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Joan E. Gross

ABSTRACT

This ethnographic study examined some of the ways that global markets and the infrastructure of agribusiness affect local smallholder farmers in the Ten Rivers region who are transitioning toward more sustainable and traditional agricultural methods. The purpose of this research was to discover what barriers smallholder farmers face in developing more sustainable agroecosystems and to then apply those barriers as possible indicators in a three tiered model of sustainability that included social, environmental, and economic components.

This research built on the theory and praxis of political ecology to gather information concerning the local knowledge held by smallholder farmers in the region. The two-fold design of this research called for the collection of relevant background information assessing secondary agricultural and geographical data pertaining to the Ten Rivers region and ethnographic data gathered through conducting semi-structured interviews with local smallholder farmers who were organically certified or used other sustainable methods of agricultural production. Quantitative and qualitative information was considered in order to provide a more

complete analysis of how smallholder farmers in the region use local knowledge to manage individual farming operations, in the context of a global market, and to address the barriers that inhibit them from becoming more sustainable.

Barriers to sustainability faced by smallholder farmers were applied as possible indicators to a three tiered model designed for assessing agricultural sustainability. Since defining barriers to sustainability is determined by local perceptions of risk, and often varies from region to region, the model addressed sustainability in the form of questions to be considered within the interrelated context of social, economic, and environmental issues. The conclusion of the study was that it is better to address the problems of sustainability from a farmer-centered, regional basis, rather than developing an externally imposed universal measure of sustainability where too much information can be lost or misinterpreted.

What Are The Environmental, Economic, and Social Barriers To Achieving Agricultural Sustainability In The Ten Rivers Region of Western Oregon?

by

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Major Professor, representing Applied Anthropology

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.

Michael Stanton, Author

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Chapter One: Introduction

There are a number of global issues regarding the adverse effects caused by overuse of natural resources in societies throughout the world. Global climate change, food shortages, and widespread pollution, combined with a human population that is continuing to grow, have caused serious concern over how to feed the world without destroying the environment through depletion of soils, water supplies, and biodiversity. The enormous impacts caused by these currently unresolved issues should be considered wakeup calls for humanity. Green Revolution technologies promoted by many in industrial agriculture were once considered a successful model for development projects and seen as answers to the world hunger problem. Those methods are now being questioned for their disastrous environmental and social impacts. While the Green Revolution effort was successful in increasing production by developing new farming technologies, only those who could afford the technology benefited, thus causing further marginalization of less affluent people who still rely on less technologically enhanced forms of agriculture. The environmental impacts of soil degradation, water loss, decreased biodiversity, and pollution caused by synthetic fertilizers and pesticides, have been dramatic and often life threatening for producers and consumers alike.

Industrial agricultural practices have increased production through continuous large-scale plantings of crops, increased irrigation, and intensive mining of soils. The use of synthetic fertilizers has allowed the planting of crops on marginal ground that is susceptible to erosion and soil depletion. Eliminating the more traditional practices of using fallow periods and crop rotation does not allow soils and plant biodiversity to recover and flourish over long periods of time. According to estimates of the Natural Resources Conservation Service, “American soil is eroding 16 times faster than it can form, and the Great Plains states have lost half their topsoils since agriculture began there” (Harper 2008:47). That means, in the last 200 years, one third of the topsoil has been lost on U.S. agricultural land (Edwards 1990).

Much of the increase in crop production is due to increased irrigation. Agriculture accounts for about seventy percent of water use worldwide (Harper 2008:49). Many irrigation systems are inefficient and wasteful, either causing soils to become waterlogged or allowing a significant portion of water runoff. Over-irrigation causes aquifer levels to drop, salinization of soils, and increases water pollution in rivers and streams due to fertilizer runoff. Farmers in the Great Plains of the U.S. are pumping water from the Ogallala Aquifer eight times faster than it recharges, reducing water reserves by nearly 20 percent of its total capacity. Land subsidence due to lowering water tables has caused parts of the Central Valley of California to drop by up to 25 feet (Harper 2008; Bell 2009). “In many areas, only some 30 to 40 percent of irrigated water actually reaches crops, with the rest being lost through evaporation and percolation, promoting salinization of groundwater” (Bell 2009:16-7).

Industrial agriculture is a major contributor to the loss of biodiversity. Plant species utilized for food have been largely reduced from thousands of different varieties used in the past to a handful of the predominant varieties of wheat, rice, rye, corn, and millet used today. Of the 30,000 varieties of rice that were once grown in

India, most of today's production comes from only ten dominant varieties. Think about the half-dozen different types of apples available at most supermarkets and then consider that in the late 1800s there were more than 100 varieties grown and sold in the United States. The mono-cropping practices of industrial agriculture decrease genetic variability and increase susceptibility to crop damage and disease. By the year 1970, seventy percent of U.S. seed corn consisted of six inbred seed varieties commercially developed by seed companies. In that year a leaf fungus infected a large percentage of the U.S. corn crop causing the Southern Corn Blight and costing more than two billion dollars to contain. The fungus was finally controlled, by introducing into new seeds, blight-resistant germplasm derived from traditionally grown corn varieties found in isolated areas of Mexico and Ethiopia that had not been reached by "the monoculture ideology of the Green Revolution" (Weizsacker1994:108; Harper 2008).

Industrial agriculture also promotes selective breeding in farm animals, leading to a loss of genetic diversity until only a handful of breeds comprise the vast majority of herds. "The propagation of only a few breeds all around the world means that the farmer must often import a whole range of inputs—from feed to medicines—to keep the animals healthy" (Norberg-Hodge et al. 2001:27). It is important to remember that these are accounts regarding only the loss of valuable genetic qualities in domesticated plants and animals and do not include the dramatic loss of biodiversity in wild plants and animals caused by industrial agricultural methods.

At the current rate of application, there are 5.6 billion pounds of pesticides used worldwide each year. Of the 881 varieties of pesticides that were in use as of 2006, “the World Health Organization (WHO) classifies 28 as ‘extremely hazardous,’ 56 as ‘highly hazardous,’ 107 as ‘moderately hazardous,’ and 119 as ‘slightly hazardous’” (Bell 2009:120). According to WHO, an estimated 25 million agricultural workers suffer serious effects of pesticide poisoning and in lesser developed countries 220,000 people die each year. At least 300,000 U.S. farm workers contract pesticide-related diseases and more than 25 people die of these preventable diseases each year. Studies on farm workers have shown that quality of life and life span are impacted through elevated rates of prostate cancer, gastric cancer, Parkinson’s disease, and chronic bronchitis due to exposure to agricultural chemicals. According to a 2003 study, women with pesticide residue in their blood were five times more likely to develop breast cancer. Water wells that were tested in California were found to contain the organochlorine insecticides DDT and Chlordane, both of which are harmful and persist for long periods in the environment. Toxic agrochemical residues remain for long periods in soil and water due to the very slow processes of natural purification and regeneration. A number of agrochemicals are known as Persistent Organic Pollutants because levels of these toxic chemicals increase in exposed humans and other animals through the process of bioaccumulation. Unfortunately, while these toxins build up in the environment, insects mutate rapidly and become chemically resistant requiring the application of more or different types of agrochemicals. While the health hazards for consumers and farm workers have increased over the last several decades, the agrochemical industry has been on a treadmill of herbicide and pesticide production that has proven very lucrative (Harper 2008; Bell 2009; Norberg-Hodge et al. 2001). Gibbon et al. (1995) state that proponents of industrial agriculture work hard to convince consumers that new scientific discoveries and future technological advances will provide solutions to the harmful effects of resource depletion or other damaging new problems as they emerge.

The vertically integrated system of industrial agriculture is divided into primary, secondary, and tertiary industries that involve growing, processing, and marketing food. The number of actual farmers and farm employees has decreased to a very small portion of total employment in the United States in recent decades. However, if supply of inputs, marketing, processing, and distribution of outputs by secondary and tertiary industries is considered, farming actually comprises 30-40 percent of the Gross Domestic Product (Blaikie and Brookfield 1987). A growing number of scientists and consumers in the United States and throughout the world have begun to question both the safety and sustainability of the present system which allows corporate control of the world food supply and promotes industrial farming methods that are based on short term profit goals rather than long term sustainability.

Sustainability has become a popular buzzword used, and misused, in many different contexts. However, most definitions of sustainability include a statement or proviso that a sustainable system "meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Industrial agricultural practices are meeting the expectations of the wealthier segment of the world population but, the cost to the global environment and human health will cause all to suffer for the few into future generations.

Growing numbers of people are becoming more attuned to ecological issues and are seeing themselves as stewards of the land rather than mere consumers of resources. Kassiola states, “Ecological thinking recognizes that the geosphere and biosphere are systems and that proper understanding of the way the world works requires people to learn how to think systemically, holistically, integratively, and in a futures mode” (2003:47). In order for any agricultural system to be sustainable, the farmer must take an integrative approach to balancing the environmental, economic, and social aspects of the entire farm system. Use of the limited stock of resources, particularly water, healthy soil, and plant and animal diversity must not exceed the ability of the agroecosystem to renew and replace those resources without excessive use of external inputs. Sustainable systems are able to maintain long-term productivity in the event of environmental, economic, and social stress and to manage a more equitable distribution of income, healthy food, and well-being within communities. Unlike industrial agricultural practices that adjust ecosystems and communities to fit the needs of corporate entities and the global market, sustainable agricultural practices are geared toward building soils, enhancing ecosystems, and strengthening communities and local regions.

Many farmers who practice industrial agricultural methods are trapped within a socially created treadmill of production. That treadmill forces them to invest all that they have in machinery, mass production of large herds of livestock, or hybrid seeds and agrochemicals in order to remain competitive in a vertically integrated system that is focused on producing profits for the industrial agriculture complex rather than producing food for consumers. The closely related treadmill of consumption encourages consumers in the United States and other industrialized countries to accumulate and consume more goods from a globalized economy because increased production requires increased consumption (Bell 2009). As Wilk states, "Everything we buy, wear, eat, and drive connects us in some way to the natural environment through long chains of connections" (Haenn and Wilk 2006:418). Is there a way to make our connections to the environment less destructive?

In this study I examine some of the ways that the treadmills of production and consumption work and how they are affecting global resources. In countries around the world local economic networks that once connected producers, distributors, and consumers have been disrupted and replaced by infrastructures of agribusiness and corporate food processors with headquarters in advanced and wealthy nations (Wilk 2006). The goal of this project was to develop an understanding of how global markets and the infrastructure of agribusiness affects local smallholder farmers in the Ten Rivers region of Oregon who are trying to move away from those treadmills in order to make the transition toward a more sustainable lifestyle using traditional agricultural methods.

The Ten Rivers region encompasses Linn, Benton, and Lincoln counties in the Willamette Valley of Oregon. Even though the border of this region is artificially determined by human design rather than a geographically established biome defined by climate and environment, I have discovered through participant observation and involvement in the community that many farmers, researchers and consumers in each county have similar interests in developing more sustainable agricultural practices in the local area. A social disconnect has been caused by externally based unsustainable production and consumption behaviors created by industrial agricultural practices. Using more traditional, community focused agricultural methods will begin to repair the social disconnect between growers of agricultural products and consumers in the marketplace (Bell 2004; Butler and Carkner 2001; Meter 2004; Shiva 2000).

The idea for this research project evolved out of a study on vertical integration begun during the winter of 2008 which considered the possibility of a vertically integrated regional agriculture system developed from a bottom-up grassroots perspective rather than the typical top-down methods used by industrial agriculture. The results of that study led to the idea of addressing issues related to the treadmills of production and consumption and the transition to a more sustainable regional system.

This research builds on theory and praxis derived from political ecology to gather data and relevant information about smallholder farmers in the Ten Rivers region of Oregon. The integrative perspective of political ecology as an alternative to more apolitical research methods was most useful for this study because, as Robbins states,

> political ecology seeks to expose flaws in dominant approaches to the environment favored by corporate, state, and international authorities, working to demonstrate the undesirable impacts of policies and market

> conditions, especially from the point of view of local people, marginal groups, and vulnerable populations. [2004: 12]

Industrial agricultural practices are most often considered conventional agriculture today and organic or non-petrochemical based systems are termed alternative methods. However, in this study I turn that categorization on its head based on the reality that humans have practiced many sustainable systems based forms of agriculture throughout the world for the last 600 generations while industrialized agricultural methods have only been practiced for eight to ten generations in some parts of the world. We have only become dependent on the industrialized global system of agriculture in the last two or three generations (Pretty 2002; Weizsacker 1994). Therefore, sustainable systems based agriculture more correctly fits the definitions of conventional, or what I will refer to as traditional, than the unsustainable alternative of industrial agriculture.

Another aspect of this research is the development of local ecological knowledge and how it is defined. In this study, I follow Berkes' (2008) example of defining local knowledge as recently accumulated knowledge obtained through active participation in a specific geographical area. This definition is separate from the land-based traditional ecological knowledge of many indigenous peoples, which is handed down through many generations and suggests more continuous forms of land management. The reasoning behind this distinction is built on the notion that, while most sustainable farming practices are based on traditional methods of agriculture, local smallholder farmers often redesign older small-scale farming equipment and discover new ways to develop technologies that can compete against the top-down structure of industrial agriculture that is now in place. In many cases traditional methods need to be relearned through sharing of local experiences and methods that have been lost or forgotten. The development of local ecological knowledge within the Ten Rivers region comes from what is known about industrial agricultural methods and the results of practicing more sustainable farming methods within the local region. Local knowledge is based on interactions between farmers and among local people working to change the present system.

One of the aims of this study was to gather and analyze both quantitative and ethnographic information in order to discover what environmental, economic, and social barriers smallholder farmers in the Ten Rivers region are facing and whether they are able to develop more sustainable practices through the use of traditional farming methods. Another aim of this research was to consider whether the barriers faced by smallholder farmers could be used as possible indicators for a model of sustainability.

The design of this research called for a phased approach that required the collection and analysis of information pertaining to agriculture in the Ten Rivers region of Oregon. Chapter two of the thesis presents the rationalization for a theoretical model based on the methods of political ecology. It also examines the background information on industrial agriculture, the treadmills of production and consumption, and explains why new methods of agricultural production are necessary. Chapter three discusses methodology of this research which included the collection of background information and qualitative data. Chapter four is a presentation of background information assessing secondary agricultural and geographical data that was relevant to the Ten Rivers region. In chapter five, the qualitative phase of the research is presented. The ethnographic portion of the study required conducting semi-structured interviews with local smallholder farmers who are organically certified or use other traditional methods of agricultural production. Analysis of gathered data was used to determine how those farmers use local knowledge to manage individual farming operations in the Ten Rivers region, in the context of a global market, and to expose the barriers that inhibit them from becoming more sustainable. Chapter six is a discussion of the sustainability barriers faced by smallholder farmers in the Ten Rivers region and how those barriers were applied to a model of possible indicators for assessing agricultural sustainability. Chapter seven is a short conclusion of the thesis project.

Chapter Two: Literature Review

Political ecology

The field of political ecology is vast and has contributors in a multitude of regions, disciplines, and varied case studies. Many scientific researchers hold a modernized view of agricultural methods and often claim objectivity while ignoring the political aspects of socio-environmental problems. Researchers in the field of political ecology however, take a normative approach to studying and seeking to understand agroecosystems.

The principles of political ecology are applicable in multi-scalar local, regional, and global contexts with the local scales of study often being more complex and becoming more generalized as they move toward the larger globalized scale. The many definitions of political ecology and perspectives of political ecologists make it difficult to nail down a solid theory and praxis. Robbins agrees with senior political ecologist Piers Blaikie that the field is quite fragmented and therefore citation in it “is largely a random affair” (2004:xviii). Political ecology is often a critique of apolitical market based and policy driven studies, most often from the perspective of marginalized populations. It is an alternative perspective that focuses more on political policies and power relations as a cause for ecological degradation and social marginalization rather than the apolitical and often simplistic approach of contemporary Western science that often blames ecological problems on overpopulation and ecoscarcity. Political ecology focuses more on the causes rather than the symptoms of environmental and social problems. According to Robbins

(2004), throughout the developmental stages of political ecology theory, the focus of study has been on production methods and livelihoods because those aspects of societies provide the most direct route to understanding various social and environmental interactions.

Development of political ecology

There were many precursors to political ecology during the twentieth century proposed by scholars attempting to explain the interactions between humans and their environment. During the mid 1950s Julian Steward developed a theory of cultural ecology, with the idea of the culture core as that collection of features that are most closely related to the arrangements of subsistence and economic activities, to describe human adaptations to the environment through various means of making a living (Haenn and Wilk 2006). Cultural ecology avoided the problematic findings of earlier determinist studies and built on a positivist approach through quantitative measurement of subsistence strategies to determine patterns of cause and effect to explain human-environment interactions. According to Robbins, cultural ecologists, "approached human-environment issues ecosystemically: humans would be seen as part of a larger system, controlled and propelled by universal forces, energy, nutrient flows, calories, and the material struggle for subsistence" (2004:28-9). By examining human adjustments to natural landscapes, cultural and behavioral transitions, and institutional adaptations, Steward developed a model that could be used for cross-cultural comparisons based on similar core subsistence strategies and secondary cultural characteristics (Haenn and Wilk 2006). The major weakness of Steward's model was that it focused too heavily on subsistence and technology without explaining the importance of symbolic features and maladaptive behaviors within cultures and how those aspects could affect the environment. Steward's methods of cultural ecology were more easily applied to rural populations with small scale subsistence strategies. As Robbins states, "The implications of this for later political ecology cannot be overstated since contemporary work continues to remain overwhelmingly in the area of subsistence production in the third world" (2004:32).

Rappaport and other anthropologists built on Steward's work to develop an eco-functionalist approach using quantitative methods to measure energy flows within ecosystems (Rappaport 1968, 1975; Vayda 1969). Rappaport relied on the methods of biological ecology in his field studies of the Tsembaga peoples of Papua New Guinea to explain the relationships between gardening, raising pigs, and the use of warfare to redistribute land and kinship. Rappaport's objective was to explain how populations were part of the ecology of the area in which they lived and how those populations interacted with each other and their environment to maintain homeostasis through ritual performance (Rappaport 1967, 1975). Rappaport used his theoretical model to analyze population distribution and carrying capacity to show how ecological balance was maintained. However, the model assumed that systems tend toward equilibrium and therefore could not be properly utilized beyond closed systems like that of the mostly isolated Tsembaga people. Moran has stated that, "the worldwide incorporation of scattered sociopolitical units within larger economic and political systems makes it impossible to treat local communities anymore as closed systems even for analytical purposes" (Moran 1990:20). For cultural ecologists, disregarding the importance of external politics in resource management and the global market often makes it difficult to explain the outcomes they observe from isolated studies (Robbins 2004: 36). However, I think it is important to note Rappaport's statement that isolated systems like those of the Tsembaga had essentially disappeared. He said that "National and international concerns replace local considerations, and with the regulation of the local ecosystems coming from outside, the system's normal self-corrective capacity is diminished and eventually destroyed" (Rappaport 1975:132). Rappaport's impressive insight foreshadowed the later developments of political ecology.

It is widely agreed that, in 1972, Eric Wolf was the first to coin the term political ecology (Peet and Watts 1996; Robbins 2004; Biersack and Greenberg 2006). According to Wolf,

> The fast-running changes which have set in after World War II—most especially the development of pursuits outside agriculture and the transformation of land, labor, tools, and money into commodities subject to households and members—suggest that the use of strategies of ownership and inheritance are now increasingly prompted by factors over which the community has little control. [Wolf 1972:203]

While models of cultural ecology were helpful in allowing for a more interdisciplinary approach, the focus in political ecology began to shift from energy flows within closed systems to the impacts of external factors.

Many of the earlier researchers who practiced political ecology methods during the 1970s and 1980s were geographers (Biersack 2006). Robbins (2004) and Biersack (2006) each cite the work of Bernard Nietschmann, a geographer trained in the methods of cultural ecology, who studied social and ecological change among the

Miskito Indians of Nicaragua. Nietschmann did extensive quantitative analysis of Miskito livelihood strategies, but found that external influences prevented homeostasis within the system. Robbins states that, “Ultimately, Nietschmann concluded, the fundamental problems of Miskito subsistence and the emerging livelihood crises along the coast were not related to the metabolism approaches of cultural ecology—but the broader global market” (2004:37). Unless researchers consider political economy and political influences in environmental changes, the result is an apolitical perspective and is incomplete.

Peet and Watts (1996) write, “Market integration, commercialization, and the dislocation of customary forms of resource management—rather than adaptation and homeostasis—became the lodestone of a critical alternative to the older cultural or human ecology” (1996:5). Apolitical perspectives seem more apt to separate humans from their environment and so form an incomplete and static picture of ecological systems. Robbins states, “It is not so much that political ecology is ‘more political’ than other approaches to the environment. Rather it is simply more *explicit* in its normative goals and more outspoken about the assumptions from which research is conducted” (2004:11). Research done from the perspective of political ecology focuses on the causes rather than the symptoms of environmental and social problems. Political ecology has gone beyond the “neo-Marxism of world system theory” (Biersack 2006:4) to become a method of assessing power relations in the local context as well as the broader context of state and global systems. Biersack states,

> Neo-Marxist political ecology assumed that transnational linkages were forged from above by hegemonic Euro-American powers. But

> grassroots activity is equally important in understanding how transnational spaces of capitalism and colonialism, globalization so-called, are created, reinforced, contested, or rebuffed. [2006: 18]

There are a number of different definitions for political ecology and it is often seen as a critique of apolitical modernistic or ecoscarcity studies. However, the goal is not so much to preserve ways of living and interacting with the environment but to provide better management strategies or to integrate more sustainable practices within societies.

Political ecology and political ecologists

Political ecology methods are used by many researchers in diverse fields of social science. It has been said that the many definitions and perspectives of political ecology are made up of a huge number of case studies that amount to what could be considered a broad list of political ecologies (Robbins 2004; Biersack and Greenberg 2006; Peet and Watts 1996). For my research it was most helpful to break the list of contributors into two broad and often overlapping categories; those who focus on the integration of nature and society, and those who focus more on the post-structuralist notion of the social construction of nature. Perhaps another way to interpret the separate categories would be to consider those who lean more toward the materialist side of political ecology that builds on Marxist theory and those who focus more on the discursive side, building on the work of Foucault.

Nature and Society

The definition given by Blaikie and Brookfield states that political ecology "combines the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself" (1987:17). While the definition is broad, it was helpful for me in my research with local smallholder farmers because it can be applied to the multiple methods and practices of farmers and policy makers based on the continuous changes in social and political forces that affect the regional environment. Blaikie and Brookfield make the land manager a central figure in what they call regional political ecology, based on local knowledge and practice, but within an array of external relations with multiple perspectives. Because "degradation is perceptual and socially defined" (1987:26), when measuring land and environmental degradation it must be understood what ideology is behind the measurement. Researchers must understand that data reliability and relevance depends on who is measuring resources and that their perspective also affects outcomes. "There are non-place based networks of economic, social, and political relations"… and those relations… "have important repercussions upon the decisions of land managers" (Blaikie and Brookfield 1987:66). The authors suggest that when studying local projects or development strategies it is important to remember; "Class interests, actual bureaucratic practice, different perceptions of the problem by various levels of the bureaucracy and rural population itself, all serve to transform original intentions" (Blaikie and Brookfield 1987:99). Projects at the community level are always influenced by external politics and policies that affect local decisions and outcomes.

An important aspect of Blaikie and Brookfield's work was the development of the Chain of Explanation and nested scales for measurement of data. The more specific or local the scale of measurement is, the more complex will be the results and, the larger the scale of measurement, the more general will be the results. Blaikie (1995) presents various levels that progress from the local to the global to describe the Chain of Explanation. According to Blaikie, the Site is the location of the individual farm or even individual fields. Symptoms of degradation are environmental or economic indicators such as crop yields and market variability. Changing yields and markets can lead to different farming practices such as new crops or inputs like irrigation and fertilizers. The farmer must decide what changes to make and whether they will be cost effective. For local growers dealing with direct marketing strategies, the needs and desires of the local and regional community have a great deal of influence on decision making strategies. The State influences farmers through the implementation of policies and regulation of land and environmental management. Changes in the global market influence oil prices, food prices, and availability of products that affect all aspects of agriculture down to the level of the individual farmer (Blaikie 1995). “Changing political and economic conditions therefore alter the context of decision-makers and set the terms for their use of the environment” (Robbins 2004:79).

It is important to remember that in both the spatial and temporal scales of measurement, decisions are affected by things that may have happened generations ago, from the effects of deforestation, previous crops grown in a location, to alterations in climate. The goal of the regional political ecology approach is to develop multiple hypotheses based on local and regional conditions rather than a single or universal model (Blaikie and Brookfield 1987).

Zimmerer and Bassett (2003) build on Blaikie and Brookfield's chain of explanation with a number of case studies that examine how political-ecological processes both generate and assimilate scaled spaces of interaction. Their focus is more on the ways those scaled spaces are socially constructed and interpreted rather than the hierarchical visualization of scale as a linear and predetermined construct that is considered the basis of the chain of explanation.

Zimmerer (2003) considers decision-making processes within individual farm households, between farming households in communities, and within the cultural landscape of Peruvian and Bolivian mountainous zones. Zimmerer uses both qualitative and quantitative methods to show that tier based zonation models of agricultural practices are inconsistent with actual planting strategies. The tier based model gives a picture of what crops will grow in mountainous regions based on changes in climate and temperature due to increasing elevation. Research shows that, in order to increase chances of crop and livestock survival due to the unpredictability of climate, landscape, and disease, farmers use strategies that form a pattern of agriculture that Zimmerer calls overlapping patchworks. "Overlapping patchworks of mountain agriculture are shown to be shaped through the political-ecological interaction of farm livelihoods and mountain environmental factors" (Zimmerer 2003:152). Diversification of production by local people causes overlapping and a much more flexible system of management than the more simplistic, elevation based, tiered zonation model. The overlapping patchworks model also shows that there is much less confidence among farmers about how to maximize production due to environmental and political-ecological uncertainties. And so, rather than a system in equilibrium as shown by the rudimentary and apolitical tiered zonation models, there is a much more complex non-equilibrium system where management is affected by interconnections between constantly shifting environmental, social, and economic aspects within the regional area.

Turner (2003) addresses problems of measuring land degradation through overgrazing of cattle that are owned by indigenous peoples in the Sahel of West Africa. Common measurement strategies consider only livestock density and the estimated carrying capacity of a particular region. These apolitical quantitative measurements of sustainable management practices do not address the social value of livestock or the environmental variability of regions and are therefore simplistic and incomplete. Turner applies political ecology methods for a more in-depth analysis of the problem of land degradation that considers both the social and ecological aspects of herding strategies. “Especially in the open range situations that prevail in much of dryland Africa, the spatial distribution is determined in large part by the land use and herding decisions of people” (Turner 2003:160). According to Turner, by focusing only on demography and estimated grazing potential, the carrying-capacity approach to range management “ignores the fact that these livestock populations are also economic entities—they are managed by their owners as producers of milk, or traction, as commodities, and as stores of wealth” (2003:163). Turner’s study shows that the spatial distribution and seasonal movements of cattle that are managed by indigenous herders throughout specified rangelands are designed to maximize grazing potential and maintain sustainability. Therefore, it is as important to understand the reasoning behind human decision-making processes as it is to understand the overall population of animals and the carrying capacity of the region.

Construction of nature

Peet and Watts (1996) suggest that political ecology offers far too many diverse explanations for degradation and marginalization to develop a sound theoretical base. Since perceptions of the environment are an active component of human imagination, political ecology is forced to focus on regional case studies involving multiple perspectives of the environment based on varying livelihood methods. Peet and Watts state,

> Notions like ‘environmental imaginary,’ which draw on the Marxist conception of consciousness, poststructural ideas about imagination and discourse, and, dare we add, environmental determinism from early-modern geography, open political ecology to considerations so different that we propose a new term to describe them—liberation ecology. [1996:37]

The idea behind liberation ecology is to reassess the dialectic between nature and society and develop discursive analyses that include multiple imaginaries and the diverse perspectives of different peoples.

Peet and Watts (1996) present two differing views of poststructural political ecology by Escobar and Bebbington. While Bebbington discusses alternative methods of development practices by indigenous peoples, Escobar goes a step farther and argues for alternatives to development. Bebbington states that, rather than accepting

State controlled Green Revolution modernization technologies, indigenous peoples in the Ecuadorian Andes have joined together with NGOs to develop grassroots federations that embrace new technologies and market strategies while maintaining or reinforcing cultural stability. What gives agrarian programs controlled by indigenous federations their alternative indigenous orientation is not based on the technologies used by indigenous peoples, but rather the goal of increasing local control of how the processes of social change occur. Bebbington (1996) suggests that development studies focusing only on local agrarian knowledge make the assumption that all local people are farmers and indigenous technology is the key to solving rural poverty. Unfortunately, that emphasis on what they know about pre-modern technology draws attention from the importance of focusing on the things they do not fully understand: “markets, politics, and the machinations of a world beyond the farm gate” (1996:91). The economic transformations created by neo-liberal development strategies have introduced competitive pressures that require increased productivity through inputs and more efficient technology. This has caused many rural people to move to cities in order to find better economic opportunities. “Rates of rural out-migration are striking. Indeed, ‘intensify or die’ might be a short but to the point development challenge for much of Andes” (1996:92). Bebbington asserts that “indigenous cultural identity hinges on sustained and corporate rural residence, and not so much on retaining traditional technologies” (1996:101). Long-term viable development projects require a restructuring of markets and a focus on regional community relationships in order to place the control of production and distribution of higher-value and processed products in the hands of local populations. More local control of production and distribution will increase farm income and reduce out-migration of rural people.

According to Escobar (1996), in practicing poststructural political ecology, it is important to consider that both exploitative and conservationist forms of capital require discursive analysis. Escobar also states that “social movements and communities increasingly face the double task of building alternative productive rationalities and strategies, and culturally resisting the inroads of new forms of capital and technology into the fabric of nature and culture” (1996:48). Escobar argues that the problem of environmental degradation, as seen by those who hold to the Dominant Western Worldview, is a problem of management that should instead be controlled by local communities. “What is problematized is not the sustainability of local cultures and realities, but rather of the global ecosystem, ‘global’ being defined according to the perception of the world shared by those who rule it” (1996:51). According to Escobar, sustainable development is meant to be viewed as a means of reconciling economic growth with the construct of the environment. “As the term is used today, ‘environment’ includes a view of nature from the perspective of the urban-industrial system. Everything that is relevant to the functioning of this system becomes part of the environment” (1996:52). Escobar states that indigenous communities need to develop alternative methods of production that are sustainable in order to forestall conventional development as well as any redevelopment or alterations of local knowledge through any form of discourse. Alternative discourses pertaining to the sustainability of a socially constructed nature must be articulated by rural communities in order to develop new narratives of how they view life and culture (1996:65). The analysis of various discourses will help in gaining a better understanding and implementing useful alternative strategies for development.

In his much cited work *After Nature*, Escobar states, “Political ecology can be defined as the study of the manifold articulations of history and biology and the cultural mediations through which such articulations are necessarily established” (Escobar 1999:3). For Escobar, the goal of political ecology is to examine the interconnections between the domains of biophysical, cultural, and economic studies in order to produce new perceptions of social nature. Based on his studies of indigenous peoples on the Pacific coast of Colombia, Escobar discusses three regimes of articulation grounded on differing perspectives, or landscapes, of nature: “the organic landscape of the communities, the capitalist landscape of the plantations, and the technoscape of the biodiversity and biotechnology researchers and entrepreneurs” (1999:5). Each regime should be studied from the scientific domain that is best suited to that perspective. Escobar suggests “we can more appropriately study organic nature through the anthropology of local knowledge, capitalist nature in terms of historical materialism, and technonature from the perspective of science-and-technology studies” (1999:6). Again, the goal is to incorporate different views of nature into new forms or hybrid natures that will allow local communities or indigenous groups to negotiate with external forces and adopt useful changes while maintaining a basic autonomy and local cohesion. Ecological considerations need to be understood in biological terms that include the complex relationships between environmental, cultural, and economic practices (Escobar 1999). For political ecologists, the question is still a matter of how best to represent each domain in order to develop cohesive models of nature that will satisfy each group in the struggle to define and practice sustainability.

One of the greatest difficulties in determining the sustainability of an ecosystem is that each term describing sustainability is a social construct interpreted differently by various stakeholders and as such each term is affected by externalities that must be observed through multi-scalar measurements over time (West 2007; Robinson 2004; Paulson et. al 2003). Because of the multiple definitions of nature, development, degradation, and sustainability held by various interest groups, it is vital that an ongoing dialogue between disciplines be maintained so that equitable measures can be taken that will ensure the preservation of land and livelihoods. Forsyth states,

> Concepts such as desertification, soil erosion, and deforestation have clearly been associated with severe environmental problems within particular contexts. Yet, used universally and uncritically, these concepts may actually undermine both environmental management and social development by adopting simplistic approaches to the causes of biophysical change, and by encouraging the imposition of land use policies that may only restrict local livelihoods. [2003:36]

Because of the multiple perceptions of environmental problems and degradation, the reliability and relevance of data collected is subject to the ideology of those who are measuring the problem. In the midst of shifting environmental policy and global markets it is important that the long-term place based land manager be central to agricultural sustainability. Many of the large companies that measure degradation and productivity in the service of agriculture have benefited from state aid more than the farmers themselves. Unfortunately, for those who are doing the actual work of farming, those companies doing the measuring and analyzing contribute very little to farm production itself and so the risks are taken by the farmers while vertically integrated corporations are left with the more secure profits (Blaikie and Brookfield 1987).

Steps should be taken to improve our understanding of environmental, social, and economic aspects of the present agricultural system through increased dialogue between farmers, researchers, policymakers, and consumers in the transition toward a more sustainable future. According to Robinson (2004), a more integrative perspective is needed while acknowledging the essentially normative and political nature of sustainability, and the recognition that achieving sustainability is a process rather than a stated goal or event. Robbins (2004) argues that researchers should focus on networks of interactions between stakeholders rather than Blaikie and Brookfield's (1987) hierarchical chain of explanation from the local to the global. In order to develop those linkages and networks, Robbins has developed what he calls a hybridity thesis that "suggests certain tendencies and trends in the collision of human and non-human nature and paves the way for new research" (2004:213). The goal of political ecologists is to define and examine the linkages between nature and culture constructs in a manner that is conducive to interdisciplinary research. Greater numbers of researchers from different disciplines working together, while expounding multiple perspectives on various issues, will provide fuller more detailed explanations for social and environmental problems. Once the multiple aspects of problems are understood, more appropriate long-term decisions can be made.

Global Industrial Agriculture

After World War II many farmers in the U.S. began to mechanize their operations with tractors and other machinery and to use synthetic fertilizers and pesticides on crops. During the 1950s, the higher costs of mechanized farming led many to begin contract farming with agricultural corporations to produce commodities like row crops or chickens for a specific price. In 1955 John H. Davis coined the term agribusiness to define the vertically integrated business of industrial agriculture (Hurt 2002). As financial investments in machinery and technology grew in size, it was in the best interests of farmers to begin specializing in fewer areas of production and develop mono-cropping methods on a larger scale. Also, “the desire for public subsidies to encourage increases in food production took precedence, and these are more easily applied to simplified systems, rather than the mixed ones” (Pretty 2002:54). Because only the most efficient large-scale farms were able to compete in a market where prices were not controlled by the farmers growing the products, farms continued to consolidate and many younger people moved to the cities in search of jobs. Large-scale farms were able to capitalize on federal support programs in order to buy more equipment and land to farm more extensively while many small-scale farms were forced to give up their operations. “The Food Security Act of 1985, for example, enabled J. G. Boswell, a California company and one of the largest producers of cotton, to collect nearly $20 million in subsidies annually” (Hurt 2002:149). In the

Central Valley of California, farmers began using a method called double dipping, that would allow them to use irrigation water and plant crops that were both subsidized by the federal government. According to Hurt, “One wheat and soybean farmer in Iowa remarked, ‘To put it quite bluntly, if you’re not farming the Government today, you’re not doing a very good job’” (2002:150)

At the beginning of the twenty-first century, farmers made up only 1.6 percent of the U.S. population and the average size farm was 432 acres. Hurt states, “If farms with $100,000 or more in annual sales are considered ‘commercial’ farms, only 16.7 percent of the total number of farms can be so classified, but these ‘commercial’ farms produced approximately 80 percent of all agricultural commodities” (2002:156). While those commercial operations make up only 16.7 percent of all farms, they receive 62 percent of federal government direct cash payments.

One of the key precepts of industrial agriculture is based on the paradigm of the Dominant Western Worldview that separates humans from their environment and assumes that nature can be dominated through modern technology (Harper 2008). Hybrid seeds developed through Green Revolution technology were designed to increase production through the inputs of synthetic fertilizers, resistance to pesticides, and increased irrigation. Unfortunately, increased irrigation and constant chemical inputs needed to maintain production levels are more expensive than traditional manure-based agricultural methods. Also, the productivity of hybrid seeds decreases rapidly in subsequent generations and therefore requires buying new seed every year rather than the traditional methods of saving a percentage of each year’s seed crops for replanting. Unlike much of the Green Revolution technology developed in government supported crop breeding centers, newer biotechnologies are increasingly run by private corporations. Pressure is put on scientists to develop feasible applications for the commercial market while solutions to problems and indirect costs of pollution and environmental degradation are left to the public and future generations. Gibbon et al. argue that, “high expectations of scientific agriculture are built up, and extravagant claims are made for some of the more sophisticated branches such as biotechnology” (1995:48). Genetic engineering has been used to create fruits and vegetables that are better able to withstand industrial harvesting and transportation methods, and bovine growth hormone was introduced to increase milk production in cows. But, the most widely promoted use of genetic engineering is by multinational corporations that sell both genetically modified seeds and chemical herbicides as a package deal that cannot be used separately (Norberg-Hodge et al. 2001; Harper 2008).

The long distance transportation of foods has become another damaging aspect of the food and agriculture industry. Most of the benefits from this unsustainable distribution system based on cheap labor and relatively low petroleum prices go to a few highly consolidated agribusinesses and speculators. Multinational corporations are able to shift foods between countries to take advantage of varying price differentials and government subsidies while farmers are left with ever smaller monetary benefits for the commodities they produce (Norberg-Hodge et al. 2001).

In the last few decades, fewer agribusiness corporations have begun to control much larger percentages of the food industry through both horizontal and vertical integration. Horizontal integration occurs when different firms at the same stage of production merge to form a larger company. Vertical integration is the merger of companies at different stages of production and distribution. Both horizontal and vertical integration are designed to increase profits and control a larger percentage of a market. A very small number of mega-corporations like Monsanto, Cargill, ConAgra, and Novartis have consolidated all aspects of production from the planting of seeds to the food on the table. DuPont, Monsanto, Syngenta, and Limagrain control 29 percent of the world market in commercial seeds while "Cargill, the global grain, oilseed, and meat processor and trader, acquired the grain storage, transportation, export, and trading operations of its rival, continental Grain Company" (Hurt 2002:163). ConAgra, IBP, Cargill, and Farmland National together control 87 percent of the cattle slaughter market. Cargill/CHS, ADM, and ConAgra control 55 percent of the flour milling market (Hendrickson and Heffernan 2007; Hurt 2002). These are just a few examples of corporate control of industrial agriculture through consolidation that have taken place in the last few decades but, you get the idea. Agribusiness consolidation at this level gives corporations the power to influence federal agricultural policy decisions as well as the ability to set prices in the global market.

The growth of a globalized vertically integrated system of industrial agriculture has replaced the many thousands of diverse agricultural systems that were adapted to local communities and ecosystems. The loss of local networks has caused a separation between producers and consumers and allowed unsustainable agricultural practices to continue. Because of the dramatic reduction in the number of farmers and the extensive horizontal and vertical integration of the production and processing industries within agriculture, many consumers at the supermarket do not understand how their food is produced, where it comes from, or how it gets to the grocery store (Pollan 2006; Flora 2001).

Treadmills of Production and Consumption

The dominant socio-economic paradigm in the United States is based on constant economic growth. Farmers who are part of an industrial agriculture system that is increasingly controlled by multi-national corporations are losing their independence and have become more a part of the disadvantaged work force rather than independent entities. They must continue to expand production in order to make enough money to maintain their position within the system and stay in business. Because farm prices are controlled by the external vagaries of the global market, large-scale farmers are unable to set their own prices for what they produce and must compete with each other by acquiring bigger equipment, farming more acres, and using newer technology in order to produce the largest amount of commodities for the cheapest price. A situation like this, where the focus is on short-term growth through increased output without concern for long-term consequences for environment or social equality, is called the treadmill of production (Schnaiberg 1980; Bell 2004; Bell 2009).

Most farmers in the United States have been forced onto the treadmill of production by environmentally and socially destructive government policies that are promoted by powerful lobbyists within the agricultural industry (Bell 2004; Bell

2009). As smallholder farms have grown and become consolidated the social, political, and geographic landscape of food production has changed until, as Bell states, “Farming is no longer the same thing as agriculture” (2004: 35).

Bell’s (2004:42-3) description of the farmers’ problem is a good explanation of what is happening with many farmers on the production treadmill today. If things go well on the farm during a particular season, meaning the right amount of sun and rain at the proper time and well running machinery that is able to handle the job, inputs like herbicides and irrigation may be relatively low and production should be high. However, chances are the other farmers in the area will most likely be growing the same crops suited to that region, and if one farmer has a good season everyone else will also have a good year and the increase in supply of products will be reflected in lower prices for those commodities. The same problem occurs in bad years. If conditions are bad for producing a crop, supplies of that crop may be low and prices for limited supplies will be high but, no one has much product to sell because it was a bad year. The only way to make money in a situation where your farming neighbors are all growing the same crops and using the same technology is to have a good year when everyone else’s crops fail, which doesn’t happen very often. Therefore, the only reliable solution to the problem for competing farmers is to expand production and buy or rent more land in order to knock other farmers in the area off the treadmill and out of business (Bell 2004).

One of the bigger problems with the commoditization of food is that people who can afford it can only eat so much of it and those who cannot afford it are not included in the market. Therefore, food has become an inelastic commodity and production is controlled primarily by short-term market demand rather than the long-term threat of population growth. Bell states, “the inelasticity of demand for food, combined with the regional specificity of most agricultural production and the regional crises that weather often brings, means that farmers experience their own treadmill in a particularly intense and local way” (2004:42). Why do farmers continue to struggle for gain in spite of the damaging effects and social inequalities of industrial agriculture? While farmers are producers they, like everyone else, are also consumers. Having the biggest tractor and farming the largest parcels of land is not only about increasing production, it is also about conspicuous consumption. People criticize the unequal distribution of wealth and status because these things are important to us all. Bell describes conspicuous consumption as “a forever receding place to try to stand” (2004:48). While consumers work to keep up with each other, the rewards become harder to achieve and the treadmill of consumption continues to accelerate. Consumers are constantly bombarded by advertisements for products that are purported to improve quality of life. Parenti states that advertisers do more than just sell particular products; “they sell an entire way of life, a way of experiencing social reality that is compatible with the needs of a mass-production, mass-consumption, capitalist society” (1986:63). The purchases of consumer goods that are used as displays of status have become a substitute for the social needs that were once provided for by community (Bell 2009).

The treadmills of production and consumption within local communities tend to expand out of control of those local populations because, while local investors are concerned with use values of the community such as family, social networks, and a strong local economy, the exchange values held by large businesses focus on the ways those communities and resources can be used to make money (Bell 2009:64). Because agribusinesses and large scale, often absentee, landowners are often better organized and have more political influence than individuals from local neighborhoods, they are able to market their products in ways that are more lucrative for business but also more damaging to communities and environment. Rather than investing in the local community and enhancing the surrounding lands, the focus of large scale agribusiness is on individual profits. The treadmills of production and consumption in industrial agriculture are created by businesses that develop markets by convincing the public that their products will make life better or more convenient and that the inequality and environmental degradation caused by the unsustainable practices of most large industries are a reasonable, or even an inevitable tradeoff (Bell 2004).

In order for farmers to stay on the treadmill of production created by industrial agricultural practices, they must increase production through improvements in technology and efficiency. Bigger and more technologically advanced tractors and harvesting machines are needed to plant more and larger fields. Specialized large scale animal operations are designed to increase productivity and are promulgated as being more efficient. In industrial agriculture, one form of improvement is the ability to obtain crop subsidies. Bell says that in order to supplement their income in a fluctuating commodities market farmers eventually end up "farming subsidies rather than the land" (2004:14). In the year 2000, the U.S. congress provided farmers with $32.3 billion in agricultural subsidies. "The federal government estimated that previous programs, such as conservation payments and price supporting loans that generated farm income, together with the new emergency subsidies, would provide farmers with 40 percent of their income for 2000…" (Hurt 2002:158). It is unreasonable to expect that this level of finite taxpayer dollars dedicated to one segment of the economy should be a sustainable answer to the problems of industrial agriculture.

Another method used by corporate farming systems to increase production efficiency is Confined Animal Feeding Operations (CAFOs). These are operations where hundreds or even thousands of animals are kept in closely confined quarters and fed large quantities of antibiotics and other drugs to stave off illnesses caused by overcrowding and will keep them alive until they are ready for slaughter. "Over eighty percent of the pigs in the United States have pneumonia, and at least fifty percent suffer from stomach ulcers at the time of slaughter" (Norberg-Hodge el al. 2001:27). These factory farms are becoming more prominent throughout the country. The methods of operation used in CAFOs degrade the environment by polluting local air, soil, and water supplies. Effluent spills from leaky manure lagoons on hog operations seeping into nearby streams and lakes "killed 5.7 million fish in 152 incidents in Iowa alone between 1996 and 2002" (Bell 2009:65). The stench of manure and ammonia from CAFOs pollutes the atmosphere. "One study estimated that ammonia evaporating from the Netherlands' highly intensive livestock industry is responsible for 30% of the acid rain in that country" (Norberg-Hodge et al. 2001:28). These industrial farming systems increase the inequality among farmers and communities through government backed intervention by large industrial agriculturalists. Lobbyists from agribusiness corporations influence governments in order to loosen regulations against pollution created by CAFOs and have "taken away the right of localities to enact anti-CAFO zoning, and banned 'nuisance lawsuits' against them" (Bell 2009: 65-6, 72) CAFOs degrade the economic and aesthetic value of property in surrounding communities so that homeowners are often unable to sell their property in order to get away from the stench. Small farming operations cannot compete with the larger factory farms because the margin of profit is so low that the only way to make money is to deal in a large volume of products. Large processors and distributors would rather deal with larger contract farmers through a vertically integrated system that controls everything from feed, to breeds of animals, to packaging of the final agricultural products (Bell 2004). Industrial agricultural methods in the United States and elsewhere are becoming increasingly unsustainable due to a false assumption that increased production is synonymous with increased efficiency.

The global agriculture system is deficient in many ways and in need of immediate repair. "With the increased use of nitrogen fertilizers, pumped irrigation and mechanical power, accounting for more than 90 per cent of the total energy inputs to farming, industrialized agriculture has become progressively less energy efficient" Pretty 2002:68). Most farmers, scientists, and individuals working for corporations within the sphere of industrial agriculture are not intentionally promoting policies that are destructive to farming communities and the environment. However, reductionist thinking that encourages those individuals to focus only on specific aspects of production without considering the long-term effects of their actions allows unsustainable practices to continue without considering accountability and a more holistic view of the entire system of agriculture.

The Agroecosystems Approach

The methods of Western science often require a linear reductionist thinking process that focuses on specific symptoms within the larger context of environmental problems. In order to develop and maintain sustainable ecosystems, a more holistic non-linear understanding of the three interconnected components of economy, society, and environment is required. According to Gibbon et al., “We continue to train natural scientists without a good understanding of the social and political context in which they work and the role they themselves play in determining outcomes” (1995:47). Reductionist methods tend to leave out many aspects of development projects that are not considered to be part of those narrowly defined studies. An important element that is often left out is how scientific findings will be accepted in local communities that will be affected by the research. According to Pretty and Chambers, “Feedback and learning from farmers’ experiences are essential for further improvement of technologies and for sustained dialogue between scientists and farmers” (2000:205). Participation in dialogue by farmers with local knowledge is preferable to the linear and unilateral monologue of authoritative science in deciding what is best for a community. According to Moran, the ecosystems approach was attractive to anthropologists because it “endorsed holistic studies of humans in their physical environment” and “suggested the possibility of common principles in biology and anthropology” (1990:11). Studies that do not consider the entire agroecosystem are only focusing on symptoms rather than the causes of environmental problems within agriculture and society.

An agroecosystem is an artificial system that must interact in non-destructive ways with the surrounding natural environment and maintain a balanced level of naturally occurring inputs like organic feeds, compost, and manure, with healthy outputs of crops and animals in order to be sustainable. The paradigm of agroecology “recognizes that a farm is also an ecosystem and uses ecological principles of diversity, interdependence, and synergy to improve productivity as well as sustainability” (Harper 2008:183).

Agroecology reflects the diversity of natural ecosystems that contain a wide variety of plants and animals. Practicing agroecology involves traditional forms of agriculture and includes methods like crop rotation, intercropping; which means growing different crops simultaneously in one field, and using cover crops to help build the soil. Maintaining soil health rather than continuous use of synthetic inputs is central to traditional agriculture. Earthworms, nitrogen fixing bacteria, fungi, and a host of other biological organisms work together to break down crop residues and other organic matter that help build the soil. Adding pasture raised grazing animals to the system helps keep weeds and pests in check while manure from the animals helps to recycle nutrients and close the biological loop in the system. Planting leguminous cover crops in rotation with other crops cuts down on soil erosion and when plowed into the soil helps restore nitrogen and organic matter to the soil. Traditional farming methods include non-hybrid, non-treated seeds and multiple cropping practices to increase diversity. Many plants such as mustard, marigolds, and sunflowers can be inter-planted with crops to cut down on pests. Traditional agriculture is more labor intensive than industrial methods and most often practiced on much smaller acreages. However, when the benefits of healthy soil and crops are considered along with the savings from unneeded input costs of heavy machinery, chemical fertilizers, and pesticides, many smallholder farmers are finding the tradeoff worthwhile (Altieri 1995; Norberg-Hodge et al. 2001; Pretty 2002; Harper 2008).

Osborn states that in order for a sustainable land and crop management system to be developed, it must balance agricultural yields with “environmental goods and services” (2005:60). In order to keep the system balanced, it must be understood that managers of the land must be able to make a continued living from that land for an extended long-term period. Part of the transition from industrial agriculture to traditional agriculture is a change from economic measurements of success to considering the value of healthy farms, families, and communities.

Netting (1993) describes sustainable agroecosystems in terms of balanced energy flows, stable production, and reasonable economic returns in balance with labor inputs over time. Increased needs for inputs typical of industrial agriculture, such as fertilizers and water, suggest an imbalance in the ecosystem. Yield production that remains stable, without increasing energy inputs and manageable pest and disease levels, indicates sustainability. If returns on production are sufficient to achieve subsistence as well as enough savings to deal with possible crises in the long-term, the overall system is in balance and sustainable (Netting 1993:136-7).

Alternatives to Industrial Agriculture

Rhoades states that "Agricultural anthropology is the comparative, holistic, and temporal study of the human element in agricultural activity, focusing on the interactions of environment, technology, and culture within local and global food systems…" (1984:46). Farmers practice methods that they feel will work best for them based on the peculiarities of their farm and the information they have inherited or accumulated through experience. However, as Blaikie and Brookfield (1987) suggest, there are many outside forces based on social, economic, and political relationships that have a great deal of influence on the decisions they make. Farmers are constantly making changes in order to improve what they feel are the most important aspects of their operations due to constantly shifting external problems and policies. Because the farmer is the one who is held accountable for decisions made on the farm, "Research must come full circle from proper problem identification to farmer acceptance or rejection" (Rhoades 1984:33).

Iowa is often considered the paragon of industrial agriculture in the United States. Bell (2004, 2009) did a long-term study of Iowa farmers that were members of an organization called the Practical Farmers of Iowa (PFI). In a state with over 90,000 farms, the 700 members of PFI make it the largest sustainable agriculture organization in Iowa, where only two species of plants, corn and soybeans, cover 60 percent of agricultural land in the state (Bell 2009:242). Members of PFI share information about sustainable practices and research done on individual farms and work to build up stronger families and communities. PFI members are proving that traditional, mostly smaller scale, farming methods still work and can be profitable in a state where most find it too difficult to change from the top-down structure of industrial agriculture.

Farming at any scale is a risky business. To challenge the dominant paradigm of constant growth and production, and thus slow down the treadmills of production and consumption, is to challenge one's knowledge and identity as well as potentially to risk one's livelihood. Bell states,

> Farmers are farmers because they identify themselves with the knowledge of farming and others identify that knowledge with them…farmers are types of farmers—grain farmers, livestock farmers, industrial farmers, sustainable farmers—because of what they know, therefore do, and therefore identify with. [2004:15]

Growing numbers of farmers are beginning to question the deleterious effects of an industrial agriculture system that tends to allow a few large corporations to reap most of the benefits of food production while leaving producers with most of the risks. Many farmers are changing their perspective of what is truly valuable and sustainable and reconnecting with their communities in order to develop, or reestablish, their identity as good stewards of the land. Like the Practical Farmers of Iowa, they are learning by doing and many are discovering that there is a better way.

Local Ecological Knowledge

Berkes (2008) defines local knowledge as recently accumulated knowledge that has been developed in response to local needs and new market opportunities within the global marketplace. Many sustainable farming practices are based on traditional methods of agriculture, with farmers developing strategies to establish niche markets that can compete with the system of industrial agriculture that is now in place. Small-scale tractors and farm implements that are no longer adequate for the increasing scale of many farms are being rebuilt and redesigned to accommodate the changing needs of local smallholder farmers. In many cases traditional methods need to be relearned through sharing of local experiences and methods that have been lost or forgotten. As Bell states,

> Advocates of sustainable agriculture have been particularly excited by new farming techniques like ridge tilling, rotational intensive grazing, deep-bedded hoop houses for hogs, and holistic management, as well as older techniques like crop rotation, flame cultivation, pasture-farrowing, and direct marketing—jargon to those outside what must now be recognized as the *sustainable agriculture movement* but a social, economic, and environmental lifeline for those inside it. [2004:5]

The development of local knowledge comes from what is known about the world and from local experience. Practicing ecological methods within an agroecosystem or local region is based on interactions between human and non-human elements within the system and among local people. While it is important to understand and acknowledge the contextual character of local knowledge, it is also important for local people and researchers to understand and work with the official knowledge systems within the broad domain of industrial agriculture that are used by experts to secure employment and control farming resources and supplies (Robbins 2004:120). As Gibbon et al. state,

> Only by developing an understanding of individual situations, by allowing local knowledge to flourish, by understanding local cultures, values and institutions, and by combining these with scientific insights and more conventional ideas and practices, along with appropriate methods of experimentation and discovery—will sustainable agriculture systems be developed. [1995:39]

Sustainability is an aspect of human behavior and social learning, within a process of negotiation over future possibilities, under conditions that are uncertain and affected by multiple variables (Pretty 2002). “It is an inherently normative concept, rooted in real world problems and very different sets of values and moral judgments” (Robinson 2004:379-80). Water and soil quality, as well as climate and land availability are all features that play a part in the types of agricultural products that can be grown effectively in a region. “Matching the crop to the environment is crucial if a farm is to be sustainable. The farm as an ecosystem benefits from plants and animals that are adapted to it” (Horne and McDermott 2001:142). Local knowledge of the climate, soil quality, and land tenure of a particular region plays a crucial role in the development of a sustainable agroecosystem. If consumer demand calls for agricultural products that do not grow well in a region, farmers are forced to grow plants in greenhouses in order to provide suitable growing conditions or consumers will buy goods shipped in from elsewhere. The increased energy inputs needed for growing produce in greenhouses and importing agricultural products from areas outside of the region cause an imbalance to any agroecosystem or region.

Barriers to Sustainability

A number of studies of sustainable farming methods have shown that farmers practice sustainable methods to produce healthier high quality farm products, reduce pollution, and become better stewards of the land. Intensive labor practices, environmental constraints, and divergent local perspectives often make the transition difficult (Drost et al. 1996). In a study on the barriers to adopting sustainable practices in the state of Utah, Roberts and Lighthall (1993) developed a three tiered model used to outline some of the changes farmers face in adapting to traditional agriculture. The three tiers are separated into market and policy imperatives that include competition and innovations in markets; the system of production and accumulation that includes land, labor, and capital; and the climate, soil, and topography that makes up the agroecological environment. Drost et al. (1996) say that the three tiered approach can be used to predict whether changes are compatible with sustainable methods based on responses to questions of social, environmental, and economic aspects of production.

Findings showed that farmers practice methods they are comfortable with and tend to adopt only those new methods they feel will minimize any risk of lowered production or crop failure. Therefore, any decisions to adopt more sustainable practices must not be too dramatically different from the existing production system. Some of the important barriers to developing sustainable practices were lack of financial incentives that would reduce the risk of changing to new methods, lack of education, and a simple unwillingness to change (Drost et al. 1996).

For many of today's farmers, the increased labor requirements of most traditional farming practices present a significant barrier to change. With the average age of farmers being over fifty years old, and the increasing numbers of young people migrating to the cities in order to find better paying jobs, the farm labor problem is substantial (Northwest Area Foundation 1994; Netting 1993).

The lack of information on agroecology and the skills necessary to practice traditional farming techniques in a complex management system is a substantial barrier to developing sustainable methods. Unlike the very limited varieties of seeds used in most monocropping operations, and the pre-measured amounts of synthetic fertilizer and pesticide inputs established by industrial agriculture, there are fewer resources for discovering the correct sustainable balance for agroecosystems that vary considerably by region (Northwest Area Foundation 1994; Pretty 2002).

Stephenson and Lev (2004) did a study in the Ten Rivers region of Oregon, at the request of local farmers that addressed the question of whether consumer demand for local goods produced through sustainable agriculture methods made niche markets viable for small farms in the local area. Study findings showed that, while customers enjoyed buying local goods and the local shopping experience, lack of convenience and availability was a barrier to more extensive participation in the local market economy. Stephenson and Lev's work has exhibited evidence that there is enough interest in the local community to warrant expansion of small farm production and the need for developing a more sustainable agricultural system within the region and within the context of the global market.

Sustainability Indicators

There is increasing pressure from politicians and donor agencies to provide reliable sustainability indicators that will measure degradation and provide sound guidance for positive actions to be taken on various development projects (Nazarea et al. 1998). VanLoon et al. state, “an indicator is a number or other descriptor that is representative of a set of conditions, and indicates or points to aspects of an issue” (2005:56). Government agencies often use top-down economic indicator models to measure environmental degradation by monitoring agricultural crop yields. If crop yields decrease, a combination of incentive programs and subsidies are used to promote change in agricultural practices. According to Paarlberg (2000), farmers with large commercial operations use their political influence to demand generous input subsidies, price supports on commodities, and trade protection. With a system of indicators based on economic measures, the wealthier farmers who own large acreages and are politically strong and well organized receive subsidies and are therefore successful while smaller farms without subsidies are unsuccessful (Blaikie and Brookfield 1987). As Bell states, “the technological, economic, and political structures that consolidate farms eventually reach a point where they do more harm than good” (2004:9). Using only economic growth indicators to measure sustainability is unreliable and simplistic. The top-down models used to measure economic productivity are not well suited to sustainable agriculture because the scale of those farms is often much smaller than those in industrial agriculture. In more sustainable systems, crops are diverse and the farming strategies include long-term environmental and social aspects requiring whole system measurements of sustainability (Northwest Area Foundation 1994; Morse and Stocking1995; Bruges and Smith 2008).

As the world becomes more interdependent, the sustainability of agroecosystems becomes more difficult to measure due to national and global influences. Each level of study from the local to the global is affected by different sociopolitical and philosophical associations that are impossible to quantify through scientific measure but are critical to understanding problems of sustainability. Unfortunately, agricultural researchers are often hesitant to consider social and cultural externalities because they involve value judgments and so measuring sustainability is confined to biological and economic efficiency (vanLoon et al. 2005).

As noted earlier, Netting considers measurement of physical, chemical, biological, and socioeconomic variables to be most relevant in predicting sustainability in a farming system. Biophysical sustainability variables can be measured through use of flow indicators such as degradation of soil, water quality, and erosion. Some possible indicators of socioeconomic sustainability are farm productivity, equity, compatibility with community needs and practices, and economic viability (Netting 1993). If the combination of these conditions on individual farms is less than optimal, that would indicate less than sustainable conditions. A number of researchers are beginning to understand the importance of developing an integrative and interdisciplinary model of sustainability indicators that incorporate the environmental, economic, and social components of agroecosystems (Rhoades 1984; Netting 1993; Drost 1996; Bell 2004; Bell 2009; Robinson 2004; Harris 2000).

According to Gibbon et al., “Without indicators, sustainability will remain confusing and complex and hence prone to rhetorical quotation” (1995:50-61).

VanLoon et al. (2005:33) use a sustainability tripod model that incorporates the economic, social, and environmental sectors into a diagrammatic representation used to illustrate the interconnectedness of the three essential components used to determine the sustainability of particular systems.

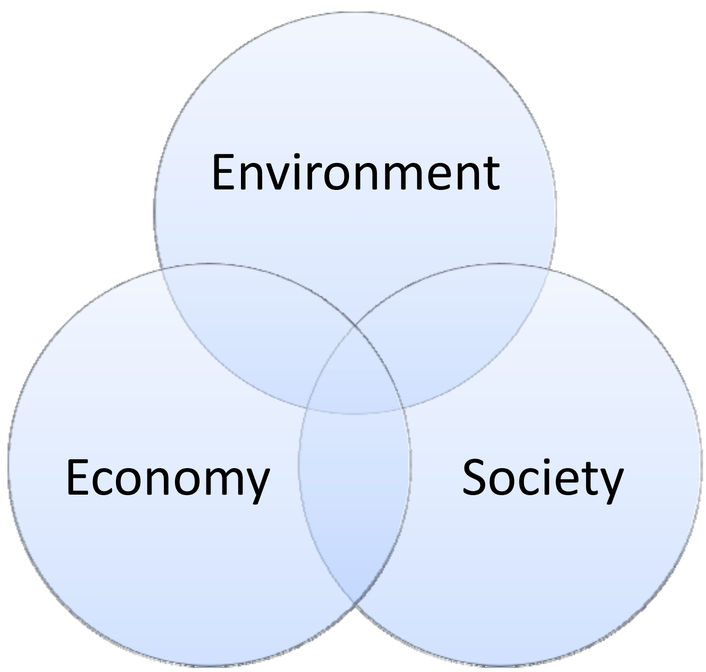


Figure 1: Sustainability Tripod (vanLoon et al. 2005)

All three components of the tripod must be considered in order to develop and analyze comprehensive indicators that can predict the sustainability of systems at various levels of study, from the individual household micro-scale, to the global macro-scale. Although this study focuses on the regional level and is therefore closer to the micro-scale measurement of sustainability, all levels of sustainability are interconnected because of various global influences. Some of the sustainability issues that are of concern in local agriculture systems are productivity, availability of resources, financial viability, ability to grow crops safely, and social equity (vanLoon 2005).

Hak et al. (2007) suggest that in order to use a sustainability model effectively, the three sectors of sustainability must be broken down into indicators of increasingly complex levels of aggregation so that interconnections between components can be understood. Stock indicators show baseline system properties at a given point in time, and flow indicators show changes in the system. Articulation between stock indicators and flow indicators at different levels of aggregation within the system is important for understanding the complete picture.

The DPSIR analytical framework is used by vanLoon et al. (2005:62), and Hak et al. (2007:129-30) to consider cause and effect relationships between components of the sustainability tripod in order to determine possible sustainability indicators. In the DPSIR framework, the 'D' stands for driving forces such as a change in lifestyle caused by the treadmill of consumption. The 'P' is for pressure caused by such things as overuse of land and resources. The 'S' stands for state of the system being measured at a particular point in time. The 'I' is for impacts caused by changes in the state of the system. The 'R' is for responses to effects on the system. This analytical framework shows that each component influences the other in a cycle that can determine relative sustainability. It is very difficult to measure degradation or sustainability in an area and even more difficult to find substantial proof that attributes degradation to anthropogenic causes. Changes in lifestyle that increase consumption of resources can put pressure on an ecosystem, but external inputs can alter the perceptions of impacts on economic and social well-being. Risk perception affects the response to impacts which in turn affects driving forces of change. According to Blaikie (1995), people make transitions in lifestyle based on ideals rather than waiting for hard proof gained through measurement of local degradation.

There is a great deal of information available that is connected to agriculture and food production. International organizations, national governments, and non-governmental organizations all produce data that can be used to study environmental, economic, and social issues. However, measuring sustainability is relatively new and many organizations focus on different aspects of sustainability. Therefore, it is often difficult to know whether information is relevant to a particular situation. Statistics that focus on crop production, land use, and economic activity to measure sustainability can be misleading due to perceptions of progress. It is often found that a proper protocol for collecting data required to measure sustainability has never been developed. Perhaps the most difficult aspect of collecting data on sustainability is that some information is subtle due to complex interconnections between various agencies and therefore difficult to quantify (vanLoon et al. 1995).

One of the greatest obstacles to defining and measuring sustainability is that various groups are in opposition due to focusing on two different scientific paradigms. One side, focused on the Human Exemptionalism Paradigm (HEP) of industrial modernization, is stuck on the treadmills of production and consumption, with their individual oriented focus on constant growth and Gross Domestic Product. The

Human Exemptionalism Paradigm suggests that humans, because they are unique in having culture, are able to solve any social or technological problems that occur and so there are no limits to growth (Harper 2008). Because of the belief that there are no unsolvable limits to human progress, proponents of this view are confident in using the same methods to measure sustainability that are used to measure growth. The other side is focused on the New Ecological Paradigm (NEP), which suggests that humans are interdependent of ecosystems and are subject to the finite limits of the global environment (Harper 2008). The new ecological paradigm centers on sustainability, with a community oriented concentration on system well-being. Proponents of the new ecological paradigm are seeking new ways of developing holistic methods of measurement that do not separate humans from the natural environment and consider both qualitative and quantitative means of measuring and analyzing sustainability.

Chapter Three: Methodology.

The idea for this research project evolved out of a study on vertical integration begun during the winter of 2008. That pilot study involved research and analysis of quantitative data compiled by Ken Meter (2004) on the Ten Rivers region and qualitative data gathered from local farmers and retailers. The information gathered was used to examine some of the ways that farmers in the region could gain more control over the marketing and processing of local farm products through direct marketing strategies. Consideration of the potential for a vertically integrated regional agricultural system developed from a small-scale to large-scale direction rather than the typical top-down methods used by the agribusiness industry led to the idea of addressing issues related to the treadmills of production and consumption and the transition to a more sustainable regional system of food production.

This research builds on theory and praxis derived from political ecology to gather data and relevant information about smallholder farmers in the Ten Rivers region of Oregon. The political ecology approach was most useful for this study because the Ten Rivers region, like any other agricultural region where many small-scale farmers are struggling to become more locally based and self sufficient, is faced with the negative impacts of government policies and global markets that are designed to promote industrial agricultural practices. One of the aims of this study was to gather and analyze both quantitative data and qualitative ethnographic data in order to discover some of the barriers smallholder farmers in the Ten Rivers region are facing and whether they are able to become more sustainable through the use of traditional farming methods. Data were collected and analyzed to determine how those farmers use local knowledge to function within the regional agricultural system and in the context of a global market. Another aim of this research was to consider whether the environmental, social, and economic barriers faced by smallholder farmers could be used as possible indicators to develop a sustainability model.

The design of this research called for a period of participant observation and the collection of qualitative data. I gathered information about agricultural production through participant observation and interviews with smallholder farmers in the region. Quantitative data was accessed through secondary agricultural sources and used as background information relevant to the Ten Rivers region. I used these different methods as a means of triangulation in order to determine whether qualitative analysis corresponded to the quantitative data gathered from secondary sources.

According to the 2007 Census of Agriculture, there are 3,602 farms in the Ten Rivers region. Two of every three farms in the area are less than fifty acres. The USDA defines small farms as those which produce $250,000 or less of yearly sales in agricultural commodities (Census of Agriculture 2009). I considered smallholder farmers to be those who own, rent, or own and rent less than fifty acres for agricultural production as my sample group. This decision was based on information gained from Meter’s (2004) study of the Ten Rivers region and through participant observation at local farms and conversations with local farmers at farmers’ markets. Smallholder farms are often more dependent on surrounding communities because of direct marketing practices and are more likely to develop trust relationships with local consumers. Farms of less than fifty acres, unlike many large corporate farms, are more likely to produce and sell niche market products like organic and heirloom vegetables or value added products like fruit preserves and jams in order to maintain an economically viable farm. However, simply being categorized as a smallholder farm does not guarantee that those farmers are using sustainable practices.

As noted previously, although there is a great deal of information focusing on food production and agriculture, measuring sustainability is relatively new and many organizations concentrate on different areas of sustainability. Data that focus on crop production, land use, and economic activity to measure sustainability can be misleading or incomplete due to varying perceptions of sustainable practices. Perhaps the most difficult aspect of collecting data on sustainability is that oftentimes the background information needed for determining sustainability is not included in statistical analysis or, is too subtle due to complex interconnections between various agencies and therefore difficult to interpret and quantify (vanLoon et al. 1995). Because of these difficulties, I chose to limit the assemblage of quantitative data to geographical information and the information available on organic production as the most consistent and reliable means of measuring the growth and development of sustainable practices in this region.

Background Information

I gathered data pertaining to the state of Oregon and the Ten Rivers region using information from the Agriculture Census websites, the National Agriculture Statistics Service (NASS), and the Economic Research Service (ERS) websites that are accessible through United States Department of Agriculture (USDA). I felt it was important to include some basic geographic information on each county in the Ten Rivers region because there are many different soil types that influence the amounts and types of inputs farmers must use to improve crop production. The varying elevations and proximity to the Coastal and Cascade mountain ranges also has a great deal of influence on growing seasons and rainfall at individual farm locations throughout the region.

The Extension Service at Oregon State University and various USDA websites were useful for locating and gathering quantitative data that was used to better understand the growth and economic viability of certified organic agriculture in the Ten Rivers region. However, since many of the smallholder farms that I was interested in are too small to require organic certification or have decided against certification for other reasons, it was necessary to reach those farmers using qualitative methods.

Qualitative methods

In order to better understand organic farming, I began by participating in an internship with the Organic Growers Club at Oregon State University so that I could get a feel for what it means to grow and sell organic produce. I also incorporated participant observation into the study through visits to direct marketing facilities like farmers markets and farm produce stands. Working with students and faculty at the OSU farm and shopping at different farmers markets and farm stands in the Ten Rivers region helped me get to know some of the farmers who were selling products by direct marketing and to recruit potential interviewees for my research.

Using non-probability sampling methods (Bernard 2006), I interviewed twenty farmers from fifteen different farms throughout the Ten Rivers region who shared their insights on the difficulties of developing sustainable practices in the local area. I conducted semi-structured interviews with smallholder farmers who are organically certified or use other sustainable agricultural methods, and semi-structured interviews with smallholder farmers who are working toward organic certification or other traditional agricultural methods. Research samples were chosen from the three counties within the Ten Rivers region based on farm size and their response to my question of whether they considered their farming methods to be sustainable. My process for choosing interviewees was non-random and opportunistic, based on availability and willingness of informants, and the snowball sampling method of questioning interviewees about other potential participants in the local area (Bernard 2006). Interviews were conducted during the winter and early spring of 2009. Each interview was conducted at the convenience of interviewees and at the location of their choice. The interviews lasted from approximately thirty minutes to a maximum of one hour and twenty minutes. Questions were open-ended and geared toward sustainability and quality-of-life issues. Interview sessions were recorded using a Sony ICD-SX68 digital recorder. An informed consent form and informational letter were offered to all participants at the time of the interviews. I analyzed and coded information collected from those semi-structured interviews by using Weft Qualitative Data Analysis software. The themes that developed through data analysis were used to determine what barriers exist for smallholder farmers in the transition to more sustainable agricultural practices. There are several ways of presenting ethnographic information. Many researchers present the data gathered from specific individuals, or in this case farms, in a chronological order while changing individual names and possibly locations to protect the anonymity of interviewees. The amounts and market values of agricultural products harvested by most of these farms would not be listed by the Census of Agriculture because it would jeopardize that anonymity. I therefore chose to categorize and present themes that developed from the analysis of interviews without the use of individual names of farms, and to change the names of farmers in order to protect their anonymity. The quotes that are presented in the qualitative section are attributed to individuals within the entire group of interviewees rather than to any particular farm.

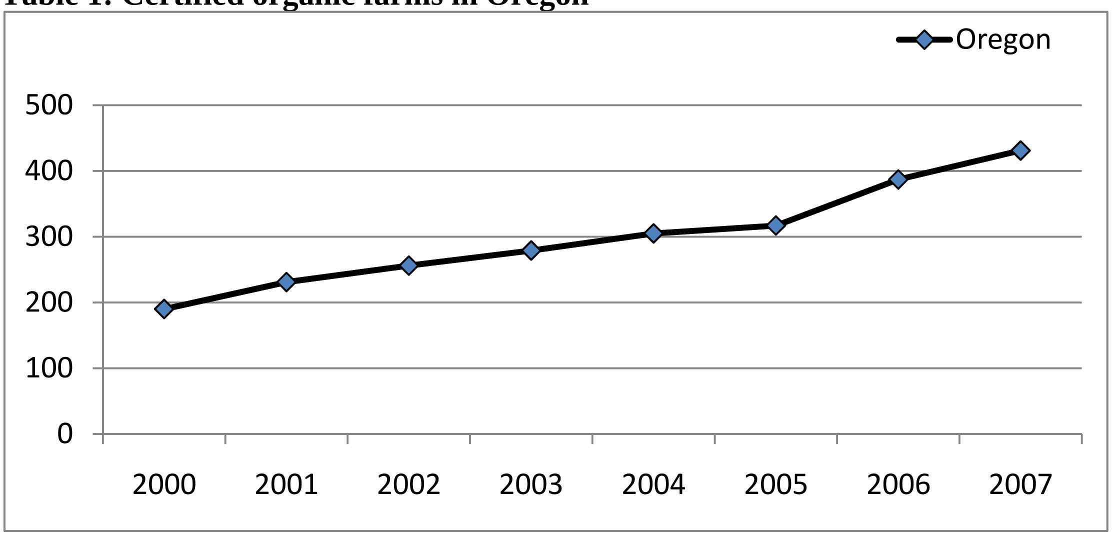
Chapter Four: Background Information on the Ten Rivers Region

One of the greatest difficulties in measuring the sustainability of agroecosystems is determining reliable sustainability indicators. Local systems are influenced by national and global policies and trends, making it difficult to determine a reliable boundary for a study. As noted earlier, agricultural researchers are often hesitant to consider sociopolitical and philosophical decisions made by farmers because they involve value judgments. Quantitative measurement of agricultural sustainability by government agencies is limited to information from certified organic operations and the growth of various sectors within the organic industry. In this section I examine background information gathered from secondary sources and government agencies in order to better understand the status of agricultural sustainability in the state of Oregon and in the Ten Rivers region.

For the past decade, organic farming has been one of the fastest growing sectors within U.S. agriculture. However, it wasn't until 2005 that all fifty states had some amount of certified organic farmland in production and only about 0.5 percent each of cropland and pasture land in the U.S. was certified organic (ERS 2009a). Fruit and vegetable acreage is the fastest growing sector within organic production and is the top selling category within the organic retail market, accounting for thirty-seven percent of organic food sales in the U.S. However, sales of organic products still accounts for little more than three percent of total U.S. food sales. That is still a very small percentage of overall agricultural production nationwide (ERS 2009b).

According to the 2007 Census of Agriculture, there are 933 farms with a total of 92,405 acres used for organic production in Oregon. There are 498 farms with one to nine acres in organic production and 243 farms with ten to forty-nine acres in organic production. That is 741 smallholder farms of less than fifty acres, with a total of 7308 acres in organic production in the state of Oregon. The following table shows the growth in the number of certified organic farms in the state of Oregon from 2000-2007. A certified farm must be certified by an accredited agent as an operation that utilizes a system of organic production or handling in compliance with the Organic Foods Production Act of 1990 (ERS 2009a).

Table 1: Certified organic farms in Oregon



(Census of Agriculture 2007)

Because farms that produce less than $5000 per year are not required to be certified, the total number of farms producing organic products is greater than the number of certified operations (2007 census of agriculture). There has been a steady growth in the number of organic operations over the past several years, indicating a continually growing demand for organic products. Since organic production is such a small percentage of overall agricultural production, the amounts of agricultural products within different sectors, such as vegetables, fruits, nuts, grains and livestock are comparatively insignificant and therefore difficult to make reliable predictions about increases within different categories of production.

I accessed data from the Census of Agriculture to determine growth of organic sales in Oregon. Information on the number of certified organic farms and value of organic products was not available for the 1997 agriculture census. The 2002 census data showed that there were 515 certified organic farms in the state of Oregon with a total sales value of $9,933,000 in organically produced commodities. Table two shows that information supplied by the 2007 Census of Agriculture was much more detailed.

Table 2: Value of US certified organic products in Oregon 2007.

Value of sales of organically produced commodities	Number of farms	Amount
Total organic product sales	799	$88,379,000
Value of sales $1 to $4,999	436	$620,000
Value of sales $5000 or more	363	$87,760,000
Crops, including nursery and greenhouse	665	$41,991,000
Livestock and poultry	95	$3,089,000
Livestock and poultry products	109	$43,299,000

(Census of Agriculture 2007)

Although it is easy to see there was dramatic growth in value of sales of organic products from 2002 and 2007, the data really is not comparable due to lack of information and differences in measurements and categorization of data. Available data on sustainable agriculture collected from government sources at the national and state levels is far too general or incomplete to provide information beyond a starting point for quantitative research. Therefore, research required further study at the regional level.

The Ten Rivers region encompasses Linn, Benton, and Lincoln counties in the Willamette Valley of Oregon. To appreciate the challenges faced by farmers in this study, it is important to understand at least some pertinent elements of the geography and climate in this bioregion and the influence those factors have on agricultural production in the region. Because of the unique and varied geography of the Ten Rivers region, many agricultural practices are not the same as those in the Midwest and other parts of the United States. Variations in climate, from the coastal regions of Lincoln County to the foothills of the Cascades in Linn County, play a major role in determining rainfall and growing seasons on different farms throughout the region. Farm elevations and geographical locations are also an important factor in determining the microclimate of individual farms. There are many different soil types throughout the region, laid down by different geological processes that create unique problems for farmers and require different inputs and farming techniques to produce viable products. In this section I used information provided by the Oregon State University Resource Atlas from each of the three counties to discuss these various geographical aspects within each county of the Ten Rivers region. I also accessed the 2007 Census of Agriculture to provide quantitative data on certified organic production at the county level.

Benton County

Benton County is the middle county in the Ten Rivers region. Located in west central Oregon, Benton County is bordered by Lincoln County to the west and Linn County to the east. The western border of Benton County runs through the Coastal mountain range and the Willamette River forms its eastern border. Corvallis is the county seat and is located about eighty miles southwest of Portland. Benton County covers an area of 668 square miles. About half of that area is covered in forest land and another third is used for agriculture. The major watersheds in Benton County are divided into three separate drainage basins. The Middle Willamette Basin covers 69 percent of the county area. The Mid-Coast Basin, in the western part of the county, covers 28 percent of the county's total area. Four percent of the total area of Benton County is included in the Upper Willamette River Basin.

The climate of Benton County is temperate. Winters are mild and wet, with about 70 percent of precipitation falling during the winter months, while summers are warm and usually dry. Higher elevations within the coast range can receive over 100 inches of precipitation per year, and rainfall decreases to about 40 inches per year in the lower elevations of the Valley. The average growing season on farms near Corvallis is 215 days (Ruttle et al. 1974).

The Benton County portion of the Willamette Valley contains a broad alluvial plain with many different soil types. Table three gives an outline of the various soil series encountered throughout the county. A detailed list of soil types can be found in Appendix (A).

Table 3: Acreage for each soil series in Benton County.

Soil Series	Acres	Percentage of County Area
Rough Mountainous Land	153,344	37.0
Melbourne	53,568	13.0
Olympic	39,872	9.8
Aiken	38,720	9.3
Chehalis	31,936	7.7
Amity	18,112	4.4

Wapato	16,896	4.1
Newberg	16,448	4.0
Willamette	14,976	3.6
Dayton	9,152	2.2
Sites	6,144	1.5
Carlton	5,632	1.3
Cascade	3,392	.8
Grande Ronde	2,688	.6
Cove	2,112	.5
Salem	512	.1
Riverwash	512	.1
Camas	448	.1
Whiteson	256	.1

(Benton County Resource Atlas 1974)

With the Willamette River bordering the eastern edge of the county, and the Coastal Range to the west, Benton County experiences diverse microclimates with varying elevations, rainfall, plant and animal habitats, and soil types. These factors all influence what can be grown by farmers and how farms are managed in different areas within the County.

There were 906 farms in Benton County in 2007. Thirty-six of those farms, with a total of 1,912 acres, were certified for organic production, an increase from twenty farms in 2002. There were thirty farms in which organic crops were harvested. Seventeen farms, with a total of 304 acres, were being converted to organic production in 2007. Table four shows the dollar value of certified organic products and the number of farms in each category of production in Benton County. The 2002 Census of Agriculture did not break values of organic products into categories but, the total value of certified organically produced commodities for Benton County in 2002 was $341,000 (Census of Agriculture 2002, 2007).

Table 4: Value of US certified organic products in Benton County 2007

Value of sales of organically produced commodities	Number of farms	Amounts
Total organic product sales	30	$3,564,000
Value of sales $1 to $4,999	16	$23,000
Value of sales $5000 or more	14	$3,541,000
Crops, including nursery and greenhouse	25	(D)*
Livestock and poultry	3	(D)
Livestock and poultry products	3	(D)

(Census of Agriculture 2007) *(D) Withheld to avoid disclosing data for individual farms.

Linn County

Linn County is the largest and most eastern county in the Ten Rivers region. The county covers approximately 2,300 square miles and lies between the Willamette River on the western border and the crest of the Cascade Range to the east. Topography varies from 212 feet above sea level near Albany to the 10,523 ft. peak of Mount Jefferson in the Cascades range. About one third of the county lies in the Willamette Valley and is fairly flat. The eastern two-thirds become increasingly mountainous and forested, covered primarily with Douglas fir.

Climate in the valley and foothills of Linn County is temperate. Precipitation ranges from averages of about forty inches per year on the western side of the valley floor to over 100 inches annual precipitation in the Cascade foothills to the east. Unfortunately for farmers, “About 60 percent of the annual precipitation occurs during November through February in the winter storm season while only 10 percent occurs during the June through September dry season” (Valde et al. 1973:3).Temperatures are mild and the growing season is over 200 days at lower elevations. The varied topography throughout the county causes multiple microclimates and can influence what farmers produce, depending on elevation and precipitation in various locations.

There was no soil table for Linn County but, these are the six soil groups listed in the Linn County Resource Atlas (Valde et al. 1973): Chehalis-Newberg; Willamette; Dayton; Amity; Holcomb, Clackamas and Courtney; Aiken and Olympic (See appendix A for detailed information).

In 2007 there were 2,325 farms in Linn County. Forty farms, with a total of 2,609 acres, were certified for use in organic production, increased from twenty-nine farms in 2002. Twenty-four of those farms, with a total of 302 acres, had organic crops harvested that year. There were twenty-five farms, with a total of 293 acres, being converted to organic production in 2007. Table five shows the dollar value of certified organic products and the number of farms in each category of production in Linn County. The 2002 Census of Agriculture did not break values of organic products into categories but, the total value of certified organically produced commodities for Linn County in 2002 was $1,298,000 (Census of Agriculture 2002, 2007).

Table 5: Value of US certified organic products in Linn County 2007

Value of sales of organically produced commodities	Number of farms	Amount
Total organic product sales	32	$2,675,000
Value of sales $1 to $4,999	17	$25,000
Value of sales $5000 or more	15	$2,650,000
Crops, including nursery and greenhouse	23	$460,000
Livestock and poultry	4	$165,000
Livestock and poultry products	6	$2,049,000

(Census of Agriculture 2007)

Lincoln County

Lincoln County is the most western county in the Ten Rivers region. Located on the central Oregon coast, Lincoln County is bounded by the Pacific Ocean to the west and borders Benton County in the coastal mountains to the east. The county covers 998 square miles and much of the area is forested.

Climate is temperate with precipitation varying from sixty inches along the coast to over 180 inches in the higher elevations of the Coast Range. Most precipitation occurs during the winter months from October through March with a monthly average of eight to twelve inches in coastal areas and twelve to twenty inches in mountainous areas. The growing season ranges from 250 days along the coast, decreasing to 140 days in mountainous areas. The Yachats, Alsea, Yaquina, Siletz, and Salmon Rivers run through the county and into the Pacific Ocean. Most of the agricultural land in Lincoln County covers the bottomlands around those rivers.

There are four general soil groups found in Lincoln County's farmland. There are alluvial soils, soils derived from igneous materials, those made up of marine sediments, and soils developed from sedimentary rock. The alluvial soils found in terraces, fans, and floodplains are made up of parent materials from the upland slopes of valleys. Soils deposits that make up the flood plains where most of the farming is done range from moderately shallow to very deep depending on local topography (Valde et al. 1974).

In 2007 there were 371 farms in Lincoln County. Of those 371 farms, fifteen were used for organic production, with a total of seventy-two acres certified organic.

There were seventeen organically certified farms in 2002. Twelve farms, with a total of seventeen acres, harvested organic crops in 2007. Nine farms, with a total of twenty acres, were being converted to organic production in 2007. Table six shows the dollar value of certified organic products and the number of farms in each category of production in Lincoln County. The 2002 Census of Agriculture did not break values of organic products into categories but, the total value of certified organically produced commodities for Lincoln County in 2002 was $113,000 (Census of Agriculture 2002, 2007).

Table 6: Value of US certified organic products in Lincoln County 2007

Value of sales of organically produced commodities	Number of farms	Amount
Total organic product sales	11	$28,000
Value of sales $1 to $4,999	8	$4,000
Value of sales $5000 or more	3	$24,000
Crops, including nursery and greenhouse	11	(D) *
Livestock and poultry	1	(D)
Livestock and poultry products	n/a	n/a

(Census of Agriculture 2007) *(D) Withheld to avoid disclosing data for individual farms.

In this section I have used pertinent data gathered from government sources that focus on crop and livestock production, land use, and economic activity to discuss organic production in the state of Oregon and within the Ten Rivers region. As noted earlier, the collected data was limited to organic production in order to improve reliability of information. The data shows an overall increase in organic production state wide and within the Ten Rivers region. However, there is a lack of information available on sustainable practices other than organic certification, meaning those who are transitioning to organic production and non-certified organic operations. There are many farmers using practices that are equally important to sustainability like cover crops, water conservation, and no-spray crops, but for different reasons are not certified and therefore are not included in the available data. Therefore, as a measure of sustainability, the information is incomplete and serves only as background information designed to give the reader a better understanding of the geography of the area and changes in agricultural production over a period of time.

Chapter Five: Qualitative Results

The farming statistics and geographic information provided by government agencies can present the reader with useful data about trends, values, and types of crops that are grown in particular regions but, there are a number of questions left unanswered by that data. Although government agencies and University extension systems are an integral part of agricultural development in the U.S. and the Ten Rivers Region, the main focus of this section is on local knowledge and the experiences of local growers. By talking to those farmers who are working toward developing sustainable agroecosystems, we can begin to understand what is happening at the individual farm level and how local practices are affecting regional sustainability.

My grandparents on my mother's side had been 'Truck Farmers' during the Depression and several of my relatives had continued that style of farming well into the 1970s, so I understood something about the difficulties of farming and direct marketing before my project began. However, my relatives often used synthetic fertilizers and pesticides on their crops because that was the type of farming that was promoted during that time. In order to better understand organic farming, I participated in an internship with the Organic Growers Club at Oregon State University. I worked with other students and volunteers to grow and harvest organic produce for weekly sales. I also visited different farmers' markets and farm stands in the Ten Rivers region so that I could get to know some of the farmers who were selling products through direct marketing strategies and to recruit potential interviewees for my research.

I interviewed twenty farmers from fifteen different farms throughout the Ten Rivers region. Of those fifteen farms, four were certified organic, ten were not certified organic but used traditional farming methods, and one farm was in the process of transitioning to being certified for organic production. The men and women I spoke with were very open and helpful in sharing their insights on the difficulties of developing more sustainable agroecosystems by using traditional farming practices in the local region. The information in this chapter is the result of my interviews with those local farmers (See appendix B for interview questions and appendix C for the list of farmers).

It was difficult to develop thoughtful interview questions for farmers that would allow them to give me their views on sustainability without introducing bias into the interviews by leading the questions toward the areas I was most interested in studying. As I mentioned earlier, there are a multitude of different definitions for sustainability and I wanted part of the interview process to show how local farmers recognize and define sustainability, whether they thought they were farming sustainably, or whether they thought about sustainability at all. Another important and very difficult aspect of the interview process was to disaggregate the concept of sustainability and then address the three separate environmental, social, and economic components within the sustainability tripod. Because of the interrelated nature of sustainability, the themes that developed during the analysis of interview responses of farmers often overlapped these three categories. While a theoretical grounding in political ecology was constant reminder of the socio-political influences of broader systems, local farmers and their personal experiences were the central focus in this study. As Rhoades (1984) states, the study of the farm must begin and end with the farmer. My goal in this section of the study was to examine the elements of sustainability to gain an understanding of what issues and barriers the farmers themselves considered to be the most pressing in the development and maintenance of sustainable agroecosystems. Once barriers were identified and better understood, the final step would be to consider whether those barriers could be useful in building a model that would address the issues as quantifiable sustainability indicators.

Much like the boundaries of the Ten Rivers region, the separate categories of sustainability are also artificially determined by human perceptions, policies, and values. Following the normative approach of political ecology in considering broader systems in relation to local behaviors and farming activities, I decided to begin with questions about general topics within agriculture and move toward more specific farming activities. I therefore began each interview with questions about how long individuals had been farming, why they had chosen the farming methods they did, and how they defined or felt about sustainability issues. I thought that by getting farmers to talk about themselves in the beginning of interviews, when they were later asked about the importance of environmental, social, and economic aspects of sustainability, interviewees were more likely to give me their thoughts on those subjects based on their own individual experiences. Answers did not always follow the numbered sequence of the interview questions, but often came in the form of personal stories that were based on local knowledge and experiences gathered from within local communities and the region. Several interesting and some surprising themes developed throughout the analysis of my interviews with farmers. As noted in the methodology section, I chose to categorize and present themes that developed from the analysis of interviews based on what the smallholder farming community had to say as a group rather than presenting the issues of individual farmers in chronological order. Some statements made by farmers were included in this section because they best summarized the overall position of the farmers' interviewed. False names for individual farmers were used for quoted statements in order to protect the anonymity of those who were interviewed.

My opening interview questions were designed to discover why smallholder farmers had decided to practice traditional farming methods, how they defined sustainability, and whether they felt their traditional farming methods were sustainable. The experience levels of those people I interviewed varied from those who were just starting out in their first few years of farming to those who had been practicing traditional farming methods for decades. Many farmers I spoke with said that they had chosen to practice traditional farming methods because of their own personal philosophies about healthy lifestyles. They felt it was a better a way of improving the health and well-being of the local environment, their families and their communities. Although sustainability was a big issue for all of the farmers I spoke with, most believed it was a difficult concept to explain clearly and an equally difficult goal to attain.

When asked which component of the sustainability tripod was most important to their farming operation, most farmers I interviewed were quick to say that all three categories were interconnected and that each plays a part in the success of a sustainable agroecosystem. However, while keeping the integrated system in mind and how each aspect plays off the others, farmers were able to give me their own ideas on which components they felt were most important or that presented barriers to their goals of a more sustainable farm. The interviewees and I understood that this disaggregation of the sustainability tripod was the product of an artificial categorization process based on human considerations of importance at a particular point in time and it is my intention that the reader should understand this as well.

One prominent farmer in the area considers sustainability to be a 'Holy Grail', something that we search for but the reality is still somewhere in the future. Most farmers I interviewed stated that there are a number of barriers that stand in the way of developing truly sustainable agroecosystems and even more difficulties in establishing sustainable communities. When defining sustainability there were minor variations in the terms used by individual farmers but, James summed it up quite succinctly when he said,

> Well, sustainability to me is farming in such a way that it doesn't compromise the ability of future generations to meet their agricultural needs. In a more specific sense, organics is part of that equation because organics tries to create a sustainable soil system, so that we're not mining the soil, we're creating a living soil organism that can keep producing food for a long time to come.

<u>Organic Certification and Sustainability</u>

I asked farmers about organic farming and the organic certification process and how important they felt that was in achieving sustainability on their individual farms. Although the opinions about certification varied among interviewees, all of the farmers I spoke with thought that organic certification was an important topic of discussion. Less than half of the farmers I interviewed were actually certified for organic production but, most felt it was necessary to have an organic standard that gives farmers an even playing field with everyone practicing by the same rules all across the country. As James put it, “if the word organic is going to mean anything there has to be certification. Now, that said, it's just a bottom line, and there are various degrees of farming skills and sustainability within organics”. Only four of the farm owners that I interviewed had operations that were certified organic and all four were certified through Oregon Tilth. These were also four of the largest farms and each of those farms had been certified for many years. I thought it was interesting that many of those farmers that were not certified said they used the Oregon Tilth website to access information about organic farming practices. As Kathy said, “we like organic I guess because it's good for our bodies, it's good for the soil, it's good for the plants, it's good for everything. We've not chosen to go certified because we are a small farm but we do believe in the philosophy behind it”. All of the crop growing farmers I interviewed said that organic farming methods, primarily the use of non-synthetic fertilizers and pest control, were central to their farming philosophy of working toward sustainability by building up the soil. However, those with smaller farming operations explained a number of significant reasons for not becoming certified.

One of the most commonly mentioned complaints about organic certification among both those farmers who were certified and those who were not certified is that the regulations do not go far enough in promoting sustainable practices. Some farmers complained that there are people who are farming organically, and who are also using large amounts of external inputs, not using cover crops, and not rotating crops as often as they should to help build the soil and be more sustainable. Their criticism was aimed primarily at large agribusiness organizations that have simply changed to organically certified production in order to make more money by catering to customer demand but are still planting and harvesting single crops from large acreages using industrial agricultural practices. Farmers said there are many important issues that are not covered by the federal standards. Those issues were summed up well by Mary who said, “How are you going to mandate wildlife conservation, how are you going to mandate social justice? It’s just not that easy”. According to the interviewees, the number one reason for smallholder farmers not to become certified is that there is too much paperwork involved in the certification process.

Most farmers with small farming operations do not have the time to spend doing paperwork and most said that doing paperwork was not the reason they got into farming. Another important and related problem is the expense of certification. There is the cost of certification to consider as well as the cost of time spent filling out the requisite paperwork. According to Kathy, “they take a percentage of your gross income, not your net income, and it's hard enough to be profitable, we're on such a thin margin as it is that we don't want to give that up". For smallholder farmers, the alternative to certification is getting to know their buyers in the marketplace and letting consumers know they are using the best possible practices to insure the health and safety of the customer.

My reason for starting these interviews with questions about organic certification and traditional farming methods was not to discover whether organic certification was good or bad but to stimulate dialogue about sustainability and how farmers work toward that goal using methods beyond simply having an organic stamp on farm products. The idea was to get farmers talking about the social, environmental, and economic aspects of sustainability.

About midway through each interview I asked farmers whether it was the environmental, economic, or social component of sustainability that was most important, or presented the most difficult barriers in the process of moving toward a more sustainable farming operation. Some said immediately that economics were the most important but the majority of farmers said it was a very difficult question to answer because the components were so closely interrelated. Once the question was asked, everyone began to discuss important elements within all three components in the struggle for sustainability. Based on the answers given by the farmers that were interviewed, I chose to categorize the social, economic, and environmental themes into related subtopics. The social component was broken into the subtopics of philosophy, government policy, and community. Subtopics within the economic component were marketing, machinery, time management, and labor issues. Environmental subtopics were land, microclimate, pest and predator issues, and water.

Social Issues

While there are social elements in each of the categories described, a number of important themes were categorized within the social sector. The most widespread reason farmers gave for practicing traditional farming methods was that those methods best conformed to their philosophical beliefs.

Philosophy

Philosophy is of course a broad term and there were many variations on how people described their reasons for practicing traditional farming methods or why they were changing from methods that are considered conventional to a more traditional farming lifestyle. When asked why some farmers change to traditional methods while others don't, Mary put it particularly well when she said,

> Some farmers view it entirely as a business, while other’s view it as a way of life. And a way of life means the soul is in the growing, and if you are part of the system, you will go to alternative means of growing… I think that's what distinguishes a lot of people who have chosen alternative methods, they want to leave the world a better place than it was.

James said, “They don't feel right about living and farming in a way that's denying future generations the ability to do the same…and so these are people that are thinking beyond themselves”. A major concern for most of the farmers I spoke with was the loss of local knowledge and the problem of trying to educate future farmers so they can carry on that knowledge and ability well into the future. That includes providing a better environment for future generations of farmers to work with. The most important ideals of many traditional smallholder farmers are maintaining a healthy environment that includes plants and animals as well as humans. There are a number of barriers preventing those farmers from fulfilling their philosophical ideals. One problem is that the culture we live in is not designed to be very efficient. According to Ted, “the ideal sustainable system would be if everybody that bought the food from our farm composted their wastes and brought them back to the farm”. There are a number of barriers in the form of laws and government regulations that prohibit a completely sustainable nutrient cycle loop, but all of the farmers I spoke with worked to replace nutrients from on-farm or local sources.

Government Policy

The farmers I interviewed spoke of a number of issues that involved local and state government agencies. Matters like the spraying of pesticides, labor issues, and farm deferrals all require understanding of, and conforming to, government regulations. Most of the issues were considered a minor irritation caused by government interference that threatened the independence of the individual farmers. A number of farmers I spoke with mentioned the importance of the USDAs Farm Bill and how changing government policies affect local smallholder farmers. One of the most talked about issues was the hiring of outside labor and interns on the farm. Educating future generations of farmers by hiring seasonal interns was a very important matter for farmers I spoke with but many were reluctant because of the difficulties and risks involved. Some had made costly mistakes and were very disappointed in government policies. James summed up a costly labor problem that led to a change in how his workers were paid by saying,

> Obviously that kind of took the wind out of our sails, we felt like the State just had no interest in the educational value of what was offered here, as well as a lot of other farms that were doing the same or similar sort of thing.

For local farmers, government policies that continue to cater to those who practice industrial agricultural methods add another level of uncertainty to what is already a risky business.

Community

Community is another broad theme that includes a number of different levels. Most of the farmers I interviewed stressed the importance of localizing the food system in order to keep money circulating within the local region. As Sandra said, "The closer together you're working, the more financially resilient the community you're living in becomes". Direct marketing was an important marketing component for all the farming operations in this study. Because the various direct marketing strategies like farmers' markets and farm stands involve a great deal of interaction with local community members, it is vital for farmers to maintain a good working relationship with their customers. For local smallholder farmers, it is important for consumers to understand that the working relationship works both ways and that farmer's need a fair price for their produce. Many farmers discussed the difficulties of competing with the unrealistic prices of food grown through industrial agriculture practices. Farmer Carol stated, "for the most part, our society is built around the ability to walk into the grocery store and get what you want. If more people could experience what goes into this, then they would be more supportive". Many farmers said that the stress of running a small farming business is compounded by the uncertainties of competing in a fluctuating global market. The answer, according to Henry, lies in "supporting farms at a level of price that doesn't go up and down all the time, and knowing that local support is there. That would change the whole nature of the way these farms operate, who they are, and how they interact with the community". Educating the public on the importance of supporting local food production was a key factor in the traditional farming philosophies of farmers but, for many, it was also a significant barrier.

I was interested to learn that a number of farmers in the Ten Rivers region did not consider themselves to be well-connected with their local communities. Some farmers experienced a closer connection and stronger support from the more distant Corvallis and Portland communities than they did for the community closest to their farm. The most common reason for this disconnect was that the immediate local communities did not support their traditional form of agriculture. James said they feel more connected to Corvallis and Portland, "because we find more people who are like-minded in those communities. There's not much interest in this local community…in organics or local food". One of the problems that worked to alienate farmers from their local communities was the need to hire labor from outside the local area. Farmers had learned that, for the most part, if people in the local community were not interested in buying local produce they most certainly weren't interested in growing or harvesting those products.

On a positive note, those farmers closer to Corvallis are experiencing a growing demand for local produce and that means less cost in transportation to far away markets and more money staying in the local area.

Economic Issues

Although most of the farmers I interviewed said that the three categories of the sustainability tripod were interconnected, when asked to choose the most important component, the majority said that the economic aspects of production were most important. The most common reason for choosing the economic component was that it is impossible to do anything unless the farmer is able to turn a profit and continue operating the business. As Ted explained,

> The environment that we farm in includes the economic and the social as well as the physical environment that we farm. If we don't have enough money coming in to pay all of our costs, it doesn't matter how environmentally benign or positive we might be, we can't stay in business and do it next year.

Many farmers said the key to having a successful farming operation is to keep track of production costs and then set a price that meets or is slightly higher than those costs in the marketplace. Sometimes, the difficulty is in finding a marketplace that will bear those costs. Many of the farmers I interviewed said that the direct marketing strategies they use, like farmers' markets, generally provide a large enough return to stay in business but that the wholesale market is more difficult because they cannot get the prices needed to meet production costs. Another important key is in finding ways to improve production by increasing yields and getting a better return for the amount of labor invested. There are a growing number of small-scale entrants into organic agriculture, partly because the initial investment in land and capital is much more manageable when compared to the large-scale farms of industrial agriculture. However, many new farmers are not successful because they are unable to meet production costs in a shifting economy and develop a viable niche in a highly competitive market. Many of the farmers I spoke with claim that there are a number of barriers that prevent them from meeting those costs and providing a living wage for themselves and employees.

Marketing

Nearly every farmer I spoke with used farmers' markets as a primary direct marketing strategy. Many said they were able to do more business in four hours at the farmers' market than they could do in an entire day at their farm stands. Very few of the farmers I interviewed used Community Supported Agriculture (CSA) as a direct marketing strategy. The primary reason for this was that the size of their operations did not warrant the need for multiple types of marketing and that farmers' markets were more convenient and less time consuming to manage. Although farmers' markets were the most prominent form of direct marketing used, there are a number of difficulties involved in that marketing strategy. For those farmers on the smallest end of the scale the price of a booth at a farmers' market can be a barrier. Because those farmers most often have small amounts and a limited variety of produce to sell, it is difficult for them to sell the amounts of produce needed to pay for their stall fees and make enough money to be worthwhile going to the market. Having the right produce available when it is needed to meet customer demand is a difficult problem for everyone selling at farmers' markets or using other direct marketing strategies. Listening to consumer demand is extremely important for farmers who wish to be successful in direct marketing situations like farmers' markets. It isn't simply a matter of growing crops that make the most money or those crops that are easiest to grow. Farmers must also be able to answer questions from consumers like, what are you feeding your chickens and where is the feed coming from? Is it coming from a local source or from industrialized farms? What types of inputs are you using on your crops and where are they coming from? Another complicating factor is that consumer demand tends to change over time.

I asked farmers how they decided what to grow for each new season. Most said they kept track of what they had sold during the previous few years, which items sold well, and which sold poorly. Everyone had their staples that they tried to grow enough of each year but, what was interesting is that even those items differed among the various farmers. I discovered that the variations depended more on the different microclimates existing where farms were located rather than variations in consumer taste. Microclimates are an issue that I will discuss more in the environmental section but, it is important to note that understanding what will grow in a particular area is a significant part of marketing for farmers. Another part of marketing that is influenced by farmers' social and environmental philosophies lies in deciding whether they will use plastic, especially in the form of greenhouses, to extend their growing seasons. The decision is important because, while implementing greenhouses is a substantial investment, they allow farmers to grow a larger variety of produce for a much greater portion of the year. So, even though farmers who don't use greenhouses may have a few select items during the early part of the season many consumers will go to stands that have a better presentation and more variety to choose from.

I discovered that many of the farmers I spoke with had not really considered the marketing aspects of their operations when they went into business and had been mostly concerned with how to get the farm started. As Janice stated,

> I have to balance the marketing and the farming and I sometimes wish there were two of me, and that's why some people don't do farmers markets, they can't deal with 100 people asking them the same questions. They don't have the temperament or the willingness and that's a whole department I didn't think of when I got into the farm.

For many farmers the presentation and visual appeal of their products was an issue that they had not considered when they started going to farmers' markets and had to learn new marketing techniques as they went along. An important part of visual presentation is the amount of time and labor it takes to set up a visually appealing presentation. Labor was a key issue and one of the most important barriers the farmers I spoke with faced in developing a successful farming operation.

Labor

The issue of labor can be broken into a number of different categories. There is the issue of labor supply or availability, the problem of hiring reliable help when it is needed, and getting workers to either stay on the farm once they have been hired or to return each season when they are needed. The types of crops that smallholder farmers grow and the scale of their farming operations requires a great deal of manual labor.

More importantly, those operations require labor from people who are skilled in that type of work. Ted stated,

> In the kind of farming that we do, the most important issue is the availability of skilled labor. A lot of people think that farm labor is unskilled but, anybody that thinks farm labor is unskilled doesn't know how to do farm labor. There are a lot of people who think that if we got rid of all the people that are working on the farm now, if we sent them back to Mexico or whatever, they could be replaced with people that are drinking coffee and wondering when they are going to get a job. It just won't work because they don't know how to hoe cabbages, and they don't know how to work, and a lot of them don't have the physical stamina that they need in order do it, and they also don't have the mental skills that it takes to do the work.

Farmers said that when they get together to talk during the winter that finding good help, both the quality and availability of farm labor, is probably the biggest issue that comes up during their discussions.

Many of the farmers I spoke with discussed the pros and cons of hiring interns on their farms. For many, hiring interns was part of the philosophy of trying to train future farmers to carry on the knowledge of how to grow their own food sustainably. The issue noted most often with hiring interns was that usually they would come to the farm and work for a year or possibly two years and then move on to work at another farm or possibly start their own farms. Or, because the interns hired are often young people, they would discover that farming was not for them and realize that they were just experimenting with that way of life and move on to another field of study. Another problem often mentioned with hiring interns is that it requires training new people year after year, which takes a lot of time and effort and can become very exhausting. Many of the growers with larger operations discovered that hiring experienced help that knew how to do the job rather than taking the time to train interns was more profitable in the long run. As James stated, “we are still interested in providing an education for future farmers but, we don't do as much as we used to, partly because we're worn out and because we don't have any support from the State”. Those farmers with smaller operations often felt that it was less time-consuming to simply do the work themselves rather than trying to train interns who were not likely to stay on for the long-term. For nearly everyone there was a concern about what it takes to hire a person, understanding the laws about interns, volunteers, apprenticeships, and child labor. I found it interesting that so many of the farmers I spoke with, especially those who were older, lamented the loss of young people on the farm. As Janet said,

> you know, when we did away with the small farmer, many of us did away with hiring teenagers after school to do the things that we would've done on a small scale. What they used to do by hand, now the farmers rely on chemicals to do the job.

Most farmers felt that in the past hiring teenagers was a win-win situation. Kathy said “the kids got to bring in a little income, they built character and learned where their food comes from, and the farmers got the labor that was most needed at the most important time of year”. Another problem that was very often discussed alongside labor issues was time management on the farm.

Time Management

For the smallholder farmer, time is the most important resource. Because it is so difficult to find and afford qualified labor for intensive manual activities like planting, weeding, pruning, and harvesting, farmers must focus on how to manage their time wisely. Animals must be cared for at the appropriate time, planting must be done at the appropriate time, and because the farmers I interviewed did not use synthetic chemical pesticides, weeds and pests must be controlled at appropriate times in a very precise and intensive manner.

Most of the farmers with larger operations sold their products at several different farmers' markets. Most had crews going to Portland farmers' markets and a few would go as far as Bend to sell their products. Therefore, transportation, market set up, and clean up were important time issues to consider. With all the problems that come with the day-to-day operations of the farm like training and supervision of workers, the planting, growing, and harvesting of crops, as well as caring for animals and machinery, it is difficult for farmers to find the time to look farther down the road to improve designs and start new projects. Many of the farmers complained that although there are a number of grants and incentive programs available for smallholder farmers that would help them to make their operations more sustainable, particularly in the area of renewable energy, it was just too difficult to find the time to do research on new projects and stay caught up with the daily paperwork required for running the farm.

For those smaller operations where the farmers are doing everything from planting crops to marketing, the stress caused by not having enough time to do everything is a serious issue. The farmers often spend long exhausting hours harvesting and preparing their goods for farmers' markets and then need to put on a happy face to be helpful and warm towards their customers at an early-morning market the following day. One of the biggest reasons for applying for grants and incentives by farmers is to gain access to machinery and technology that will allow them to do more work and increase production with the limited amount of labor that they have available.

Machinery

A very significant barrier faced by smallholder farmers is the lack of appropriate scale technologies that will allow them to increase production and help them to get everything they need done in a timely fashion because, as many of the farmers I spoke with said, “there just aren't enough hours in the day”. Most of the farmers improvise and modify equipment that has been purchased or gathered together from older farming operations. Much of the equipment being used by the farmers I spoke with is very old and from a time when the scale of farming was more appropriate for smallholder operations: In other words, more traditional farming equipment. All of the farmers I spoke with said they try to mechanize their operations as much as possible. Unlike the few very large pieces of machinery that are needed on industrial farms for large-scale mono-cropping operations, these smallholder farmers must utilize and improvise with many different and smaller types of equipment. There is the necessity for small tractors and equipment like cultivators and plows, tillers and mowers, which allow growers to farm more intensively. Because labor cost and availability is such a significant problem, there is always the pressure to mechanize operations as much as possible. Also, there is the motivating factor that mechanization is simply easier on the body and allows people to work longer hours.

Unfortunately, most of the crops being grown and sold directly to customers must be harvested by hand because machines would simply beat things up too much and make products unsellable. And so, even with the help of mechanization and appropriate scale technology, there is still a huge amount of manual labor involved.

For those farms with several acres in production, or those farmers who are trying to increase their acreage under cultivation, a big problem was the cost of new equipment. As Dale stated, “much of the technology that small farmers are using, they're pulling out of farm buildings and sheds, stuff that's 30, 40, and 50 years old”. One of the problems with improvising and modifying old equipment is that often parts are difficult to find or unavailable and, because the equipment is being improvised and modified, there is often a lot of time-consuming trial and error that goes into perfecting equipment to increase production.

For most of the farmers I spoke with, mechanization was more often a matter of necessity rather than a desire to increase the use of machinery. The problem they said was that as more petroleum powered machinery is used on the farm, the less environmentally sustainable the operation becomes, and many struggled with rationalizing that paradox.

<u>Environmental issues</u>

There were several important themes that fell under the heading of the environmental component. I kept the environmental category limited to physical aspects such as soil and land issues, water, microclimate, and pest problems. However, like the other components of the sustainability tripod, the environment is just one aspect of a farming operation that is closely tied to everything else. The central focus of all the produce growing farmers I spoke with was the importance of building up healthy soil in order to develop and maintain a more sustainable agroecosystem.

Land

Creating a healthy and sustainable soil system was an important part of the farming philosophy held by most of the growers I spoke with. The idea, they said, was to create a living soil organism that will continue to produce food far into the future as opposed to many industrial agriculturalists that tend to see the soil as a medium into which various external inputs like pesticides and fertilizers are added in order to increase output.

The primary land issues for farmers were the price of land and capital expenses of getting involved in farming, barriers caused by land use planning, and the availability of land that is accessible and usable for farming operations. A few of the farmers had either inherited property or bought land that was previously in non-organic production and they were in the process of transferring the farming operations from heavy chemical use to organic food production. However, the majority of farmers I interviewed had started from scratch and had worked to build their farming operations from the ground up. Some of those farms were situated in locations where the practices of surrounding farms had an effect on their smallholder operations.

Several of the farmers I spoke with mentioned the problem of drift. They said that it was important for the farmers who were trying to grow produce organically to consider chemical drift from farmers who were spraying crops in the surrounding area.

Most said it was an issue more closely related to community ties and the importance of maintaining good relationships with your neighbors so that time-consuming arguments or lawsuits did not occur. Most agreed that once people in the surrounding areas understood the importance of keeping organic goods free of synthetic chemicals it was not such a big problem but, sometimes education is a slow process.

Many farmers said that tax deferrals for farmers were useful but sometimes it was difficult for smallholder's to maintain what is considered a viable farm in order to get those tax cuts. Farmer Kate told me, “unless you find a place that is already zoned EFU (Exclusive Farm Use), it is very difficult to get a small piece of property that would make a good farm without paying higher taxes or having to go through a lot of hoops”.

A significant barrier for larger operations that were trying to accommodate a larger work force was caused by land-use laws that did not allow farmers to provide community housing for workers on the farm. Farmers agreed that land-use laws were important but, it is not helpful to put up barriers that prevent farmers from being more productive and financially successful.

One of the biggest barriers for farmers was that once their operations began to be more successful and they were ready to increase production, there was often no land available in the near vicinity for them to expand their farming operations. With all of the time constraints that I spoke of earlier it was just not feasible for farmers to try to acquire property that was a long distance from their original operations because of the time and energy involved in hauling people, equipment, and produce back and forth between sites. The alternative to acquiring more land was to farm the original property more intensively often by adding greenhouses to extend the growing season.

The practice of farming more intensively can lead to more difficulties for farmers. One problem was that farming more intensively requires more inputs to replace nutrients needed to maintain a healthy soil system. Farming more intensively requires everything to work harder, from machinery, to human labor, to the soil itself. Intensification involves more time, energy, and expense from farmers but also goes against the philosophy of building up and maintaining healthy soil that requires less maintenance and fewer inputs over time and is therefore more sustainable in the long run. None of the farmers I interviewed were against the use of greenhouses or those who utilized them extensively due to limitations of space but, many tried to minimize the use of non-renewable resources like plastics made from petrochemicals. Every operation I visited had at least one greenhouse or some form of plastic covering that was designed to extend the growing season and reduce the effects of the various microclimates in the region.

Microclimate

When I began this project I had not considered the importance of microclimates but soon realized that it was an important issue and in many cases a significant barrier for farmers in the Ten Rivers region. As was noted in chapter four, various climates throughout the three counties range from the coastal regions of western Lincoln County, the coastal range, the lower valley elevations in Benton and Linn counties, to the higher elevations of the Cascade Range in eastern Linn County.

As Janice put it, “in the Willamette Valley you’ve got varying elevations, varying moisture, you've got clouds, you've got no clouds, there are diverse fluctuations and you need to learn what you can and cannot do on your land”. Those living in coastal areas are often at higher elevations and are more limited to cold weather crops that they can grow outdoors or need to utilize greenhouses in order to increase production or extend growing seasons. Unlike the large mono-cropping operations where the treadmill of production determines farming practices, these smaller operations emphasize diversity and so farmers are able to compete by growing products that are more suitable to a particular area. Many smallholder farmers have been able to turn what those in industrial agriculture would consider a limitation into a positive marketing strategy by advertising local seasonal produce at farmers’ markets. Farmer James, who wanted to limit the use of greenhouses said, “by growing things that were only adapted to this site we became more attuned to the seasons and I think we have a better and deeper understanding and a deeper feeling for what's happening right here by only growing seasonal produce”. Those smallholder farmers who raise animals for sale are not quite as limited by the effects of various microclimates on growing seasons but the issue of local climate and global climate change was a concern for everyone.

Water

All of the farmers I spoke with were concerned about the issue of water. Even those who were near rivers and had plenty of water for their farming operations said that the issue will become increasingly important in the future due to changes in growing seasons caused by global climate change. For many of the farmers I spoke with, water was the primary limiting factor on their farms. Location of farms played a key role in the amount of water that was available for irrigation purposes. Much like changing microclimates, a distance of a few miles could mean a difference of many pounds in water pressure from a well. Several farmers used rainwater catchment systems and drip irrigation to lessen the strain on their wells but, the problem was that those systems are expensive to install and maintain. Many farmers spoke of the importance of building up the soil with organic matter and planting cover crops in order to increase its water holding capacity.

Pests and Predators

The problem of dealing with pests in a sustainable fashion, whether they are insects, weeds, or animals that are a threat to plants and livestock, is a very complex matter when the farm is viewed as a closely integrated agroecosystem. Farmers need to consider the timing and consequences of each action they take to control pests and how those measures will affect other things on the farm. Many of the farmers I spoke with lived in areas where controlling animals that do damage to both plants and livestock were simply a part of the daily struggle. Most felt that having natural predators around the farm was a worthwhile trade-off that allowed for a healthier and more diverse system. As Kate told me,

> Our laying chickens are out on the pasture 365 days a year. Our broilers are protected by shelters but those shelters are on grass and they get moved to a fresh piece of grass every day. So, they're a little better protected from the crows and the hawks and the coyotes and the bobcats and the raccoons, while having the benefit of eating the grass and having fresh air, and it makes a difference.

I got the impression that farmers saw predators not as something they were fighting against and trying to eradicate, but as an important part of an agroecosystem that needed to be understood and properly managed.

Unlike those growers who use synthetic pesticides to control pests, farmers using traditional methods must be more careful in their management practices. As Mary said, “We have to be a little bit more timely in our management practices because we don't have some of the ‘hammers’ available to conventional growers.” Many farmers used mating disruption or confusion pheromone techniques that require a more precise and more intensive approach to pest control. Other methods farmers used were to plant insectiary plants in the fields and beetle banks to provide ground habitat for beetles and other beneficial insects. Many also place bat boxes and bird boxes on the farm to provide habitat for those animals that eat a lot of flying insects. Overall, the key to maintaining a healthy agroecosystem and controlling pest problems was to encourage biodiversity on the farm.

Maintaining ecological stability is central to traditional, systems based farming operations. Most farmers see a pest outbreak as an imbalance in the system and they try to regain and maintain that balance through diversity. It is important to have a diverse cropping mix that rotates several different types of crops and utilizes cover crops. Those traditional farming methods contribute to a healthier agroecosystem and help to build soil as well as control both plant and insect pests. There is a vast amount of local knowledge that is required to understand how the overall system works on individual farms. That local knowledge is invaluable for the intense focus and precise timing needed to ensure that pest problems don't get out of hand and crops or livestock are not lost because of poor management skills.

Developing local knowledge takes time and often a lot of research on the part of smallholder farmers. As mentioned earlier, time and the availability of appropriate scale technologies are often a limiting factor for farmers. Most of the farmers I spoke with spent many hours searching the Web for information on how to deal with pests in a sustainable manner. Most were willing to try new products and methods for lessening pest problems but in the end it still came down to a lot of trial and error and manual labor to learn the best ways to improve production and sustainability.

Farmers say that acquiring useful knowledge is important both on the farm and for educating consumers within the local community. I wrapped up my interviews by asking questions about the most important issues facing farmers today and the future of farming.

The Future of Farming

My goal in asking about the future of farming was to see if the interviewees had changed their thoughts on the most important issues for smallholder farmers and perhaps discover any new ideas about barriers to sustainability. Most were fairly optimistic about the future but said the most important issues that need to be addressed in the near future are healthcare, financial stability, and education resources for both farmers and consumers.

Healthcare

Healthcare was one of the most important issues for all of the farmers that I spoke with. From concerns over lack of healthcare, to the problem of paying health benefits for workers, to the necessity of keeping an outside job in order to maintain health benefits and continue their farming operations, healthcare was a significant barrier for everyone. As Janice stated,

> I know I should have health care but who can afford it? Health insurance is heavy on my mind because, what if something happened to me, no one else is going to run this place, but at the same time, I don't have the money to dish out every month. So, I'm in a pickle and I'm not sure what to do.

Many said that if landowners were able to pay their workers higher wages and health benefits, it would increase the likelihood that those workers would stay on the farm for a longer period of time. Also, workers would be able to stay in the area and raise families that would in turn become an important part of the agricultural community.

Financial Stability

A major focus for the majority of farmers I spoke with was in achieving financial stability. I chose to discuss the issue here as well as in the Economic Issues component because most farmers viewed financial stability as a future event. Farmers said that in order for the farm to be sustainable, they had to be able to make a reasonable living. Unlike the volume-based, subsidy supported enterprises within industrial agriculture; smallholder farmers will need to get a substantially larger amount of money for their produce in order to be sustainable.

Farmers said that there are consumers out there who are willing to pay more for their food but the numbers of people who are unwilling, and unable, to pay a greater price is still very high. There is a willingness to pay more for food that is healthy and sustainably grown but, that willingness needs to go much further if we are going to create a truly sustainable system. As James explained,

> generally, the economics of farming don't allow us to support very many people at a family wage. And so, that's one of the biggest barriers, if we were getting more money for our produce then we'd be able to support more people who would stay longer, and that experience really pays off in creating that community to run the farm.

A number of farmers said that it is often those people with a better understanding of what goes into the production of their food who are willing to pay more. When people are motivated beyond simply getting the best deal financially, and are incited by broader social concerns, they are willing to pay more for food and so support the larger issue of sustainability. And so, another important issue for the present as well as the future of farming is the education of both farmers and communities as consumers.

Education

Many farmers mentioned Oregon State University as a resource but the opinions about how helpful the University was ranged from the very positive to the very negative. Most stated that there were a number of useful resources available at the University that were helpful to farmers who already have established farming operations. However, there has been a lack of resources available on how to farm successfully, especially for new people who are just getting into farming.

Farmer James said,

> You can go to the university and learn to farm, and come out with a twenty thousand dollar or more debt, and then you have to try to get into a farming enterprise that doesn't pay very much, it's kind of hard to do when you've got a lot of debt, or you can go work on other peoples' farms, they can't really afford to spend much time educating you, because they need you to produce.

There was an overall consensus that the University has become more interested in organic crop production in the last several years but focus on the broader topic of sustainable agriculture was still an issue where the resources are fairly limited.

Although most of the farmers I interviewed were critical of the overuse of pesticides and industrial agricultural practices, there was very little rancor against those farmers who were not as concerned about sustainable methods, nor was there an attitude of ‘us against them’. Many felt that there were answers to farming issues out there in the broader farming community but, information was often too difficult to access. Farmers said they hoped that as the availability of resources grows and, as the numbers of people who are interested in sustainable farming increases, the easier it will be for both new and experienced growers to become economically, socially, and environmentally sustainable. However, it was often noted that although there is an impressive network of farmers interested in traditional agriculture here in the Willamette Valley, farmers still tend to be independent-minded people and they don't often go to other people for advice on how to run their farming operations. For now, even though conditions are slowly improving, there is often a lack of connection among farmers and the majority of consumers which makes it difficult for local smallholder farmers to prosper.

Chapter Six: Discussion

The first aim of this research study was to gather and analyze both quantitative and ethnographic data in order to discover what environmental, economic, and social barriers smallholder farmers in the Ten Rivers region are facing and whether they are able to develop more sustainable practices through the use of traditional farming methods. The other aim of this project was to consider whether the barriers faced by those smallholder farmers could be used as possible indicators for a model of sustainability.

This research was based on the theory and praxis of political ecology. The impacts caused by industrial agricultural methods, the treadmills of production and consumption, and a number of alternative agricultural methods were also explored. I kept that background information in mind while gathering data and relevant information about the ways that smallholder farmers in the Ten Rivers region of Oregon live and work in the local area, within the context of the global environment.

As I moved forward with my research for this study it became increasingly apparent that political ecology was the most appropriate theoretical model to incorporate into project. Robbins states,

> political ecology seeks to expose flaws in dominant approaches to the environment favored by corporate, state, and international authorities, working to demonstrate the undesirable impacts of policies and market conditions, especially from the point of view of local people, marginal groups, and vulnerable populations. [2004: 12]

The local smallholder farmers I spoke with were often dealing with the undesirable impacts of government policies and externally imposed market conditions. It became clear that changes in the global market influenced all aspects of agricultural production, from the price of gasoline needed to transport farm products to the market, to the prices that local consumers were willing to pay for those products.

While interviewing farmers for this project, the terms microclimates and diversity were repeated many times and were a reminder of Zimmerer's (2003) discussion of overlapping patchworks used in mountain agriculture. There were a number of parallels between the overlapping patchwork model and the methods used by local farmers to maximize production in the midst of environmental and political-ecological uncertainties. Crop diversification was utilized in order to maximize the chances for success in non-equilibrium agroecosystems affected by shifting environmental, social, and economic elements in the local region.

The work of Escobar (1996, 1999) and Bebbington (1996) was very influential in helping me to see the importance of developing alternative discourses based on local knowledge acquired through participation in unique regions and communities. Different views of nature and environmental degradation can be incorporated into new strategies that allow local communities a stronger voice in negotiating with external forces in the adoption of changes in management plans that will promote sustainability.

This research was designed to present the views of local smallholder farmers that are based on local knowledge developed through active participation in various communities throughout the Ten Rivers region. A number of farmers in the area are using traditional farming methods to repair the social disconnect caused by externally based unsustainable production and consumption behaviors created by industrial agricultural practices. Analysis of data was presented to show how farmers use local knowledge to manage smallholder farms within the context of a global market and to expose the barriers that make it difficult for them to farm more sustainably. In discussions with local farmers I learned that there was a great deal of concern over the damaging effects caused by industrial agricultural practices. Although the terms treadmill of production and treadmill of consumption were seldom used in those discussions, it was clear that the farmers I interviewed were more concerned with the long-term process of building up communities rather than short-term competition in the global market. The Economic constraints caused by neo-liberal strategies have introduced competitive pressures that require increased productivity through inputs and larger more efficient mechanical technologies. Those strategies have caused many rural people to move to cities in order to find better economic opportunities. Long-term sustainable development projects require a restructuring of markets and a focus on regional community relationships that will increase control of production and distribution of higher-value and processed products in the hands of local populations. More local control of production and distribution will increase farm income and reduce out-migration of rural people. All of the farmers I spoke with were working hard to develop more sustainable agroecosystems to increase the overall well-being of their homes and communities.

In chapter four I presented background information gathered from government agencies to address some of the important aspects of agricultural sustainability in the state of Oregon and in the Ten Rivers region. Most of the gathered data was limited to information from certified organic farming operations and growth in various sectors within the organic industry. Although organic farming has been one of the fastest growing sectors within U.S. agriculture for the past decade, sales of organic products still accounts for little more than three percent of total U.S. food sales (ERS 2009a). Results of analyzed data collected from government sources showing a fairly steady increase in the overall production within the organic market was not unexpected. However, even though the information pertaining to many sectors was fairly limited, it appeared that organic growers in Oregon and the Ten Rivers region seemed to be struggling to find which crops were best suited to local markets and developing niche markets for their products. I felt confident enough with the results to suggest that the quantitative information did conform fairly well to the ethnographic data presented in chapter five. More farmers are attempting to farm organically but, they are encountering barriers that make it difficult for them to prosper. Collecting ethnographic data from smallholder farmers in the Ten Rivers region allowed me to better understand the barriers that individual farmers were facing in developing more successful farming operations and sustainable agroecosystems.

Although farmers practice methods that they feel will work best for them based on the peculiarities of their individual farms and the information they have inherited or accumulated through experience, personal philosophies were the deciding factor in how operators chose appropriate farming methods. This research has described how local farmers apply their own personal philosophies to farm management practices in order to produce healthier high quality farm produce, reduce pollution, and become better stewards of the land. Research has shown that the limitations to increasing production caused by intensive labor practices, environmental constraints, and divergent local perspectives of both consumers and producers have often made the transition to more sustainable agriculture a difficult process.

My goal when I began this research was to interview smallholder farmers in the Ten Rivers region to discover what barriers prevented them from adopting more sustainable farming practices and then apply that information to a model of that would present those limitations and shortfalls as measureable sustainability indicators. As vanLoon et al. state, "an indicator is a number or other descriptor that is representative of a set of conditions, and indicates or points to aspects of an issue" (2005:56). Government agencies often use top-down economic indicator models to measure environmental degradation by monitoring agricultural crop yields. If crop yields decrease, it is assumed to be a clear indication that changes in agricultural practices are required to increase productivity. Based on the quantitative information gathered during this research study, it would appear that the overall growth in organic production is positive and therefore indicates an increase in sustainability. As I noted earlier, using only economic growth indicators to measure sustainability is unreliable and simplistic. The top-down models used to measure economic productivity were not well suited to this study because the scale of these smallholder farms did not allow most to even show up on the records. For the group of smallholder farmers I studied for this research project, crops are diverse and production is comparatively small scale, with most sales limited to direct marketing strategies. Farming practices included considerations of long-term environmental and social aspects requiring holistic measurements of sustainability that are not included in most models.

Local studies are affected by multilevel national and global influences that are difficult to quantify through scientific measure but are critical to understanding problems of sustainability. As noted earlier, agricultural researchers have often been hesitant to consider social and cultural externalities because they involve value judgments and so measuring sustainability is confined to biological and economic efficiency (vanLoon et al. 2005).

I chose to follow the lead of other researchers and try to develop an integrative model that incorporated the environmental, economic, and social components of sustainability (Rhoades 1984; Netting 1993; Drost 1996; Nazarea et al. 1998; Bell 2004; Bell 2009; Robinson 2004; Harris 2000). As my research progressed and the importance of local knowledge applied to specific locations and microclimates became clearer, I grew less optimistic about the possibility, or even the need, to design a model of sustainability indicators that could be applied to areas beyond the Ten Rivers region. Nevertheless, I carried on my research with the hope that some form of model could be developed. Like vanLoon et al. (2005), I chose to build a sustainability tripod model that would incorporate economic, social, and environmental components into a diagrammatic representation that would be used to illustrate the interconnectedness of sustainability in regional agroecosystems.

All three components of the tripod were considered in the effort to develop comprehensive indicators that could be used to predict the sustainability levels of smallholder farming systems. Although this study focused on the regional level and should therefore be considered small-scale, a theoretical background in political ecology required an awareness and inclusion of external influences caused by government policies and global agricultural markets into the model.

As Hak et al. (2007) have suggested, I worked to develop a sustainability model in which the three components of sustainability were broken down into indicators of increasingly complex levels of aggregation so that interconnections between components could be visualized easier and also better understood. I adopted the DPSIR analytical framework used by vanLoon et al. (2005:62), and Hak et al. (2007:129-30) to analyze the cause and effect relationships between components of the sustainability tripod and to determine possible sustainability indicators. In the DPSIR framework for this study, the 'D' stands for driving forces. Those would be personal philosophies held by individual farmers, environmental limitations caused by land, soil, and other geographic issues, and economic limitations affecting financial stability. The 'P' is for pressure caused by such things as lack of water and other resources caused by agricultural intensification, government policies, and consumer demand. The 'S' stands for state of the system being measured at a particular point in time. The 'I' is for impacts caused by changes in the state of the system such as pest outbreaks, health issues, and changes in the agricultural market. The ‘R’ is for responses to both internal and external effects on the system. The analytical framework can be used to show that each component influences the others in a cycle that determines relative sustainability. It is very difficult to measure degradation or sustainability in an area and even more difficult to find substantial proof that attributes degradation to anthropogenic causes. Changes in lifestyle or livelihoods can increase consumption of resources and put added pressure on an ecosystem. But, external inputs in the form of consumer goods can also alter the perceptions of impacts on environmental, economic, and social well-being. The ways that people perceive potential risks to natural resources affects their response to impacts which in turn affects driving forces of change. In other words, people make transitions in lifestyle based on their own ideals and philosophies rather than waiting for quantitative evidence of local degradation based on scientific measurements (Morse and Stocking 1995).

Like others, I struggled for some time with the problem of quantifying information that was essentially subjective and based on individual perceptions gained through personal experiences. The question was how the information that had been acquired through interviews with local farmers could be turned into sustainability indicators that were applicable to areas beyond the Ten Rivers region. In the end it was the farmers that I spoke with who helped me to realize that the idea of sustainability itself is a subjective notion that often changes depending on different individuals, communities, and regions. To apply sustainability indicators that were gathered from the Ten Rivers region to other agricultural regions would simply be a continuation of the top-down model of applying externally imposed criteria for the measurement of sustainability to areas where local circumstances, with unique social, environmental, and economic constraints, may be viewed from an entirely different perspective (Nazarea et. al 1998). I reminded myself of Blaikie and Brookfield's (1987) explanation that the goal of the regional political ecology approach is to develop multiple hypotheses based on local and regional conditions rather than a universal model that may or may not be useful in different areas.

Once I began to see the sustainability model as a means of asking relevant questions about subjective ideals rather than a quantitative measurement of sustainability based on a predetermined standard, I became much more comfortable with how the model could be used by both farmers and researchers. Rather than seeing sustainability as a standard to be met with grades of pass or fail given to different communities, the data that I gathered from the Ten Rivers region could be presented to farmers in the local area and in different regions who could then consider that information from the perspective of local communities. Farmers in different regions and communities could then apply their own local knowledge to those issues presented by the sustainability model which are most relevant to their particular situations and perhaps share their information with farmers in other areas. In the end, the final product became a model of sustainability questions in a tripod form that farmers can use to make their own determinations about where they stand on the sustainability scale.

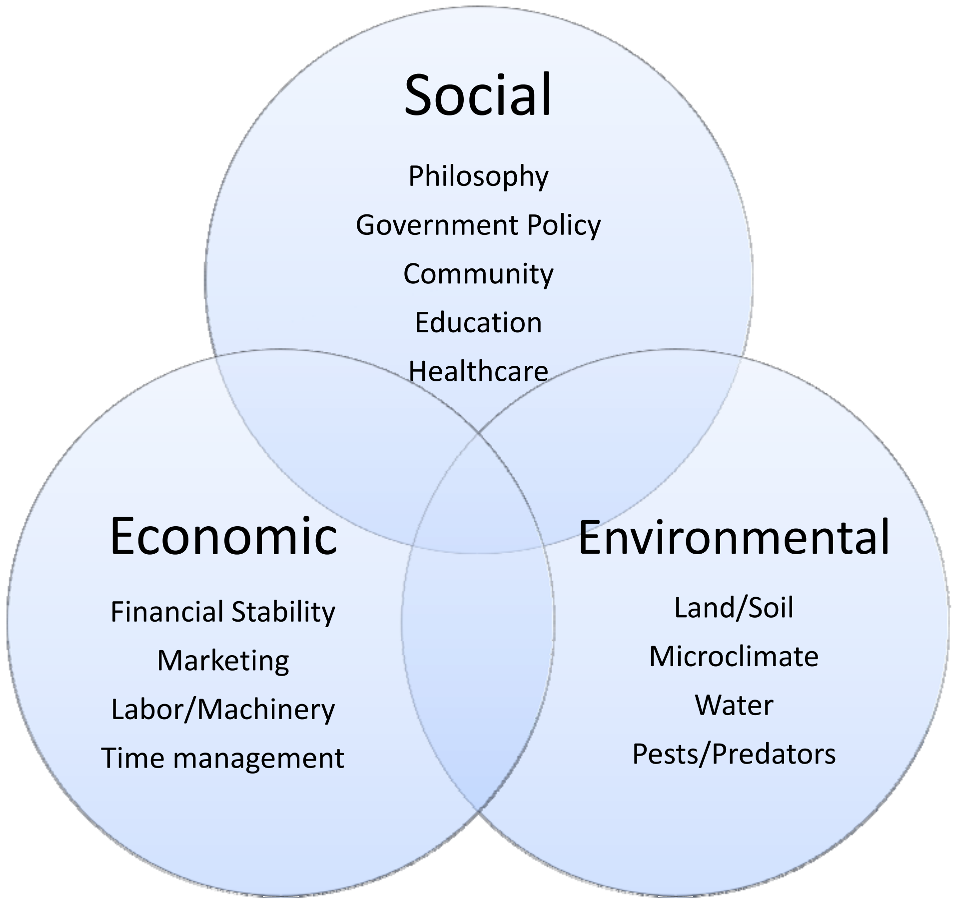


Figure 2: Sustainability Questions Tripod.

The subheadings within each of the three sustainability components are based on the themes that developed through interviews with smallholder farmers in the Ten Rivers region. Categories within the three components are intentionally broad and designed to guide farmers and researchers in asking more specific questions about issues that farmers face in transitioning to more sustainable agricultural practices. I think it is important to reiterate the interconnectedness of each of the components within the sustainability questions tripod. The tripod model stresses the circular nature of cause and effect and shows that while subheadings may be assigned to relevant places within the tripod, a more complete understanding of any of these individual issues depends upon their context within the broader system. However, I was careful to place the issues of primary concern to the farmers in the Ten Rivers region first in each list of subheadings within the three components in the sustainability questions tripod

In the social component, individual philosophies of farmers were the element that shaped their identities and helped them to determine their views of environmental and economic issues. In the economic component, financial stability was a primary concern for all the farmers in this study. Without financial stability it is impossible to move forward and accomplish what is necessary to develop and maintain a sustainable agroecosystem or a healthy lifestyle. The most important subheading within the environmental component was the combined issue of land and soil. Land is of course the primary element in farming. In order to develop a sustainable agroecosystem, farmers must have available land to develop and maintain a healthy soil system. Each of these elements, while crucial to a successful farming operation, is very subjective when placed in the form of a question and therefore should not be confined to externally imposed categories of measurement. Individual philosophy is a vital part of the farmer's identity and should therefore not be quantified. Financial stability is determined in part by the individual farmer's worldviews but is also determined in part by the local region in which the farmer is doing business. Land and soil issues are also determined primarily within the local context. Land prices and availability differs from region to region. Soil types and quality also vary depending on the location and geographical contours of each area and history of land use. Therefore, it is important to consider each of these issues within the sustainability questions tripod on a region to region basis, within the context of national and global social, economic, and environmental issues.

My research on the topic of sustainable agriculture began at a very broad macro-scale and moved progressively toward a very small micro-scale. There is a great deal of information available that is connected to agriculture and food production. International organizations, national governments, and non-governmental organizations all produce data that can be used to study environmental, economic, and social issues. The information I found pertaining to industrial agriculture and the treadmills of production and consumption was very helpful in laying the groundwork for this study. The agricultural information that was found in government websites was also useful in gaining a better understanding of organic agriculture at the state and regional level. However, based on my own micro-scale research, this is what I learned about sustainable agriculture at the local level: smallholder farmers develop their own ideas and philosophies about traditional farming methods based on local knowledge that is gained through their own experiences. Then, those beliefs are applied to, and altered by, the physical demands and limits of the daily farming operation. Those physical and social aspects are also influenced by the external vagaries of government policies as well as local community demands and desires.

Gibbon et al. have stated that, “Without indicators, sustainability will remain confusing and complex and hence prone to rhetorical quotation” (1995:50-61). I say, sustainability is confusing and complex. It is a subject that should remain open to dialogue so that farmers who are actively working toward increasing sustainability will not be hindered by external constraints. Relying only on sustainability indicators to quantify, and therefore simplify, complex issues will result in an unrealistic and apolitical oversimplification of the subject and, what is worse, leave out the foundational elements of the story.

Chapter Seven: Conclusion

With the effects of global climate change being felt in diverse places around the world, it is important to consider how different groups of people will adapt to those changes in order to develop and maintain a sustainable means of food production. We are all participants in agriculture. The ways in which the global environment is manipulated and degraded by the vertically integrated system of industrial agriculture has become a widely accepted paradigm where our need to feed a growing population outweighs the need to sustain the environment in which we live. The problem is that we often think that global systems operate in a certain way and that they cannot be changed. However, the present system of industrial agriculture was intentionally put in place and therefore it can intentionally be changed (Robbins 2004).

Vertical integration is often seen as a tactic used by large multi-national corporations to gain control over what crops are grown, how they are grown, and what prices consumers will pay for agricultural products. A growing number of environmentally and socially conscious individuals say that the way to combat the consolidation of agriculture and food production by large agribusiness corporations is to develop sustainable organic farming methods and so regain control over what seeds are planted and the technology that is used in farming.

One of the goals of this project was to gain an understanding of how global markets and the infrastructure of agribusiness affect local smallholder farmers in the Ten Rivers region of Oregon. The central focus of this study was on those smallholder farmers who are trying to move away from the treadmills of production and consumption that support industrial agriculture in order to make the transition toward a more sustainable lifestyle using traditional agricultural methods.

Farming is an inherently risky business. Each year growers essentially gamble the farm against the uncertainties of growing conditions armed with their own hard won knowledge and abilities that determine whether they are able to bring in their yearly crops. Farmers have a right, and a need, to be cautious. Livelihoods depend upon developing local knowledge and an understanding of the demands of local communities. Smallholder farmers face many barriers on the road to more sustainable farms and communities. They are working hard to support and nurture a growing social awareness that will allow more people to distance themselves from the treadmills of production and consumption and start building a new paradigm; one that allows farmers to stop working against the environment and start working with it.

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Appendices

Appendix A: Soils

Benton County Soils
A Soil Survey of Benton County was published in 1924 by the Bureau of Soils, U.S.D.A. The following discussion is based upon this soil survey.

Melbourne Series. These soils are brown, reddish-brown, or in places light-brown to yellowish-brown in color. The subsoil is yellow to yellowish- brown, and locally mottled with gray or brown and red iron stains. Bedrock is generally encountered at depths varying from 3 to 8 feet. These soils are derived from sandstone or shale rock, and rocks are common in the lower subsoil. The series generally is developed in the lower foothills, and the topography varies from broken to gently rolling. Where the topography allows, cultivation can produce excellent results with proper management. The remainder of the area supports a forest growth of mainly fir and oak.

Olympic Series. The surface soil, 8 to 12 inches deep, consists of brown to dark-brown friable silty clay loam to heavy, plastic clay. The subsoil is a brown compact silty clay loam, clay loam, or clay, underlain at depths varying from 2 to 6 feet by massive bedrock, mainly basalt. Fragments of the parent rock occur throughout the profile. Rock and outcrops are numerous on the steeper and more broken slopes. Olympic soils are of residual origin, derived from the weathering of basalt and associated igneous rocks. They occur mainly throughout the hill and mountain section of the central part of the county.

Aiken Series. The surface soil consists typically of 10 to 12 inches of red to brownish-red silty clay loam. The subsoil is red in color, slightly heavier than the surface soils and compact. It may contain numerous round, partly cemented brown or rusty-brown iron concretions. In places the soil includes angular frgaments of basalt, and the bedrock is found at shallow depths (generally 4 to 6 feet) though it rarely outcrops. The soil is friable and easily worked. The Aiken soil is a residual soil derived from the weather in place of basalt and to some extent from coarser grained igneous rocks. It is prominently developed on the eastern slopes of the Coast Range south of Mary's River where it occupies nearly one-half of the total area of residual soils in that section. Other large areas are located along Soaj Creek, Woods Creek, and in the vicinity of Wren and Blodgett.

Chehalis Series. The surface soil consists of a light brown to yellowish-brcMn friable silty clay loam to find sandy loam 10 to 18 inches deep. The subsoil is brown to slightly reddish-brown material which is similar to or heavier than the surface soil. The subsoil grades into lighter textured material, which underlies nearly all the Willamette River bottom soils at depths of 2 to 6 feet or more. This soil is developed on the flood plains of nearly all creeks and larger streams of the county. It is derived from recently deposited alluvial material. This soil is very productive and it is extensively farmed.

Amity Series. The surface soil consists of 14 to 18 inches of brown or light grayish-brown silty clay loam, which is plastic when wet and has a tendency to bake upon drying. The subsoil is a light grayishbrown compact silty clay loam or clay loam. It is invariably mottled. The surface is gently sloping to nearly flat, and during periods of heavy rainfall, water stands on these soils for several days at a time. Surface drainage is fairly good in places, but underdrainage is restricted. Wapato Series. The surface soil is a faintly mottled brown, dark brown, or dark grayish-brown, smooth, heavy silty clay loam 8 to 12 inches deep. The subsoil, to a depth of 26 inches or more, is a moderately compact drab or brown clay or clay loam mottled with rusty-brown, yellow and gray. The wapato soil is an extensive recent-alluvial soil, occuring in nearly all the smaller stream valleys. The surface is almost level to gently sloping and the drainage is generally poor.

Newberg Series. The surface material is brown to rather dark brown fine sandy loam, loam or silty clay loam, with subsoils generally slightly lighter brown and lighter textured. The subsoil layer is encountered at depths varying from 1 to 3 feet and continues to a depth of several feet. This series closely resembles the Chehalis soils. This soil series consists of recent-alluvial soils, found close to nearly all rivers and creeks. Even though these soils may be subject to overflow, drainage is generally good. Due to its high natural fertility, these soils are very important agriculturally.

Willamette Series. The surface soil consists of 10 to 14 inches ofa dull-brown to light-brown, smooth. friable silt loam or silty clay loam. Some areas contain appreciable quantities of rounded and subangular gravel. This soil occurs in a number of areas scattered through the old alluvial deposits of the valley sections. The surface is gently sloping to slightly undulating, broken here and there by the steep banks of drainage ways. Drainage is well developed.

Dayton Series. The surface soil is a gray or light grayish-brown to dull brownish-gray plastic silty clay loam, 12 to 18 inches deep. It is low in organic matter, and when dry has a characteristics white or gray appearance, which is the reason for the local name of "white land". The upper subsoil, between 6 and 14 inches thick, consists of a heavy drab or dark bluish-gray impervious clay, slightly mottled. The lower subsoil is composed of gray to yellowish-gray friable silty clay loam or silt loam, with numerous mottling stains. The topography is nearly level, and after rains water often stands on the surface for weeks at a time. Both surface and subsoil drainage are very poor.

Sites Series. The surface soil consists of 8 to 20 inches of brownish- red to dull-red moderately friable clay containing appreciable quantities of organic matter and red iron concretions. It is underlain by a compact red clay grading into bedrock at 2 to 4 feet. The topography is generally steep and broken, though the crests of the larger hills are comparitively smooth. The soil is of residual origin being derived from weathering or sandstone and shale. The largest area of this soil occurs between Monroe and Alpine. The soil is productive, but can be improved by application of fertilizers.

Carlton Series. The surface soil is a grayish brown smooth silty clay loam of friable ructure', 8 to 13 inches deep. It is underlain to loam or si].ty clay loam, mottled in the lower and more poorly drained areas. Bedrock is quite deep, occurring at depths of more than 7 feet, even though partly weathered shale fragments are encountered at depths of 4 feet or more. The Canton silty clay loam occurs throughout the foothills areas. The surface is gently rolling or hilly to smoothly sloping. Surface drainage is well-developed, though underdrainage is not good in all places.

Cascade Series. The surface soil typically consists of 12 to 14 inches of brown to light-brown clay loam. The subsoil is a yellow or brownish-yellow clay loam of compact structure. Bedrock is reached at depths of 4 to 6 feet. The Cascade soil is a residual soil derived from the coarser grained basic igneous rocks. It occupies the forests of the flat or plateau-like lower hills or areas of gently sloping and rolling topography. Drainage is generally good. The soil is productive, but can be improved greatly by fertilizing.

Grande Ronde Series. The surface soil, with an average depth of 14 inches, consists of a yellowish-brown to light-brown smooth-textured silty clay loam,, low in organic matter. The subsoil, to a depth of 22 inches, consists of yellowish-brown silty clay, mottled with gray or iron stains. The soil occupies terraces and alluvial slopes and is derived mainly from water-laid deposits having their source in the sandstone or shale rocks of the adjacent hills. The topography is gently sloping to undulating and surface drainage is usually good, though underdrainage is restricted.

Cove Series. The Cove clay consists of 15 to 20 inches of black, dark gray, or very dark brown clay, underlain by a black waxy clay. The subsoil usually grades into lighter textured, grayish, mottled material at depths ranging from 36 to 60 inches. The type occupies low areas bordering the base of the higher terraces, or areas of outwash from the adjacent hills. Drainage is poorly developed. Cove clay is a productive soil, but poor drainage and clayestruure provide some difficultiesin working it.

Salem Series. The surface soil has a depth of 10 to 12 inches and consists of a friable brown to reddish-brown clay loam or clay. The subsoil is a reddish-brown to brown heavy clay loam or light-textured clay with a large amount of gravel. Gravel predominates below a depth of 30 to 36 inches. The soil occupies a terrace position from 10 to 30 feet above the flood waters of the streams. The surface is gently sloping to undulating. Surface and internal drainage are good to excessive.

Riverwash. Riverwash is a nonagricultural type of material, consisting of sand, gravel, and cobble, which lies only a few feet above the normal flow of the rivers. In general, this soil type supports no vegetation, though a few alders or willows have found a foothold in some protected areas.

Camas Series. The surface soil consists of 15 to 20 inches of brown to dark-brown friable clay loam. The subsoil is a brown clay loam containing gravel in the upper part, which increases in quantity to a depth of 30 to 40 inches, where a layer of porous sand and gravel is encountered. This soil occupies the deeper former channels of the Willamette River and is rather unimportant agriculturally.

Whiteson Series. The surface soil consists of 8 to 10 inches of light-gray to brownish-gray or grayish-brown plastic silty clay loam. The upper subsoil is a drab clay, very compact, plastic, and impervious. The lower subsoil consists of a slightly less compact drab clay. This soil is found in stream bottoms, and its drainage is poor. Due to the insignificant extent (256 acres), this soil is unimportant agriculturally.
(Ruttle et al. 1974)

Linn County soils:

Chehalis-Newberg--These soils occur all along the Willamette River, the North and South Santiam Rivers, and the Santiam River, and to some extent along the Calapooya River, Crabtree Creek and Thomas Creek. For the most part, these soils are adapted to the production of all crops, but are primarily devoted to the production of mint, vegetables, tree fruits and nuts, and berries.
Willamette--There is one large area of Willamette soils along Muddy Creek, and also along the Albany-Lebanon highway. These soils are adapted to all field crops and can produce vegetables and horticulture crops.
Dayton--There are large areas of Dayton soils from Albany south to the Lane County line. This area includes some rather large bodies of Wapato, dark colored Dayton, and Dayton silty clay loam. This soil group produces the major part of the county's grasses and seed crops.
Amity--The Amity soils are usually intermingled with the Willamette and Dayton soils. Amity soils adaptability range depends a great deal on drainage. Under good drainage, capabilities are much the same as those of Willamette soils.
Holcomb, Clackamas, and Courtney Clay--There are some rather extensive areas of this soil group east of Albany toward Scio. Drainage is a need as is a general fertility program. Production is somewhat limited because of these two factors.
Aiken and Olympic--Large areas of these soils are located in the hill sections of the county around Scio, Lacomb, and Sweet Home These soils have a wide range of adaptability, but vary widely in depth. Chief crops grown on these soils are grains and grasses. (Valde et al. 1973:6).

Appendix B: Interview Questions

<u>Research questions</u>

1. Why do you farm and what kind of farmer would you say you are? Do you farm full time? How long have you been farming?
2. What do you consider ‘alternative’ or sustainable farming methods, compared to conventional farming methods, and what types of alternative methods do you use on your farm?
3. What do you think about organic certification? Is it a good idea? Is it important? Is it too easy or too difficult to get certified?
4. Have you always practiced sustainable farming methods or are you working toward changing from more conventional agriculture methods?
5. What important changes have you made on your farm in recent years to make it more sustainable and what challenges did you face in making those changes?
6. Why do some farmers change to alternative farming methods while others don’t?
7. How do you find information on sustainable farming methods—internet, university extension service, farm neighbors—and how do you know, or trust, that what you are hearing is in your best interest?
8. Do you feel you work pretty independently on your farm or do you consult/interact with other farmers in the area?
9. How do you perceive your place, as a farmer, in the community and has that perception changed over time?
10. My research focuses on the environmental, economic, and social barriers farmers face in developing sustainable farming methods. What aspect—environmental, economic, or social—do you feel is most important or most difficult in making the move toward sustainability? (or, break this into three separate questions addressing each aspect of the sustainability tripod)
11. How do you decide what to grow—ask the question and then see if follow-up questions should be asked—are decisions based on environmental or climate concerns, economics, socially acceptable products consumers may want to try?
12. Do you sell products only through direct marketing or do you sell wholesale also?
13. Does the micro-climate on your farm affect your growing season and what you grow?
14. How do you divide up the labor/chores on the farm? Do you depend more on manual labor or do you lean toward mechanical technology to get the work done? (Gender roles, do you make a distinction between home and farm?)

15. How would you describe your ‘ideal’ farm and what barriers are keeping you from achieving that ideal?
16. What are the most important issues facing farmers today?
17. Are there any questions I should have asked that you would like to discuss?

Appendix C: Farmers

Farmer Name	Years Farming	Acres Farmed
Susan	Less than 10	Less than 10
Angela	Less than 10	Less than 10
Dave	Less than 10	Less than 10
Ted	More than 30	More than 30
Carol	Less than 10	10
Darlene	Less than 10	Less than 10
Kate	10-20	More than 30
James	20-30	20-30
Laura	Less than 10	Less than 10
Janet	More than 30	Less than 10
Mary	20-30	10-20
Dale	More than 30	10-20
Henry	More than 30	10-20
Bill	10-20	20-30
Pat	10-20	20-30
Mark	Less than 10	10-20
Kathy	Less than 10	10-20
Janice	20-30	Less than 10
John	More than 30	More than 30
Sandra	Less than 10	More than 30