of business, personal health, relationship with governmental agencies or as possible participants in water quality studies); and OSU Extension Service as a *Direct Communicator* to the local farmers. *Indirect Communication* can be seen from one of the interviews, as an informant mentioned that they had heard of Atrazine studies being conducted in the Midwest, where high levels of the pesticide were detected in water sources and agricultural activities were cited as one of the major causes. It can be assumed that Willamette Valley growers became aware of this issue and as expressed by my informant, began to wonder whether their farming practices may be having hidden impacts.

Information Channels includes *Individual Senses,* such as the judgments on the aesthetics of drinking water, i.e. sight, smell and taste*; Informal Social Networks,* such as family, friends and coworkers or any informal associations with fellow community members that farmers regularly communicate with; and *Professional Information Brokers* in this case would be USDA agents, OSU Extension Service, DEQ, and field men from local fertilizer companies. From these *Information Channels, Social and Individual Social Stations* were affected and include *Opinion Leaders*; *Cultural and Social Groups*, such as churches and other farmers; *Government Agencies* (DEQ, USDA, county and city governments); *Voluntary Organizations* (farmer groups, cooperatives, or commodity commissions); and *News Media* (*The Capital Press, The Corvallis Gazette Times,* Eugene's *Register Guard,* and various local radio and television stations).

Various messages from these stations were then interpreted *by Individual* and *Institutional and Social Behavior Stations*, and can be illustrated by responses in *Political and Social Action* (GWMA Action Committee creation) and *Organizational Responses* (DEQ declares GWMA). The resulting information flow from the initial stage creates secondary impacts, which may include:

- Enduring mental perceptions, images and attitudes;
- Impacts on the local or regional economy;
- Political and social pressure;
- Social disorder;
- Changes in risk monitoring and regulation;
- Increased liability and insurance costs;
- Repercussions on other technologies and on social institutions (Kasperson 1992:160).

In the secondary stage, *Ripple Effects,* the impacts suggested by Kasperson (1992) directly affect persons and organizations that are most closely associated with the risk signal. For example, farmers, other residents and businesses within the GWMA would be the first groups directly affected, followed by residents, farmers and businesses located just outside of the GWMA boundary. Afterwards, the ripples would spread out to reach interest groups, soil conservation districts, nongovernmental agencies representing local interests, water districts, and grassroots environmental organizations, to name a few. State and federal agencies, such as DEQ, ODA, OSU Extension Service, USDA, and EPA would then be influenced. The ripples would eventually have affects on future generations.

According to Kasperson (1992):

> *consequences* associated with a particular risk or risk event are (a) the direct effects that are normally treated in technical risk analysis, such as health effects, property damage, medical costs, and emergency response costs; and (b) the effects associated with the interaction of such harms with the social

> processing of the risk events, such as social stigmatization, group conflict, loss of sense of community, and social disruption (1992:161).

For example, land values could potentially be affected, as word of the GWMA spreads, not only affecting homeowners, but realtors who rely on commission of sales and who are responsible for disclosing whether the drinking water may be contaminated. Farmers could face having their products labeled in such a way that buyers could see that their products were produced in a GWMA, not only causing potential financial losses, but also further stigmatizing the communities within the GWMA boundaries. Reputations may become tarnished, as the levels of trust between farmers, buyers, and governmental agencies become more constrained.

As shown by my informants choosing to have their wells tested and responding by either using bottled water or relocating their wells, it can be said that the initial risk signal was amplified. Once the growers felt that their drinking water was safe, they began attenuating following risk signals. For example, the announcement of the GWMA in May 2004 did not cause the growers to amplify this signal, as they had already responded. One informant claimed that the news of the GWMA was late in coming:

Well, what they don't quite understand is that we knew it already before they even brought the subject up. It wasn't rocket science to us what happens. We've been soil testing on this farm for 10 years, so we knew exactly what was happening (Tim).

One specific question that I asked of all the growers was whether they had made any modifications in their fertilizer practices since the announcement of the GWMA. All of them indicated that they had not made changes due to the GWMA, however, they did indicate that they had already been making modifications to their practices, particularly fertilizer practices, mostly due to economic reasons rather than in response to this risk signal. In addition, the closing of the local cannery (Agripac) had more to do with crop changes (from row crops to grass seed) than any other risk signal.

The difficulty with using SARF is that risk signals can come in rapid succession, which complicates temporal issues. For example, once my informants became aware of elevated nitrates in their groundwater, which they use for drinking water, some took action by having their wells tested or by using bottled water. When the GWMA was announced, this signal appears to have been attenuated as farmers felt that they had already dealt with this issue. Furthermore, from their perspective, there are other nonpoint sources that need to be dealt with (e.g. leaky septic systems) that are outside of their scope of control. As these messages get reinterpreted, amplified or attenuated over a short period of time, it becomes difficult to separate out one risk signal from another and to explain it chronologically; risk signals tend to overlap and the lines between them become quite fuzzy.

I would argue, despite this difficulty, that this framework helps to explain how individuals as part of social organizations pay attention to specific risks or chose to ignore them. If placed on a continuum, with amplification and attenuation at opposite ends, I believe that varying levels of amplification and attenuation would be revealed, based upon one's self-interest and proximity to the risk. This can be seen in Douglas, Wildavsky and Dake's cultural patterns, where Individualistic social organizations place market demands as their top priority. I believe that these cultural patterns can give us a general idea of how a particular group of people may react to certain environmental risks, however, always problematic of generalizing, we risk losing sight of the overlapping that can take place between the cultural patterns. For example, farmer cooperatives is one overlapping tendency, where joining together in an egalitarian social organization is used to promote individualistic gains.

I do not see my informants as one-dimensional characters, rather they show particular patterns based on their economic endeavors, yet are still human beings, full of contradictions and complexities. They are not heartless or mindless, throwing all caution to the wind, but are caught between competing interests and as entrepreneurs, must make decisions that sometimes may cause them to question their convictions. However, decision-making processes are validated by one's social organization, showcasing cultural patterns and biases that may predict what choices will be made in the future, in this case, choices concerning risk perception, leading to action or inaction. How these choices are made is reflected in SARF, which may help predict the social impacts that result from such choices.

Chapter Seven

Conclusion and Recommendations

Agricultural practices incorporated new technologies over the last half of the 20th century, including the usage of chemical fertilizers in an effort to increase crop production, which has resulted in excess nitrogen, in the form of nitrates, to leach into underground aquifers. The level of nitrates in drinking water that has been shown to cause potential health affects is 10ppm, as stipulated by the EPA. Following Oregon Law ORS 468B.180, governmental agencies, such as the DEQ have stepped up efforts to curb nonpoint sources of water pollution by designating areas that have 70% of EPA's maximum containment level (10 mg/L) as Groundwater Management Areas and forming committees that represent local interests within the area to research and implement various programs and recommendations for reducing nitrates in the groundwater.

The GWMA action committee located in the southern Willamette Valley has been assigned the task of creating solutions for nitrate leaching into the groundwater. Because agricultural activities have been identified as one of the nonpoint sources of nitrate leaching, local growers were targeted as one of the communities-of-interest, whose activities have direct bearing on the issue at hand. In an effort to understand what farmers perceive as barriers or incentives in following best management practices related to water quality, as defined by OSU Extension Service, farmers were asked to participate in an anthropological study that would characterize their story for presentation to the GWMA action committee, and serve as the basis of my thesis.

Based on the information gathered in the interviews and using cultural theory to explain cultural biases and patterns, I see the farmers' social organization most closely associated with Douglas' Individualistic cultural pattern (1982). This pattern shows that market concerns dominate this group and is directly related to their perceptions of risk. From this standpoint, it can be said that any recommendations formulated by the GWMA action committee will need to be aware that economic concerns are of utmost importance to local farmers and any suggestions for change will need to be sensitive to their priorities. By understanding how this cultural pattern influences risk perceptions, the GWMA committee, along with other state and federal agencies, can begin to address communications based on this pattern.

In addition, growers themselves could use the results from this study to conceptualize their perceptions of risk, helping them to realize their role and whether they choose to amplify or attenuate risk signals. For example, having "hands on" experiences with chemical applications, such as fertilizer and pesticides, growers may be susceptible to downplaying risks that non-farmers may amplify. By recognizing their tendencies in relation to risk perceptions, growers may be compelled to reach outside of their commonly used information sources and become familiar with other media sources. This could potentially influence their decision-making processes. At the same time, farmers' practices should be relayed to the greater community, who may begin to understand the growers' trend towards precision agriculture (e.g. GPS monitoring).

Knowing that farmers use field men from fertilizer companies to inform their decision making also can serve as a communication bridge between OSU Extension

Service and fertilizer corporations, such as Wilbur-Ellis, SureCrop, Wilco and Simplot. If farmers are missing valuable information, such as how nitrate levels fluctuate seasonally, OSU Extension Service can provide this information more readily, possibly in conjunction with field representatives. Therefore, it is important that OSU Extension Service's publications reach their intended audience, ensuring that farmers are aware of the results from studies, and can also provide avenues for extension agents to retain regular contact with their associated growers.

Another recommendation that the GWMA committee is considering at this time is whether to use a recognition process that would validate the efforts of communities working on retaining or improving water quality. One such process, known as the "Groundwater Guardian," is currently supported by The Groundwater Foundation as a way of enabling communities to reach goals (Result Oriented Activities (ROS)) in water quality issues (The Groundwater Foundation 2000). For example, after discovering high nitrate levels in their groundwater source, the City of Chippewa Falls, Wisconsin accepted an out of court settlement with a local fertilizer cooperative for $525,000, and was able to invest in a nitrate filtration system for their drinking water system. As a Groundwater Guardian, the city implemented a plan to protect the cities' wells from contamination by identifying and inventorying potential contaminant sources and managing existing and potential sources (Nelson 2003). As the farming community achieves goals pertaining to protecting groundwater by monitoring nitrate leaching, a recognition program, such as the Groundwater Guardian, may circumvent potential stigmas that could have a direct impact on local communities and their businesses.

Frustrating the GWMA committee's recommendation process is the fact that eliminating nitrates from drinking water sources will be a long process. Even with the discovery and awareness of the level of nitrates, limiting the amount of any source of nitrogen leaching into the groundwater will be difficult. The risk signals from this problem will continue to reverberate throughout the local communities, eventually reaching the larger society, as the social amplification of risk framework illustrates. Risk perception can be very powerful and should not be underestimated, keeping in mind that "public perceptions of risk have been found to determine the priorities and legislative agendas of regulatory bodies" (e.g. EPA) (Slovic 1997:22).

At the time of this writing, the GWMA action committee has approved the last of the four subcommittees' action plans and is now in the process of determining measurements for the outcomes of the voluntary strategies, which is proving to be quite complicated. Questions that remain surround the topic of how to "measure" whether the action plan is working and which indicators to use. As the problem of eliminating or lowering nitrates in groundwater could take several generations, determining when and what to use as goalposts to resolving the issue is problematic: Will five years be sufficient in measuring for success? Or one hundred? Which wells will be measured? Will the nitrate level be averaged over time? The problem is far from being solved.

Another question that beleaguers the GWMA committee is funding. DEQ is currently the lead agency for the committee, but may not continue to be. Some committee members believe that OSU Extension Service would be a beneficial leading agency due to their connection with researchers and funding sources. Ultimately, the entire committee process could change depending on who the lead agency is and how they want the committee to continue.

Supported by governmental agencies, the GWMA committee represents local interests, both public and private. One important aspect of this diverse group of actors is its many voices, though potentially divergent, that represent various beliefs and values. As the GWMA committee considers various options for dealing with contaminated groundwater and chooses recommendations for action, the effectiveness of their plans will be reflected in culturally appropriate strategies, paying attention to the needs and wishes of the people living in the target area (Kottak 1999).

Limitations of the Study

One limitation to this study is the number of participants that were involved. This limitation is due to the number of potential participants that were involved in the PCAPS study (who were still farming) and their willingness to be included in my study. A more in-depth study would reach outside of the OSU Extension Service's list and into the grower community at large. The parameters of this study were decided by OSU Extension Service and their preference to interview growers that they had worked with in the past.

In addition, the timing of the study made it difficult to conduct multiple interviews with growers. Rather than starting the study in the late spring when growers are gearing up for the growing season, it would prove most beneficial to conduct such a study during the winter months, when growers can commit more time as study participants. Also, with the initial report due in June and the Institutional Review

Board (IRB) approval in late April, there was very little time to pursue a broader study.

Another limitation is the assumed biases of using participants known to have worked with OSU Extension Service in the past. Though it allows for understanding what these growers see as potential barriers to suggested BMPs, it does not represent growers who chose not to get involved in OSU studies. Assumptions can be made, however, that growers who do not work regularly with OSU may have even less knowledge on the nitrate leaching issue and therefore, may be unaware of recommended BMPs or of the health concerns related to consumption of drinking water with elevated nitrates.

Future Research

Future studies could incorporate random growers in an effort to expand what was learned from this study. By spending more time with growers, historical farm records could show changing practices over generations of each farm. Additionally, a health record could be created for each farmer's family as a way to document any trends in risk-related diseases.

Another study could focus primarily on the political actors involved. Political ecology could be used as a means of illustrating the power relationships that exist between agencies or between agencies and the committee members, as well as within the committee itself. My focus remained on the growers' perceptions, rather than the politics involved in the full committee or on the interests of the general public.

Also, research could revolve around the idea of the social organizations and the cultural patterns espoused by Douglas and Wildavsky (1982) and Dake (1992), particularly how these patterns are seen from a Hierarchical and/or an Egalitarian view. This could involve a comparative analysis of governmental agencies and grass roots organizations to see how their decision-making processes differ or how their perceptions of risk relate to each organization.

Bibliography

Agrawal, Arun.

2003 Sustainable Governance of Common-Pool Resources: Context, Methods, and Politics. *Annual Review of Anthropology.* 32: 243-62.

Almasri, Mohammad N., and Jagath J. Kaluarachchi.

2004 Assessment and Management of Long-Term Nitrate Pollution of Ground Water in Agriculture-Dominated Watersheds. *Journal of Hydrology.* 295: 225-245.

Alvira, Diana, Victor Cabrera, Sebastian Galindo, Solomon Haile, Kibiby Mtenga, Alfredo Rios, Nitesh Tripathi, and Jose A. Villagomez.

2003 *Nutrient Management in the Suwannee River Basin: Perceptions of Stakeholders.* http://72.14.203.104/search?q=cache:k6qw-ZruFUEJ:plaza.ufl.edu/vcabrera/files/sondeo.pdf+Victor+Cabrera+Nutrient+management&hl=en&gl=us&ct=clnk&cd=2. (21 August 2005).

Bennett, John W.

1973 Ecosystemic Effects of Extensive Agriculture. *Annual Review of Anthropology.* 2: 36-45.

Berkes, Fikret.

2005 Why Keep a Community-Based Focus in Times of Global Interactions? *Topics in Arctic Social Sciences.* 5:33-43.

Bernard, H. Russell.

2002 *Research Methods in Anthropology.* Third Edition. Walnut Creek: Altamira Press.

Bonanno, Alessandro and Douglas H. Constance

2003 The Global/Local Interface. In *Challenges for Rural America in the Twenty-first Century,* edited by David L. Brown and Louis E. Swanson. pp. 241-253. University Park: Pennsylvania State University Press.

Brun, Wibecke.

1994 Risk Perception: Main Issues, Approaches and Findings. In *Subjective Probability,* edited by G. Wright and P. Ayton. pp. 295-320. Chichester: John Wiley & Sons.

Buck, Susan J.

1989 Cultural Theory and Management of Common Property Resources. *Human Ecology.* 17(1): 101-116.

Burke, Byan E.

2001 Hardin Revisited: A Critical Look at Perception and the Logic of the Commons. *Human Ecology.* 29(4):449-476.

Buttel, Frederick H.

2003 Continuities and Disjunctures in the Transformation of the U.S. Agro-Food System. In *Challenges for Rural America in the Twenty-first Century,* edited by David L. Brown and Louis E. Swanson. pp. 177-188. University Park: Pennsylvania State University Press.177-188.

Causapé, J., and D. Quílez, and R. Aragués.

2004 Salt and Nitrate Concentrations in the Surface Waters of the CR-V Irrigation District (Bardenas I, Spain): Diagnosis and Prescriptions for Reducing Off-site Contamination. *Journal of Hydrology.* 295: 87-100.

Cutter, Susan L.

1993 *Living With Risk: The Geography of Technical Hazards.* London: Edward Arnold. 1-59.

Cvetkovich, George, and Timothy C. Earle.

1992 Environmental Hazards and the Public. *Journal of Social Issues.* 48 (4): 1-20.

Dake, Karl.

1992 Myths of Nature: Culture and the Social Construction of Risk. *Journal of Social Issues.* 48 (4): 21-37.

Davidson, Osha Gray.

1990 *Broken Heartland: The Rise of America's Rural Ghetto.* New York: The Free Press.

Department of Environmental Quality.

2006 Fact Sheet. Southern Willamette Valley Groundwater Management Area Declared. http://groundwater.oregonstate.edu/willamette. (1 November 2004).

2005 Groundwater Quality in Oregon. DEQ Report to the Legislature. www.deq.state.or.us/pubs/legislativepubs/2005Reports/groundwater.pdf. (15 October 2005).

2006 Chapter 468B — Water Quality. 2003 Edition. http://landru.leg.state.or.us/ors/468b.html. (15 March 2006).

Douglas, Mary and Aaron Wildavsky.

1982 *Risk and Culture: An Essay on the Selection of Technical and Environmental Dangers.* Berkeley: University of California Press.

Edel, Matthew.

1973 *Economies and the Environment.* Englewood Cliffs: Prentice-Hall.

Eiser, J. Richard.

2001 Attitudes, Decisions and Perceptions of Risk: A Social Psychological Analysis. In *Environmental Risks: Perception, Evaluation and Management,* edited by Gisela Böhm, Josef Nerb, Timothy McDaniels and Hans Spada, pp. 109-135. Amsterdam: Elsevier Science.

Feaga, J., R. Dick, M. Louie, J. Selker.

2004 Nitrates and Groundwater: Why Should We Be Concerned With Our Current Fertilizer Practices? *Oregon State University Agricultural Experiment Station.* Special Report 1050.

2004 Field Measurements of Nitrate Leaching Below Willamette Valley Row and Mint Crops. *Oregon State University, Agricultural Experiment Station.*

Gardner, Kristin K., and Richard M. Vogel.

2005 Predicting Ground Water Nitrate Concentration from Land Use. *Ground Water.* May-June 43(3): 343-352.

The Groundwater Foundation.

2006 Guide to Groundwater Guardian. The Groundwater Foundation. http://www.groundwater.org/gg/guide.html. (20 March 2006).

Hardin, Garrett.

1968 The Tragedy of the Commons. *Science.* 162(3859): 1243-1248.

Hinkle, S. R.

1997 Quality of Shallow Groundwater in Alluvial Aquifers of the Willamette Basin, Oregon, 1993-95. U. S. Geological Survey Water Resources Investigations Report 97-4082-B. http://oregon.usgs.gov/pubs_dir/Pdf/97-4082b.pdf. (15 October 2005).

Hobbs, Daryl.

1995 Social Organization in the Countryside. In *The Changing American Countryside: Rural People and Places,* edited by Emery N. Castle, pp. 369-396. University Press of Kansas.

Jackson-Smith, Douglas B.

2003 Transforming Rural America: The Challenges of Land Use Change in the Twenty-First Century. In *Challenges for Rural America in the Twenty-first Century.* Edited by David L. Brown and Louis E. Swanson. pp. 305-312. University Park: Pennsylvania State University Press.

Jacobs, James A.

1990 *Fruit and Vegetable Cooperatives.* Rural Cooperative Publications. United States Department of Agriculture. http://www.rurdev.usda.gov/rbs/pub/cir113.pdf. (15 October 2005).

Johnson, Scott L., Richard M. Adams and Gregory M. Perry.

1991 The On-Farm Costs of Reducing Groundwater Pollution. *American Agricultural Economics Association.* Nov. 1991: 1063-1073.

Kasperson, Jeanne X., Roger E. Kasperson, Nick Pidgeon, and Paul Slovic.

2003 The Social Amplification of Risk: Assessing Fifteen Years of Research and Theory. In *The Social Amplification of Risk,* edited by Nick Pidgeon, Roger E. Kasperson, and Paul Slovic, pp. 13-46. Cambridge: University Press.

Kasperson, Roger E.

1992 The Social Amplification of Risk: Progress in Developing an Integrative Framework. In *Social Theories of Risk,* edited by Sheldon Krimsky and Dominic Golding, pp. 153-178. Westport: Praeger.

Kasperson, Roger E., Otwin Renn, Paul Slovic, Halina S. Brown, Jacque Emel, Robert Goble, Jeanne X. Kasperson, and Samuel Ratick.

1988 The Social Amplification of Risk: A Conceptual Framework. *Risk Analysis.* 2: 177-187.

Kempton, Willett, and James S. Boster and Jennifer A. Hartley.

1995 *Environmental Values in American Culture.* Cambridge: The MIT Press.

Kirkendall, Richard S.

1996 The State and the Corporation in the Shaping of the Rural West. In *The Changing American Countryside: Past, Present and Future,* edited by Emery Castle and Barbara Baldwin, pp. 99-105. Conference Papers Nov 30- Dec 1, 1995. Western Rural Development Center: OSU.

Kottak, Conrad P.

1999 The New Ecological Anthropology. *American Anthropologist.* 101(1): 23-35.

Little, Paul E.

1999 Environments and Environmentalisms in Anthropological Research: Facing a New Millennium. *Annual Review of Anthropology.* (28): 253-84.

Martinis, Cheryl.

2001 Oregon Farmers Hurt by Closure of Frozen Foods Plant in Woodburn. *The Oregonian.* April 27.

McGee, R. Jon and Richard L. Warms.

2004 *Anthropological Theory: An Introductory History.* 3rd Ed. Boston: McGraw Hill.

McMichael, Philip.

2003 The Impact of Global Economic Practices on American Farming. In *Challenges for Rural America in the Twenty-first Century,* edited by David L. Brown and Louis E. Swanson. pp. 400-423. University Park: Pennsylvania State University Press.

Morgan, M. Granger and Baruch Fischhoff, Ann Bostrom, Lester Lave, and Cynthia J. Atman.

1992 Communicating Risk to the Public: First, Learn What People Know and Believe. *Environment, Science, and Technology.* 26 (4): 2048-2056.

National Research Council.

1996 *Understanding Risk: Informing Decisions in a Democratic Society.* Washington, D.C.: National Academy Press. 1-10.

Nelson, Jennifer.

2005 An Ounce of Prevention: The City of Chippewa Falls, Wisconsin. Reprinted from *The Aquifer.* Fall 2003.18 (2): 1.

Oakerson, Ronald J.

1995 Structures and Patterns of Rural Governance. In *The Changing American Countryside: Rural People and Places,* edited by Emery N. Castle, pp. 397-418. University Press of Kansas.

Oregon Department of Human Services.

2006 Health Effects Information: Nitrate. http://groundwater.oregonstate.edu/willamette. (1 November 2004).

Porter, Philip W.

1965 Environmental Potentials and Economic Opportunities—A Background for Cultural Adaptation. *American Anthropologist.* 67:4 09-420.

Puntenney, Pamela J.

1995 Solving the Environmental Equation: An Engaging Anthropology. *National Association for the Practice of Anthropology Bulletin.* 15(1): 4-18.

Renn, Ortwin, and William J. Burns, Jeanne X. Kasperson, Roger E. Kasperson, and Paul Slovic.

1992 The Social Amplification of Risk: Theoretical Foundations and Empirical Applications. *Journal of Social Issues.* 48 (4): 137-160.

Robbins, William G.

1997 *Landscapes of Promise: The Oregon Story, 1800-1940.* Seattle: University of Washington Press.

2004 *Landscape of Conflict: The Oregon Story, 1940-2000.* Seattle: University of Washington Press.

Rosa, Eugene A.

2003 The Logical Structure of the Social Amplification of Risk Framework (SARF): *Meta*theoretical Foundations and Policy Implications. In *The Social Amplification of Risk,* edited by Nick Pidgeon, Roger E. Kasperson, and Paul Slovic, pp. 47-79. Cambridge: University Press.

Russo, Ed.

2001 Eugene, Oregon, Farmers Co-op Closes Amid Losses. *TheRegister Guard.* November 23.

Schilling, Keith and You-Kuan Zhang.

2004 Baseflow Contribution to Nitrate-Nitrogen Export From a Large, Agricultural Watershed, USA. *Journal of Hydrology.* 295: 305-316.

Selker, John and D. Rupp.

2004 Groundwater and Nitrogen Management in Willamette Valley Mint Production. *Oregon State University Extension Service.* Publication EM 8861.

Slovic, Paul.

1997 Public Perception of Risk. *Journal of Environmental Health.* 59(9): 22-24.

1987 Perception of Risk. *Science.* 236 (4799): 280-285.

Southern Willamette Valley Groundwater Management Area.

2006 What This Is All About. http://groundwater.oregonstate.edu/willamette/. (20 March 2006).

Starrs, Paul F.

1996 The Nature of the Present-Day American West. In *The Changing American Countryside: Past, Present and Future,* edited by Emery Castle and Barbara Baldwin, pp. 107-114. Conference Papers Nov 30- Dec 1, 1995. Western Rural Development Center: OSU.

SWiG Update.

May 2003 Southern Willamette Groundwater Project. http://groundwater.oregonstate.edu/willamette. (1 November 2004).

United States Environmental Protection Agency.

2006 Consumer Factsheet on: Nitrates/Nitrites. http://www.epa.gov/ogwdw000/dwh/c-ioc/nitrates.html. (20 March 2006).

Vayda, Andrew P., and Bonnie J. McCay.

1975 New Directions in Ecology and Ecological Anthropology. *Annual Review of Anthropology.* (4): 293-306.

Washington State Department of Agriculture Seed Program.

2006 AgriBio Tech Creditors Awarded US$14.87 Million Against Former CEO, Loan Entity, Reports Diamond McCarthy Taylor Finley Bryant & Lee, LLP. http://agr.wa.gov/Inspection/SeedInspection/docs/SeedWise.pdf. (15 October 2005).

Wildavsky, Aaron, and Karl Dake.

1990 Theories of Risk Perception: Who Fears What and Why? *Daedalus.* 119 (4): 41-60.

Wolfe, Sean.

2005 Ruling Won't Undo Harm to Grass Seed Farmers. *Albany Democrat-Herald*. February 1, 2005. http://www.dhonline.com/articles/2005/02/01/news/local/news04.txt. (17 November 2005).

Young, John A.

1982 Productive Efficiency and the Adaptations of Small-Scale Farmers. *Human Organization.* 41 (3): 208-215.

Zweers, Will and Jan J. Boersema.

1994 *Ecology, Technology and Culture.* Cambridge: The White Horse Press.

Appendices

Appendix A

Region 3: Profile Mid/Southern Willamette Valley

Population and Demographics

In 2000, the population of the South/Central Willamette region was 927,883, representing an increase of 19% during the last decade. This rapid growth is projected to continue by approximately 15% at a rate of 1.9% per year over the next 20 years according to the Oregon Office of Economic Analysis.

Table 1. South/Central Willamette Region Population Growth

County	1990 Population	2000 Population	% Change 1990-2000
Benton	70,811	78,153	10%
Lane*	272,669	309,659	12%
Linn	91,227	103,069	13%
Marion	228,483	284,834	25%
Polk	49,541	62,380	26%
Yamhill	65,551	84,992	30%
Total:	**778,282**	**923,087**	**19%**

*These figures do not include the coastal area (see Region 1). Source: U.S. Bureau of the Census, 1990 and 2000 Redistricting Data.

According to Table 1 above, the largest growth has occurred in the three most northern counties that border the Portland Metropolitan area (average of 29%). This current growth pattern (both urban and rural) impacts how agencies prepare for emergencies as changes in the population and development can increase risks associated with hazards. Table 2 illustrates the populations living in incorporated and unincorporated areas of these counties.

Table 2. Urban/Rural Populations

County	Incorporated	Unincorporated
Benton	59,407	18,746
Lane*	215,507	94,152
Linn	66,850	36,219
Marion	205,102	79,732
Polk	45,801	16,579
Yamhill	60,350	24,642
Total:	**653,017**	**274,866**

*These figures do not include the coastal areas. Source: U.S. Bureau of the Census, 1990 and 2000 Redistricting Data.

Appendix B

Groundwater Management Area Action Committee Members

Elected Officials

Cliff Wooten, Linn County Commissioner
Linn County Courthouse
PO Box 100
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Agricultural Working Group

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(sharing committee position)
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Public Drinking Water Working Group

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Public Drinking Water Working Group

COMMITTEE VICE-CHAIR

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Residential Working Group

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Business

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Agriculture

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Agricultural Working Group
Farmer/Agribusiness
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Other

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Residential Working Group

Appendix C

Value of Oregon agriculture: Crop production, 2004

Crop	Acres	Production	Value
Field crops			
Barley	66,000	4,818,000 bu	$8,672,000
Corn, grain	28,000	4,760,000 bu	$12,852,000
Corn, silage	30,000	750,000 tons	$17,678,000
Hay, alfalfa	480,000	2,064,000 tons	$231,168,000
Hay, all other	650,000	1,560,000 tons	$150,540,000
Hops	5,107	8,612,000 lbs	$19,894,000
Oats	20,000	2,000,000 bu	$3,600,000
Peppermint	23,500	2,115,000 lbs	$27,918,000
Potatoes	37,000	19,775,000 cwt	$91,587,000
Sugarbeets	12,600	396,000 tons	$14,216,000
Wheat, all	955,000	55,980,000 bu	$201,669,000
Seed crops			
Alfalfa seed	5,680	3,605,000 lbs	$4,154,000
Bentgrass seed	7,870	4,273,000 lbs	$10,204,000
Bluegrass seed	20,100	17,975,000 lbs	$15,275,000
Fescue seed	155,360	233,991,000 lbs	$92,480,000
Ryegrass seed			
Annual	124,890	254,051,000 lbs	$50,810,000
Perennial	177,630	257,208,000 lbs	$153,767,000
Fruits and nuts			
Apples	6,500	80,000 tons	$26,057,000
Blackberries	6,300	46,900,000 lbs	$33,407,000
Blueberries	3,500	34,000,000 lbs	$27,418,000
Cherries, sweet	12,000	42,000 tons	$48,380,000
Cranberries	2,900	495,000 bbls	$17,383,000
Grapes for wine	11,100	19,400 tons	$32,204,000
Hazelnuts	28,600	36,800 tons	$52,992,000
Peaches	800	3,200 tons	$2,774,000
Pears, Bartlett	4,400	61,000 tons	$21,025,000
Pears, other	13,000	149,000 tons	$55,678,000
Prunes and plums	1,900	7,500 tons	$2,637,000
Raspberries, red	1,900	6,700,000 lbs	$5,763,000
Strawberries	2,400	32,400,000 lbs	$15,839,000
Vegetables			
Beans, snap (proc.)	17,800	115,320 tons	$20,655,000
Corn, sweet (all)	33,200	260,333 tons	$28,165,000
Onions	18,500	12,876,000 cwt	$74,396,000
Peas, green	16,700	41,400 tons	$7,774,000

County gross farm and ranch sales, 2004

Rank	County	Dollars
1	Marion	$518,728,000
2	Clackamas	$354,299,000
3	Washington	$252,378,000
4	Yamhill	$242,662,000
5	Umatilla	$235,784,000
6	Linn	$230,212,000
7	Morrow	$212,465,000
8	Klamath	$182,779,000
9	Malheur	$171,623,000
10	Polk	$124,434,000
11	Lane	$119,201,000
12	Benton	$106,500,000
13	Tillamook	$100,085,000
14	Multnomah	$75,872,000
15	Jackson	$75,072,000
16	Douglas	$67,736,000
17	Hood River	$66,282,000
18	Harney	$60,617,000
19	Wasco	$60,038,000
20	Baker	$53,405,000
21	Lake	$53,236,000
22	Jefferson	$49,622,000
23	Union	$47,308,000
24	Coos	$46,570,000
25	Crook	$43,158,000
26	Wallowa	$41,474,000
27	Grant	$29,359,000
28	Josephine	$27,792,000
29	Columbia	$26,231,000
30	Sherman	$24,964,000
31	Gilliam	$24,741,000
32	Deschutes	$24,520,000
33	Curry	$23,002,000
34	Lincoln	$11,353,000
35	Clatsop	$9,743,000
36	Wheeler	$6,530,000

Contains Recycled Materials

Value of Oregon agricultural exports, 2004

Commodity	Value
Wheat and products	$171,419,000
Vegetables and preparations	$158,300,000
Seeds	$111,200,000
Fruits and preparations	$106,400,000
Nursery products	$35,484,000
Tree nuts	$31,234,000
Dairy products	$17,600,000
Christmas trees	$14,520,000
Hides and skins	$12,500,000
Feed and fodders	$12,100,000
Live animals and red meat	$5,700,000
Feed, grain and products	$5,400,000
Poultry and products	$2,200,000

Oregon commercial fish landings, 2004

Type of fishery	Pounds	Value
Crab	27,269,808	$42,844,000
Groundfish	25,596,901	$16,315,000
Salmon	5,922,086	$12,954,000
Tuna	10,594,609	$9,003,000
Shrimp	12,206,890	$4,740,000
Whiting	130,238,044	$4,488,000
Other	82,291,437	$7,006,000
Total	294,119,775	$97,350,000

Oregon's record high production years 1980-2004

Crop	Amount	Unit	Year
Apples	102,500	tons	1987
Barley	20,805,000	bu	1986
Bartlett pears	85,000	tons	1981
Hay	3,624,000	tons	2004
Hazelnuts	49,500	tons	2001
Onions	12,876,000	cwt	2004
Potatoes	30,683,000	cwt	2000
Prunes and plums	33,000	tons	1980
Ryegrass, ann.	266,460,000	lbs	1999
Snap beans	173,990	tons	1989
Strawberries	1,014,000	cwt	1988
Sweet cherries	60,000	tons	1988
Sweet corn, proc.	452,330	tons	1995
Wheat	77,400,000	bu	1980

OREGON AGRICULTURE: FACTS AND FIGURES

The value of Oregon's 2004 agriculture was just over $4.1 billion. Production value of cattle, milk, and grass seed increased sharply. It was a record year for hay and onion production. Oregon farmers and ranchers raised more than 220 other commodities as well.

Information furnished by the Oregon Agricultural Statistics Service, Janice A. Goodwin, State Statistician and Oregon State University Extension Service

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Oregon farms, 2004

Number of farms	40,000
Land in farms (acres)	17,200,000
Average farm size (acres)	430
Value per acre (dollars)	$1,250

Operations

Size of operation (acres)	Percent of total farms
1-9	23.4%
10-49	39.0%
50-179	18.8%
180-499	8.5%
500-999	3.9%
1000-1999	2.5%
2000 or more	3.9%

By type	Percent
Individual	88.4%
Partnership	5.7%
Incorporated	5.2%
Other (cooperative, estate/trust, institutional)	0.8%

Age of operator	Percent of operations
Under 25	0.5%
25-34	4.4%
35-44	14.4%
45-54	26.6%
55-64	24.9%
65 and over	29.2%

Average age = 54.9

Oregon's top 40 commodities

Rank	Commodity	Value
1	Greenhouse and nursery products	$817,608,000
2	Cattle and calves	$503,469,000
3	Hay, all	$381,708,000
4	Milk, all	$363,200,000
5	Grass seed, all	$350,783,000
6	Wheat, all	$201,669,000
7	Christmas trees	$142,626,000
8	Potatoes, all	$91,587,000
9	Pears, all	$76,703,000
10	Onions, all	$74,396,000
11	Hazelnuts	$52,992,000
12	Cherries, all	$49,819,000
13	Eggs	$47,233,000
14	Crab landings, all	$42,844,000
15	Blackberries	$33,407,000
16	Grapes	$32,204,000
17	Corn, grain and silage field	$30,530,000
18	Mint for oil	$29,948,000
19	Sweet corn	$28,165,000
20	Grass and grain straw	$27,543,000
21	Blueberries	$27,418,000
22	Apples	$26,057,000
23	Horses	$25,996,000
24	Snap beans, processing	$20,655,000
25	Hops	$19,894,000
26	Cranberries	$17,383,000
27	Ground fish landings, all	$16,315,000
28	Strawberries	$15,839,000
29	Sugarbeets	$14,216,000
30	Hay silage	$14,105,000
31	Vegetable and flower seed	$13,478,000
32	Squash and pumpkins	$13,403,000
33	Salmon	$12,954,000
34	Tomatoes	$11,666,000
35	Raspberries	$10,715,000
36	Sheep and lambs	$10,207,000
37	Tuna, albacore landings	$9,003,000
38	Barley	$8,672,000
39	Mink	$8,117,000
40	Green peas, processing	$7,774,000

2004 national ranking of Oregon agricultural production

Commodity	Rank	% of U.S.
Blackberries	1	100%
Hazelnuts	1	100%
Loganberries	1	100%
Raspberries, black	1	100%
Ryegrass seed	1	99%
Orchardgrass seed	1	97%
Sugarbeets for seed	1	92%
Crimson clover	1	87%
Fescue seed	1	75%
Boysen and youngberries	1	62%
Red clover seed	1	49%
Dungeness crab	1	38%
Potted florist azaleas	1	37%
Christmas trees	1	31%
Herbs dried	1	8%
Peppermint	2	30%
Onions	2	16%
Hops	2	16%
Snap beans, processing	2	14%
Spearmint	2	12%
Raspberries, red	2	10%
Prunes and plums	2	2%
Pears	3	24%
Kentucky bluegrass seed	3	21%
Sweet cherries	3	15%
Blueberries	3	12%
Nursery crops	3	11%
Mink pelts produced	3	10%
Austrian winter peas	3	9%
Cranberries	3	8%
Strawberries	3	1%
Green peas, processing	4	11%
Sweet corn, processing	4	9%
Potatoes, all	4	4%
Wine grapes	5	1%

Oregon's top producing counties, 2004

Greenhouse and nursery	Gross sales
Clackamas	$186,710,000
Marion	$186,110,000
Washington	$153,495,000
Yamhill	$113,480,000
Multnomah	$53,330,000

Cattle and calves	Number
Malheur	215,000
Harney	114,000
Morrow	100,000
Baker	97,000
Klamath	96,000

Hay	Tons
Klamath	420,900
Lake	414,000
Malheur	352,000
Harney	288,000
Umatilla	285,400

Caneberries	Gross sales
Marion	$25,261,000
Clackamas	$14,119,000
Washington	$8,816,000
Yamhill	$3,797,000
Multnomah	$3,269,000

Potatoes	Cwt
Morrow	9,000,000
Umatilla	7,500,000
Klamath	3,060,000
Malheur	2,132,000

Wheat	Bushels
Umatilla	19,578,000
Morrow	6,028,500
Sherman	5,874,000
Malheur	4,623,500
Gilliam	3,806,000

Pears	Tons
Hood River	172,544
Jackson	84,425
Wasco	6,495
Marion	1,212
Josephine	1,125

Wine grapes	Tons
Yamhill	5,652
Polk	3,079
Washington	2,510
Jackson	2,079
Marion	1,310

Appendix D

Table 39. Fertilizers and Chemicals Applied: 2002 and 1997

[Data are based on a sample of farms. For meaning of abbreviations and symbols, see introductory text]

Item	United States	Alabama	Alaska	Arizona	Arkansas	California
Commercial fertilizer, lime, and soil conditioners [1] .... farms, 2002	1,078,435	20,794	291	2,674	22,109	47,029
1997	1,293,513	29,890	344	2,821	26,703	48,240
acres treated, 2002	248,060,293	2,131,242	27,256	804,352	6,163,706	7,858,818
1997	244,030,565	2,478,843	31,130	872,537	6,113,828	7,326,319
Cropland fertilized, except cropland pastured ...... farms, 2002	894,260	10,323	276	2,423	13,990	45,321
1997	1,104,096	16,840	330	2,529	17,499	44,598
acres treated, 2002	224,080,451	1,329,319	25,097	796,477	5,215,080	7,728,457
1997	225,094,355	1,619,886	29,345	860,501	5,318,250	7,198,921
Pastureland and rangeland fertilized .... farms, 2002	361,145	14,579	56	379	12,291	2,626
1997	343,065	17,402	52	430	12,013	2,242
acres treated, 2002	23,979,842	801,923	2,159	7,875	948,626	130,361
1997	18,936,210	858,957	1,785	12,036	795,578	127,398
Manure .... farms, 2002	347,585	5,574	70	745	7,218	7,436
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	22,749,251	403,936	1,547	91,978	610,094	725,529
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control- insects [2] .... farms, 2002	357,274	4,597	28	1,540	4,770	33,340
1997	391,866	4,374	52	1,495	3,929	30,460
acres treated, 2002	65,697,023	695,992	495	589,093	2,073,357	5,522,671
1997	64,843,633	875,523	712	663,277	1,562,934	5,543,207
Weeds, grass, or brush .... farms, 2002	708,252	11,122	64	1,416	13,710	33,139
1997	733,799	10,015	101	1,348	13,459	31,477
acres treated, 2002	193,968,317	1,257,946	6,294	513,462	5,172,219	5,343,829
1997	191,923,447	1,307,106	12,988	523,050	5,453,554	5,079,329
Nematodes .... farms, 2002	36,877	776	2	89	432	3,479
1997	46,065	1,319	1	136	726	3,785
acres treated, 2002	5,936,346	185,072	(D)	28,776	223,251	365,616
1997	6,870,740	236,617	(D)	48,941	350,722	471,321
Diseases in crops and orchards .... farms, 2002	92,334	1,455	1	290	1,504	17,349
1997	123,839	2,249	10	212	2,107	17,502
acres treated, 2002	12,392,362	157,800	(D)	57,063	610,344	2,163,639
1997	14,097,914	257,409	86	58,947	697,693	2,020,484
Chemicals used to control growth, thin fruit, or defoliate .... farms, 2002	44,725	896	2	307	1,121	6,043
1997	56,191	1,207	4	510	1,722	5,569
acres on which used, 2002	10,874,350	374,503	(D)	162,112	869,072	995,403
1997	12,364,587	337,935	78	269,813	911,522	1,209,011

Item	Colorado	Connecticut	Delaware	Florida	Georgia	Hawaii
Commercial fertilizer, lime, and soil conditioners [1] .... farms, 2002	10,017	1,978	1,240	23,375	23,456	4,042
1997	12,801	2,586	1,457	26,946	27,197	3,974
acres treated, 2002	3,519,111	99,981	406,936	3,039,792	3,182,450	127,996
1997	4,224,734	93,617	372,622	2,966,255	3,771,829	133,927
Cropland fertilized, except cropland pastured ...... farms, 2002	9,136	1,820	1,202	17,128	14,056	3,941
1997	11,887	2,496	1,406	20,511	16,828	3,900
acres treated, 2002	3,451,201	93,310	403,595	2,118,739	2,583,641	116,609
1997	4,150,472	88,753	370,952	2,247,247	3,236,094	130,257
Pastureland and rangeland fertilized .... farms, 2002	1,533	469	179	8,442	13,338	134
1997	1,481	376	134	8,518	11,952	105
acres treated, 2002	67,910	6,671	3,341	921,063	596,836	11,387
1997	74,262	4,864	1,670	719,006	533,735	3,660
Manure .... farms, 2002	3,626	1,141	695	2,477	6,524	730
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	220,736	42,632	84,903	175,125	408,867	3,812
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control- insects [2] .... farms, 2002	3,766	734	530	13,203	9,056	1,840
1997	5,448	912	603	11,911	8,987	1,604
acres treated, 2002	851,005	28,080	149,822	1,784,261	1,830,739	41,616
1997	1,621,901	26,380	141,822	1,618,850	2,098,544	34,673
Weeds, grass, or brush .... farms, 2002	7,356	856	1,076	14,906	13,513	2,820
1997	7,806	1,036	1,123	11,789	11,853	2,685
acres treated, 2002	2,721,058	45,128	333,103	2,007,823	2,196,073	101,258
1997	2,425,333	48,214	351,075	1,506,834	2,102,575	122,576
Nematodes .... farms, 2002	230	64	32	2,946	1,972	275
1997	374	64	81	2,364	2,609	350
acres treated, 2002	48,968	2,076	(D)	341,080	451,632	8,169
1997	50,759	3,166	18,166	291,986	494,576	11,086
Diseases in crops and orchards .... farms, 2002	684	415	188	8,215	2,825	800
1997	1,249	487	207	8,049	4,218	1,033
acres treated, 2002	106,349	15,221	20,608	1,181,175	499,949	30,824
1997	204,512	12,734	29,227	1,044,477	589,008	33,343
Chemicals used to control growth, thin fruit, or defoliate .... farms, 2002	270	89	34	1,287	1,991	216
1997	371	99	42	1,117	2,826	184
acres on which used, 2002	53,911	1,468	3,632	205,921	729,171	26,378
1997	104,054	2,699	10,374	118,899	806,250	15,184

See footnote(s) at end of table.

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Table 39. **Fertilizers and Chemicals Applied: 2002 and 1997** - Con.

[Data are based on a sample of farms. For meaning of abbreviations and symbols, see introductory text]

Item	Idaho	Illinois	Indiana	Iowa	Kansas	Kentucky
Commercial fertilizer, lime, and soil conditioners [1] ..... farms, 2002	9,772	48,390	34,165	56,912	37,497	49,358
1997	12,161	57,884	44,716	67,510	43,746	67,976
acres treated, 2002	3,549,336	16,782,432	9,117,243	16,295,095	18,108,114	3,995,943
1997	3,632,458	15,552,028	9,238,553	15,153,429	17,437,467	3,975,148
Cropland fertilized, except cropland pastured ..... farms, 2002	8,562	47,209	32,332	55,204	33,682	41,923
1997	11,216	56,146	42,845	65,609	40,136	62,024
acres treated, 2002	3,429,696	16,545,246	8,960,114	15,667,911	16,781,674	2,986,164
1997	3,541,325	15,323,488	9,056,283	14,551,870	16,717,947	3,083,795
Pastureland and rangeland fertilized ..... farms, 2002	2,933	5,812	6,332	8,953	9,712	21,797
1997	2,412	5,781	6,506	9,369	8,175	20,407
acres treated, 2002	119,640	237,186	157,129	627,184	1,326,440	1,009,779
1997	91,133	228,540	182,270	601,559	719,520	891,353
Manure ..... farms, 2002	3,902	13,187	14,236	26,512	5,881	10,769
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	281,136	756,625	696,485	2,333,984	540,838	364,471
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control- Insects [2] ..... farms, 2002	3,333	24,773	12,372	20,331	8,944	17,396
1997	3,878	26,996	14,754	25,613	9,509	26,389
acres treated, 2002	989,857	5,848,946	2,579,182	3,714,004	2,175,534	694,573
1997	1,017,229	4,794,349	2,254,308	3,372,025	2,637,425	789,618
Weeds, grass, or brush ..... farms, 2002	9,078	40,212	25,540	46,334	24,597	19,179
1997	9,340	44,650	30,515	55,600	29,054	18,858
acres treated, 2002	2,539,472	18,112,970	8,632,117	16,716,673	10,303,445	1,957,109
1997	2,605,511	16,354,567	8,670,757	17,526,559	10,506,603	2,168,629
Nematodes ..... farms, 2002	577	1,827	1,031	1,762	362	737
1997	812	1,801	1,174	1,440	481	1,803
acres treated, 2002	243,399	284,103	145,579	292,947	64,586	25,778
1997	197,693	230,960	139,991	180,135	112,086	43,756
Diseases in crops and orchards ..... farms, 2002	978	1,425	1,113	834	548	4,011
1997	1,603	1,899	1,894	1,186	692	9,430
acres treated, 2002	387,232	126,617	95,256	113,930	71,114	89,983
1997	476,262	197,090	146,112	137,737	153,056	174,751
Chemicals used to control growth, thin fruit, or defoliate ..... farms, 2002	532	332	313	190	432	2,127
1997	978	1,289	1,098	48	676	3,270
acres on which used, 2002	183,835	48,277	8,074	3,196	94,612	32,880
1997	247,146	311,612	132,255	1,850	160,951	86,227

Item	Louisiana	Maine	Maryland	Massachusetts	Michigan	Minnesota
Commercial fertilizer, lime, and soil conditioners [1] ..... farms, 2002	13,836	3,053	6,537	2,945	25,388	40,541
1997	17,436	3,463	7,947	4,177	32,662	49,204
acres treated, 2002	3,018,494	239,758	1,059,252	107,375	5,478,283	13,506,782
1997	3,113,713	252,455	1,135,051	122,163	5,902,896	13,375,189
Cropland fertilized, except cropland pastured ..... farms, 2002	8,331	2,824	5,904	2,671	24,450	39,644
1997	11,286	3,276	7,480	3,967	32,027	48,529
acres treated, 2002	2,604,749	230,385	1,003,516	99,678	5,423,039	13,390,425
1997	2,771,342	242,627	1,102,124	113,700	5,849,145	13,283,230
Pastureland and rangeland fertilized ..... farms, 2002	7,017	574	2,024	554	2,920	3,173
1997	7,712	452	1,500	538	2,456	2,577
acres treated, 2002	413,745	9,373	55,736	7,697	53,244	116,357
1997	342,371	9,828	32,927	8,463	53,753	91,939
Manure ..... farms, 2002	1,139	1,928	3,485	1,498	11,955	22,288
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	63,717	95,447	251,097	29,537	700,621	1,864,031
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control- Insects [2] ..... farms, 2002	5,217	1,356	2,391	1,464	8,314	8,694
1997	6,320	1,668	2,993	2,009	10,635	9,662
acres treated, 2002	2,143,485	132,868	297,784	42,128	990,827	1,634,613
1997	2,047,916	118,274	319,580	42,056	1,304,182	1,533,162
Weeds, grass, or brush ..... farms, 2002	8,484	1,203	4,285	1,301	18,709	31,615
1997	7,800	1,683	5,173	1,615	22,149	38,509
acres treated, 2002	2,701,578	164,738	726,366	45,942	4,367,194	11,820,351
1997	2,806,889	157,661	906,098	50,679	4,535,954	13,748,064
Nematodes ..... farms, 2002	531	114	220	186	971	861
1997	645	104	267	230	1,067	787
acres treated, 2002	165,910	7,754	21,509	4,664	86,159	166,242
1997	235,410	5,015	30,560	4,616	123,935	111,463
Diseases in crops and orchards ..... farms, 2002	1,525	700	831	795	3,315	1,676
1997	1,932	975	984	1,354	4,494	2,366
acres treated, 2002	506,112	80,999	43,099	22,396	346,183	650,827
1997	496,828	89,817	50,990	26,777	390,025	661,044
Chemicals used to control growth, thin fruit, or defoliate ..... farms, 2002	1,563	354	248	154	1,062	400
1997	1,424	406	268	184	1,541	1,090
acres on which used, 2002	818,911	45,735	11,133	2,004	86,216	107,195
1997	532,687	46,541	26,603	4,246	139,325	246,589

See footnote(s) at end of table.

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Table 39. Fertilizers and Chemicals Applied: 2002 and 1997 - Con.

[Data are based on a sample of farms. For meaning of abbreviations and symbols, see introductory text]

Item	Mississippi	Missouri	Montana	Nebraska	Nevada	New Hampshire
Commercial fertilizer, lime, and soil conditioners [1] ... farms, 2002	17,020	59,166	10,809	31,084	935	1,318
1997	22,840	65,173	13,225	36,845	945	1,588
acres treated, 2002	3,186,586	10,772,234	6,647,571	13,335,071	279,739	60,752
1997	3,266,639	10,058,615	6,749,820	12,503,513	239,178	64,184
Cropland fertilized, except cropland pastured ... farms, 2002	9,317	42,172	10,061	29,995	754	1,200
1997	13,463	47,482	12,506	35,780	872	1,497
acres treated, 2002	2,630,833	7,665,904	6,463,919	12,847,411	258,157	55,538
1997	2,645,925	7,477,168	6,574,575	12,226,140	226,151	59,167
Pastureland and rangeland fertilized ... farms, 2002	10,831	33,960	1,869	5,145	249	325
1997	12,363	32,310	1,887	4,660	153	314
acres treated, 2002	556,753	3,106,330	183,652	487,660	21,582	5,214
1997	620,714	2,581,447	175,245	277,373	13,027	5,017
Manure ... farms, 2002	2,953	11,476	3,123	8,703	334	955
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	201,513	650,193	220,702	614,740	34,514	36,626
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control-						
Insects [2] ... farms, 2002	4,389	9,503	1,383	13,276	277	410
1997	3,684	9,460	1,699	17,045	292	493
acres treated, 2002	1,897,524	1,723,042	445,226	4,108,341	111,182	8,301
1997	1,462,116	1,431,113	404,629	4,855,566	79,037	9,124
Weeds, grass, or brush ... farms, 2002	8,952	26,014	9,166	25,223	609	433
1997	8,225	27,840	10,556	28,104	559	517
acres treated, 2002	2,796,802	6,442,157	5,760,062	11,351,476	166,320	17,911
1997	3,217,879	7,230,901	5,665,275	10,207,818	110,070	22,691
Nematodes ... farms, 2002	414	711	133	864	11	69
1997	529	840	179	1,122	7	22
acres treated, 2002	255,963	154,950	15,858	215,190	10,681	869
1997	255,364	137,120	27,506	269,349	6,543	741
Diseases in crops and orchards ... farms, 2002	785	1,028	521	615	36	243
1997	1,213	1,247	707	678	21	300
acres treated, 2002	290,956	71,721	248,564	101,406	14,063	4,042
1997	315,077	117,677	373,362	176,010	7,750	4,015
Chemicals used to control growth, thin fruit, or defoliate ... farms, 2002	1,814	694	251	281	17	60
1997	1,428	1,368	277	540	21	112
acres on which used, 2002	1,170,098	291,349	64,684	55,176	2,445	1,061
1997	934,827	420,230	76,170	140,232	8,625	2,396

Item	New Jersey	New Mexico	New York	North Carolina	North Dakota	Ohio
Commercial fertilizer, lime, and soil conditioners [1] ... farms, 2002	5,133	4,302	15,631	33,911	15,563	42,428
1997	5,326	5,568	20,266	41,217	19,802	50,846
acres treated, 2002	373,719	712,501	2,214,663	4,056,927	16,671,283	7,619,885
1997	390,371	761,476	2,345,761	3,993,070	16,369,427	7,765,241
Cropland fertilized, except cropland pastured ... farms, 2002	4,512	3,978	15,159	26,809	15,445	40,427
1997	5,093	5,004	19,799	33,721	19,739	49,098
acres treated, 2002	357,700	664,096	2,132,029	3,616,451	16,601,444	7,430,881
1997	378,247	726,640	2,297,443	3,596,248	16,341,375	7,599,817
Pastureland and rangeland fertilized ... farms, 2002	1,184	725	2,602	14,744	520	7,482
1997	527	911	1,895	14,101	336	6,279
acres treated, 2002	16,019	48,405	82,634	440,476	69,839	189,004
1997	12,124	34,836	48,318	396,822	28,052	165,424
Manure ... farms, 2002	1,717	1,583	12,921	9,106	4,662	21,471
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	42,626	121,175	1,196,388	465,132	268,782	845,582
1997	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control-						
Insects [2] ... farms, 2002	1,961	2,202	5,539	13,981	3,670	11,530
1997	2,036	1,826	7,497	15,717	4,527	13,520
acres treated, 2002	127,982	285,680	579,898	2,336,809	1,601,682	1,121,876
1997	132,369	335,403	694,591	2,011,011	1,535,865	1,226,579
Weeds, grass, or brush ... farms, 2002	2,414	2,109	9,911	20,422	13,871	31,767
1997	2,517	2,082	12,317	17,902	16,140	33,947
acres treated, 2002	263,337	384,455	1,233,452	3,193,582	14,112,382	6,678,161
1997	276,276	407,843	1,502,166	2,676,939	13,323,641	6,703,731
Nematodes ... farms, 2002	168	92	503	3,735	108	633
1997	235	106	551	5,897	236	1,040
acres treated, 2002	12,767	13,033	49,162	516,565	53,245	72,532
1997	11,151	14,398	61,880	469,049	114,663	90,677
Diseases in crops and orchards ... farms, 2002	931	426	2,634	3,723	1,881	2,401
1997	1,248	519	3,783	6,103	1,734	3,322
acres treated, 2002	58,916	26,684	154,506	364,392	1,208,071	91,796
1997	68,259	46,736	240,194	403,478	898,955	140,701
Chemicals used to control growth, thin fruit, or defoliate ... farms, 2002	191	223	860	2,690	628	947
1997	192	311	1,140	2,958	618	1,476
acres on which used, 2002	8,177	31,724	56,140	737,735	284,337	39,835
1997	8,592	37,266	78,849	578,632	244,272	118,517

See footnote(s) at end of table.

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Table 39. Fertilizers and Chemicals Applied: 2002 and 1997 - Con.

[Data are based on a sample of farms. For meaning of abbreviations and symbols, see introductory text]

Item	Oklahoma	Oregon	Pennsylvania	Rhode Island	South Carolina
Commercial fertilizer, lime, and soil conditioners [1] ...... farms, 2002	35,819	18,666	28,448	451	11,530
1997	39,788	19,143	36,570	590	16,135
acres treated, 2002	8,101,126	2,698,778	2,665,724	13,718	1,441,055
1997	8,473,398	2,714,101	2,879,448	17,239	1,693,665
Cropland fertilized, except cropland pastured ...... farms, 2002	22,659	14,261	26,812	422	7,645
1997	26,839	15,118	35,564	557	11,238
acres treated, 2002	5,656,134	2,485,645	2,501,909	12,746	1,149,298
1997	6,624,941	2,537,138	2,773,004	15,720	1,418,245
Pastureland and rangeland fertilized ...... farms, 2002	21,425	6,865	8,310	72	6,189
1997	18,904	6,018	5,784	90	7,109
acres treated, 2002	2,444,992	213,133	163,815	972	291,757
1997	1,848,457	176,963	106,444	1,519	275,420
Manure ...... farms, 2002	4,529	5,474	23,228	170	2,690
1997	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	286,576	151,103	1,333,504	2,920	181,573
1997	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control- insects [3] ...... farms, 2002	7,290	6,004	11,882	203	3,582
1997	6,708	5,422	14,714	233	4,224
acres treated, 2002	1,225,276	565,754	791,004	6,246	613,177
1997	1,335,015	605,096	914,293	6,240	732,331
Weeds, grass, or brush ...... farms, 2002	24,599	15,018	19,547	174	5,546
1997	19,658	13,262	23,079	199	6,421
acres treated, 2002	4,743,526	2,181,158	1,530,696	7,108	834,976
1997	4,078,263	1,940,342	1,777,409	8,775	1,093,348
Nematodes ...... farms, 2002	183	762	907	13	929
1997	390	820	1,379	15	1,615
acres treated, 2002	17,885	71,185	55,013	801	177,530
1997	58,066	111,372	90,818	(D)	294,269
Diseases in crops and orchards ...... farms, 2002	766	4,017	3,267	98	936
1997	1,167	4,826	4,748	132	1,591
acres treated, 2002	49,043	431,907	99,619	2,494	83,162
1997	137,804	585,305	149,917	2,416	213,507
Chemicals used to control growth, thin fruit, or defoliate ...... farms, 2002	374	1,213	1,073	28	586
1997	623	971	1,252	21	987
acres on which used, 2002	72,721	99,297	37,078	206	168,692
1997	113,921	79,442	50,338	275	257,557

Item	South Dakota	Tennessee	Texas	Utah	Vermont
Commercial fertilizer, lime, and soil conditioners [1] ...... farms, 2002	16,219	46,460	98,573	6,166	2,473
1997	18,863	57,751	110,836	7,467	2,977
acres treated, 2002	10,182,001	4,020,902	19,113,597	629,362	262,248
1997	8,928,309	4,015,287	18,244,875	736,095	261,726
Cropland fertilized, except cropland pastured ...... farms, 2002	15,721	32,543	62,411	5,452	2,319
1997	18,491	43,713	71,551	6,762	2,835
acres treated, 2002	9,852,202	2,855,209	13,742,856	574,224	244,028
1997	8,736,492	2,937,121	14,540,383	686,528	239,413
Pastureland and rangeland fertilized ...... farms, 2002	2,766	27,764	54,264	1,679	618
1997	1,973	27,393	53,911	1,811	666
acres treated, 2002	329,799	1,165,693	5,370,741	55,138	18,220
1997	191,817	1,078,166	3,704,492	49,567	22,313
Manure ...... farms, 2002	7,448	7,999	10,173	2,859	2,187
1997	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	580,457	225,199	994,543	112,030	237,859
1997	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control- insects [2] ...... farms, 2002	4,128	9,093	27,709	2,641	562
1997	4,738	11,721	20,422	2,636	593
acres treated, 2002	1,255,724	1,032,685	7,230,112	264,684	25,951
1997	1,073,891	710,379	7,063,641	228,237	22,390
Weeds, grass, or brush ...... farms, 2002	14,105	19,968	62,345	3,908	1,151
1997	17,204	18,467	50,875	3,914	1,289
acres treated, 2002	8,151,070	2,185,450	13,701,320	342,301	91,261
1997	8,559,230	2,126,102	12,238,123	360,013	92,523
Nematodes ...... farms, 2002	1	760	1,668	81	31
1997	243	1,069	2,394	85	37
acres treated, 2002	(D)	91,759	530,679	3,956	2,108
1997	67,194	58,968	840,167	4,752	2,694
Diseases in crops and orchards ...... farms, 2002	176	2,543	4,282	295	193
1997	310	4,944	5,279	385	324
acres treated, 2002	40,949	161,402	556,678	(D)	6,112
1997	119,918	151,251	921,135	10,594	8,823
Chemicals used to control growth, thin fruit, or defoliate ...... farms, 2002	9	2,907	4,587	138	43
1997	364	2,041	6,587	206	66
acres on which used, 2002	(D)	542,879	1,881,805	2,886	1,031
1997	106,596	372,441	2,476,428	6,288	2,335

See footnote(s) at end of table.

--continued

Table 39. **Fertilizers and Chemicals Applied: 2002 and 1997** - Con.

[Data are based on a sample of farms. For meaning of abbreviations and symbols, see introductory text]

Item	Virginia	Washington	West Virginia	Wisconsin	Wyoming
Commercial fertilizer, lime, and soil conditioners [1] ..... farms, 2002	25,547	16,331	7,982	38,303	2,968
1997	29,923	17,433	10,238	49,128	3,389
acres treated, 2002	2,328,792	4,346,053	374,774	6,473,456	857,999
1997	2,209,009	4,404,844	338,340	6,514,992	815,769
Cropland fertilized, except cropland pastured ..... farms, 2002	20,626	14,180	6,775	37,335	2,718
1997	25,496	15,687	9,141	48,529	3,154
acres treated, 2002	1,742,799	4,214,559	265,360	6,344,416	730,581
1997	1,763,606	4,349,010	262,914	6,398,501	772,879
Pastureland and rangeland fertilized ..... farms, 2002	12,991	3,620	3,392	4,953	735
1997	11,185	2,690	2,915	3,710	582
acres treated, 2002	585,993	131,494	109,414	129,040	127,418
1997	445,403	55,834	75,426	116,491	42,890
Manure ..... farms, 2002	7,317	5,446	4,225	30,491	1,329
1997	(NA)	(NA)	(NA)	(NA)	(NA)
acres treated, 2002	382,194	231,497	130,068	2,316,691	138,727
1997	(NA)	(NA)	(NA)	(NA)	(NA)
Chemicals used to control-					
Insects [2] ..... farms, 2002	6,133	8,017	989	12,338	593
1997	7,390	8,261	1,256	15,461	910
acres treated, 2002	701,322	1,076,928	37,398	1,582,101	110,388
1997	596,450	1,146,627	43,396	1,601,456	169,063
Weeds, grass, or brush ..... farms, 2002	12,199	13,084	2,223	30,561	2,419
1997	10,849	12,766	2,379	34,729	2,565
acres treated, 2002	1,211,547	3,602,017	98,296	4,595,578	463,976
1997	1,170,455	3,447,820	95,779	4,138,375	491,051
Nematodes ..... farms, 2002	1,288	874	69	1,291	81
1997	1,783	905	171	1,851	144
acres treated, 2002	129,411	155,841	3,264	152,241	9,003
1997	157,625	136,890	3,751	169,422	21,138
Diseases in crops and orchards ..... farms, 2002	2,280	4,902	432	1,805	39
1997	3,570	5,335	668	3,090	92
acres treated, 2002	155,107	594,650	13,602	168,150	8,112
1997	210,915	564,913	12,295	222,800	21,696
Chemicals used to control growth, thin fruit, or defoliate ..... farms, 2002	866	3,163	149	910	80
1997	1,264	3,504	297	1,557	67
acres on which used, 2002	93,380	269,037	5,099	84,117	5,465
1997	123,585	271,232	6,064	138,921	8,701

[1] Data for 1997 exclude lime.
[2] Data for 1997 include treatment of crops, including hay, but not other land.

Appendix E

List of Semi-Structured Interview Questions

Who are your current customers?

Do you grow any contract (specialty) crops?

How would you say that what farmers choose to grow was impacted by the closing of the local cannery (Agripac)?

How would you define "best management practices"?

What do farmers base their fertilizer and irrigation decisions on? How do they make these decisions?

Where do farmers get information on fertilizer and irrigation recommendations?

When OSU tested your fields in '92 – '98, did the results of this study cause you to modify any fertilizer or irrigation practices?

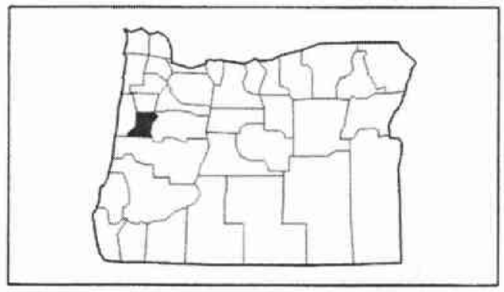
Do you use ground water for drinking water?

Can you tell me if you have any concerns regarding the level of nitrate in the ground water?

Do you believe that elevated nitrate levels in the ground water pose any serious or detrimental health risks if used as drinking water?

Appendix F

NASS
FACT FINDERS FOR AGRICULTURE
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D.C.



2002 Census of Agriculture
County Profile

Benton, Oregon

Number of farms
912 farms in 2002, 858 farms in 1997, up 6 percent.

Land in farms
130,203 acres in 2002, 137,465 acres in 1997, down 5 percent.

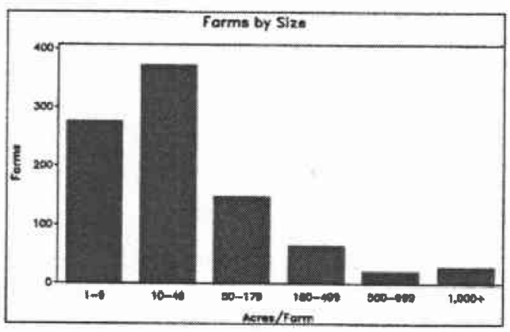
Average size of farm
143 acres in 2002, 160 acres in 1997, down 11 percent.

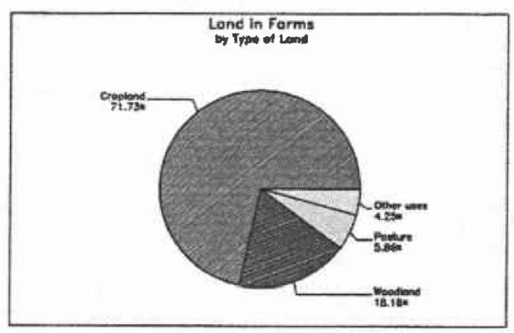
Market Value of Production
$84,585,000 in 2002, $71,918,000 in 1997, up 18 percent.
Crop sales accounted for $74,215,000 of the total value in 2002.
Livestock sales accounted for $10,370,000 of the total value in 2002.

Market Value of Production, average per farm
$92,746 in 2002, $83,821 in 1997, up 11 percent.

Government Payments
$285,000 in 2002, $321,000 in 1997, down 11 percent.

Government Payments, average per farm receiving payments
$5,582 in 2002, $4,793 in 1997, up 16 percent.





2002 Census of Agriculture
County Profile
United States Department of Agriculture, Oregon Agricultural Statistics Service

Benton, Oregon

Ranked items among the 36 state counties and 3,078 U.S. counties, 2002

Item	Quantity	State Rank	Universe [1]	U.S. Rank	Universe [1]
MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD ($1,000)					
Total value of agricultural products sold	84,585	13	36	650	3,075
Value of crops including nursery and greenhouse	74,215	9	36	257	3,070
Value of livestock, poultry, and their products	10,370	24	36	1,855	3,070
VALUE OF SALES BY COMMODITY GROUP ($1,000)					
Grains, oilseeds, dry beans, and dry peas	3,022	13	31	1,415	2,871
Tobacco	-	-	-	-	560
Cotton and cottonseed	-	-	-	-	656
Vegetables, melons, potatoes, and sweet potatoes	20,890	5	34	100	2,747
Fruits, tree nuts, and berries	3,032	16	33	195	2,638
Nursery, greenhouse, floriculture, and sod	2,039	19	32	793	2,708
Cut Christmas trees and short rotation woody crops	24,926	2	25	2	1,774
Other crops and hay	20,307	10	36	74	3,046
Poultry and eggs	(D)	(D)	36	(D)	2,918
Cattle and calves	2,366	28	36	2,047	3,053
Milk and other dairy products from cows	5,616	12	31	576	2,493
Hogs and pigs	114	10	36	1,413	2,919
Sheep, goats, and their products	419	12	36	218	2,997
Horses, ponies, mules, burros, and donkeys	387	18	36	549	3,014
Aquaculture	(D)	(D)	28	(D)	1,520
Other animals and other animal products	923	7	35	140	2,727
TOP LIVESTOCK INVENTORY ITEMS (number)					
Cattle and calves	6,863	30	36	2,345	3,059
Sheep and lambs	5,013	14	36	224	2,867
Colonies of bees	3,803	5	30	154	2,392
Layers 20 weeks old and older	3,140	11	36	873	2,983
Rabbits [3]	(D)	(D)	29	(D)	1,966
TOP CROP ITEMS (acres)					
All Field and grass seed crops	37,082	6	24	7	1,293
Cut Christmas trees	12,085	3	29	3	1,877
Forage - land used for all hay and haylage, grass silage, and greenchop	10,457	27	36	1,725	3,059
All Vegetables harvested	8,481	4	34	75	2,710
All Wheat for grain	5,356	15	29	891	2,517

Other County Highlights

Economic Characteristics	Quantity
Farms by value of sales	
Less than $1,000	257
$1,000 to $2,499	204
$2,500 to $4,999	124
$5,000 to $9,999	93
$10,000 to $19,999	75
$20,000 to $24,999	18
$25,000 to $39,999	29
$40,000 to $49,999	16
$50,000 to $99,999	17
$100,000 to $249,999	31
$250,000 to $499,999	19
$500,000 or more	29
Total farm production expenses ($1,000)	55,430
Average per farm ($)	60,912
Net cash farm income of operation ($1,000)	32,006
Average per farm ($)	35,172

Operator Characteristics	Quantity
Principal operators by primary occupation:	
Farming	455
Other	457
Principal operators by sex:	
Male	707
Female	205
Average age of principal operator (years)	54.1
All operators [2] by race:	
White	1,489
Black or African American	5
American Indian or Alaska Native	12
Native Hawaiian or Other Pacific Islander	6
Asian	4
More than one race	-
All operators [2] of Spanish, Hispanic, or Latino Origin	45

(D) Cannot be disclosed. (Z) Less than half of the unit shown. See "Census of Agriculture, Volume 1, Geographic Area Series" for complete footnotes.
[1] Universe is number of counties in state or U.S. with item.
[2] Data were collected for a maximum of three operators per farm.
[3] Items with a rank that cannot be disclosed are separated by a blank line, position in table does not indicate rank.

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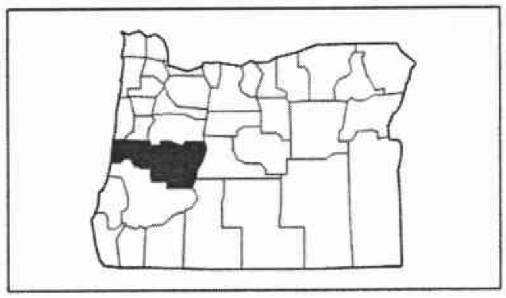
FACT FINDERS FOR AGRICULTURE
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D.C.



2002 Census of Agriculture County Profile

Lane, Oregon

Number of farms
2,577 farms in 2002, 2,512 farms in 1997, up 3 percent.

Land in farms
234,807 acres in 2002, 238,014 acres in 1997, down 1 percent.

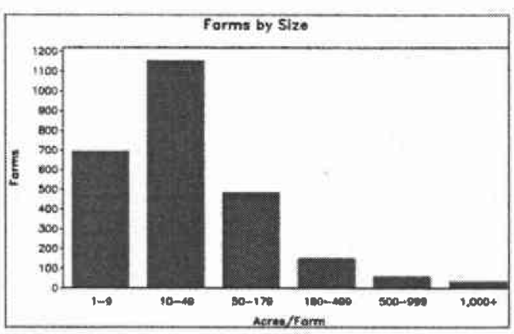
Average size of farm
91 acres in 2002, 95 acres in 1997, down 4 percent.

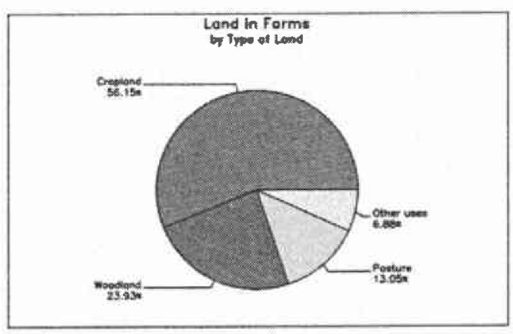
Market Value of Production
$87,824,000 in 2002, $90,545,000 in 1997, down 3 percent.
Crop sales accounted for $58,616,000 of the total value in 2002.
Livestock sales accounted for $29,208,000 of the total value in 2002.

Market Value of Production, average per farm
$34,080 in 2002, $36,045 in 1997, down 5 percent.

Government Payments
$674,000 in 2002, $430,000 in 1997, up 57 percent.

Government Payments, average per farm receiving payments
$7,404 in 2002, $3,382 in 1997, up 119 percent.





2002 Census of Agriculture
County Profile
United States Department of Agriculture, Oregon Agricultural Statistics Service

Lane, Oregon

Ranked items among the 36 state counties and 3,078 U.S. counties, 2002

Item	Quantity	State Rank	Universe [1]	U.S. Rank	Universe [1]
MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD ($1,000)					
Total value of agricultural products sold	87,824	12	36	633	3,075
Value of crops including nursery and greenhouse	58,616	13	36	379	3,070
Value of livestock, poultry, and their products	29,208	12	36	962	3,070
VALUE OF SALES BY COMMODITY GROUP ($1,000)					
Grains, oilseeds, dry beans, and dry peas	1,274	18	31	1,714	2,871
Tobacco	-	-	-	-	560
Cotton and cottonseed	-	-	-	-	656
Vegetables, melons, potatoes, and sweet potatoes	5,955	13	34	272	2,747
Fruits, tree nuts, and berries	6,683	11	33	133	2,638
Nursery, greenhouse, floriculture, and sod	21,001	7	32	132	2,708
Cut Christmas trees and short rotation woody crops	2,229	7	25	29	1,774
Other crops and hay	21,474	9	36	69	3,046
Poultry and eggs	5,919	5	36	575	2,918
Cattle and calves	7,622	16	36	1,195	3,053
Milk and other dairy products from cows	10,290	8	31	370	2,493
Hogs and pigs	131	8	36	1,375	2,919
Sheep, goats, and their products	1,916	2	36	47	2,997
Horses, ponies, mules, burros, and donkeys	1,073	3	36	118	3,014
Aquaculture	1,327	4	28	146	1,520
Other animals and other animal products	930	6	35	138	2,727
TOP LIVESTOCK INVENTORY ITEMS (number)					
Broilers and other meat-type chickens	(D)	6	32	(D)	2,599
Layers 20 weeks old and older	56,376	4	36	488	2,983
Cattle and calves	25,844	18	36	1,196	3,059
Sheep and lambs	17,704	3	36	69	2,867
Horses and ponies	5,529	3	36	34	3,065
TOP CROP ITEMS (acres)					
All Field and grass seed crops	43,685	4	24	5	1,293
Forage - land used for all hay and haylage, grass silage, and greenchop	28,149	13	36	784	3,059
Hazelnuts (Filberts)	4,003	5	17	5	126
All Vegetables harvested	3,120	11	34	207	2,710
All Wheat for grain	3,117	18	29	1,109	2,517

Other County Highlights

Economic Characteristics	Quantity
Farms by value of sales	
Less than $1,000	779
$1,000 to $2,499	629
$2,500 to $4,999	351
$5,000 to $9,999	262
$10,000 to $19,999	196
$20,000 to $24,999	41
$25,000 to $39,999	74
$40,000 to $49,999	39
$50,000 to $99,999	78
$100,000 to $249,999	58
$250,000 to $499,999	30
$500,000 or more	40
Total farm production expenses ($1,000)	87,582
Average per farm ($)	34,039
Net cash farm income of operation ($1,000)	7,906
Average per farm ($)	3,073

Operator Characteristics	Quantity
Principal operators by primary occupation:	
Farming	1,286
Other	1,291
Principal operators by sex:	
Male	1,972
Female	605
Average age of principal operator (years)	55.1
All operators [2] by race:	
White	4,123
Black or African American	8
American Indian or Alaska Native	36
Native Hawaiian or Other Pacific Islander	3
Asian	18
More than one race	39
All operators [2] of Spanish, Hispanic, or Latino Origin	61

(D) Cannot be disclosed. (Z) Less than half of the unit shown. See "Census of Agriculture, Volume 1, Geographic Area Series" for complete footnotes.
[1] Universe is number of counties in state or U.S. with item.
[2] Data were collected for a maximum of three operators per farm.

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UNITED STATES DEPARTMENT OF AGRICULTURE
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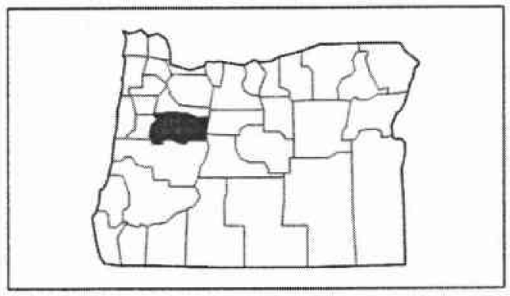


2002 Census of Agriculture County Profile

Linn, Oregon

Number of farms
2,346 farms in 2002, 2,412 farms in 1997, down 3 percent.

Land in farms
385,589 acres in 2002, 416,737 acres in 1997, down 7 percent.

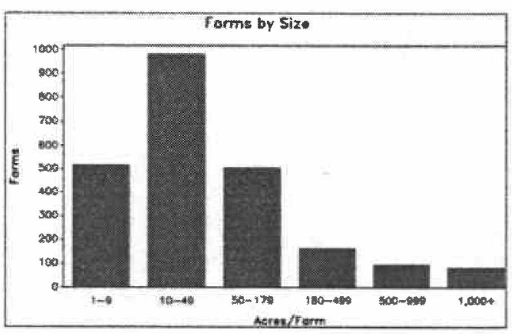
Average size of farm
164 acres in 2002, 173 acres in 1997, down 5 percent.

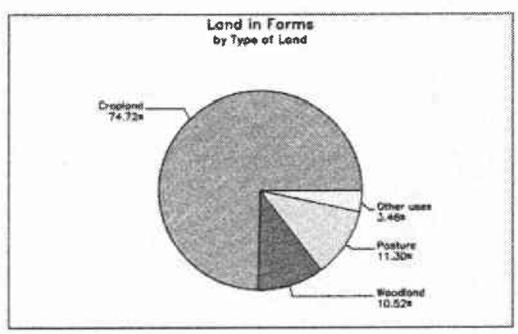
Market Value of Production
$151,817,000 in 2002, $180,322,000 in 1997, down 16 percent.
Crop sales accounted for $110,303,000 of the total value in 2002.
Livestock sales accounted for $41,514,000 of the total value in 2002.

Market Value of Production, average per farm
$64,713 in 2002, $74,760 in 1997, down 13 percent.

Government Payments
$1,006,000 in 2002, $527,000 in 1997, up 91 percent.

Government Payments, average per farm receiving payments
$7,186 in 2002, $3,356 in 1997, up 114 percent.





2002 Census of Agriculture
County Profile
United States Department of Agriculture, Oregon Agricultural Statistics Service

Linn, Oregon

Ranked items among the 36 state counties and 3,078 U.S. counties, 2002

Item	Quantity	State Rank	Universe [1]	U.S. Rank	Universe [1]
MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD ($1,000)					
Total value of agricultural products sold	151,817	8	36	241	3,075
Value of crops including nursery and greenhouse	110,303	7	36	106	3,070
Value of livestock, poultry, and their products	41,514	8	36	696	3,070
VALUE OF SALES BY COMMODITY GROUP ($1,000)					
Grains, oilseeds, dry beans, and dry peas	2,928	15	31	1,430	2,871
Tobacco	-	-	-	-	560
Cotton and cottonseed	-	-	-	-	656
Vegetables, melons, potatoes, and sweet potatoes	6,475	12	34	251	2,747
Fruits, tree nuts, and berries	4,089	13	33	160	2,638
Nursery, greenhouse, floriculture, and sod	11,243	8	32	232	2,708
Cut Christmas trees and short rotation woody crops	1,011	11	25	53	1,774
Other crops and hay	84,558	1	36	5	3,046
Poultry and eggs	6,648	4	36	549	2,918
Cattle and calves	11,351	13	36	897	3,053
Milk and other dairy products from cows	14,719	6	31	286	2,493
Hogs and pigs	378	3	36	1,097	2,919
Sheep, goats, and their products	4,832	1	36	9	2,997
Horses, ponies, mules, burros, and donkeys	1,029	4	36	126	3,014
Aquaculture	626	9	28	229	1,520
Other animals and other animal products	1,930	2	35	51	2,727
TOP LIVESTOCK INVENTORY ITEMS (number)					
Broilers and other meat-type chickens	403,845	3	32	412	2,599
Sheep and lambs	55,903	1	36	13	2,867
Cattle and calves	32,265	14	36	991	3,059
Mink	14,280	2	4	27	117
Layers 20 weeks old and older	6,763	5	36	772	2,983
TOP CROP ITEMS (acres)					
All Field and grass seed crops	184,575	1	24	1	1,293
Forage - land used for all hay and haylage, grass silage, and greenchop	23,396	16	36	958	3,059
All Vegetables harvested	6,456	6	34	115	2,710
All Wheat for grain	5,479	14	29	882	2,517
Sweet corn	4,215	3	27	36	2,279

Other County Highlights

Economic Characteristics	Quantity
Farms by value of sales	
Less than $1,000	670
$1,000 to $2,499	533
$2,500 to $4,999	276
$5,000 to $9,999	229
$10,000 to $19,999	188
$20,000 to $24,999	43
$25,000 to $39,999	66
$40,000 to $49,999	23
$50,000 to $99,999	76
$100,000 to $249,999	97
$250,000 to $499,999	68
$500,000 or more	77
Total farm production expenses ($1,000)	122,930
Average per farm ($)	52,467
Net cash farm income of operation ($1,000)	34,037
Average per farm ($)	14,527

Operator Characteristics	Quantity
Principal operators by primary occupation:	
Farming	1,321
Other	1,025
Principal operators by sex:	
Male	1,992
Female	354
Average age of principal operator (years)	55.3
All operators [2] by race:	
White	3,652
Black or African American	-
American Indian or Alaska Native	38
Native Hawaiian or Other Pacific Islander	11
Asian	13
More than one race	24
All operators [2] of Spanish, Hispanic, or Latino Origin	73

(D) Cannot be disclosed. (Z) Less than half of the unit shown. See "Census of Agriculture, Volume 1, Geographic Area Series" for complete footnotes.
[1] Universe is number of counties in state or U.S. with item.
[2] Data were collected for a maximum of three operators per farm.