AN ABSTRACT OF THE THESIS OF


Title: Local Resilience, Canola Cropping, and Biodiesel Production

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Courtland L. Smith

New technology may have negative, as well as positive, effects on a sociocultural system. Biodiesel is growing in popularity as a fuel alternative that addresses global warming and reduces dependency on petroleum. The biodiesel innovation fits well into the existing behavioral infrastructure of Linn and Benton Counties, Oregon. The introduction of this technology fuels two community-based biodiesel initiatives: the Corvallis Biodiesel Cooperative (CBC) and the OSU Biodiesel Initiative (OBI). However, the increasing demands for biodiesel increases the demand for vegetable oil. Canola is the most efficient oil producing crop suggested for the southern Willamette Valley of Oregon. Canola cropping fits into the behavioral infrastructure of local grass seed growers' tradition. However, canola cropping presents outcrossing risks to neighboring specialty seed and organic growers. This calls into question the resilience and sustainability of canola cropping. The decisions made about biodiesel production and oilseed cropping will impact the future environment, culture, political autonomy, and sustainability of this local community. The dominant values that serve this
community will determine the resilience of culture and identity that is maintained or emerges in the face of social-ecological challenges and technological innovations.

The research methodology includes interviews, participant observation, and informational media to triangulate data. These methods serve to inform an integrated framework of holistic, values analysis, social-ecological, and cultural materialism theoretical approaches. The holistic approach provides the behavioral components and the values analysis approach provides the mental components that are integrated into a cultural materialism framework. These components are evaluated by the social-ecological approach. Evaluation of the CBC and OBI suggests that values play a greater role in cultural materialism than previously believed. A new theoretical perspective emerges to explain resilience and causal effects. The social-ecological approach, illustrated by panarchy theory, is also integrated into the cultural materialism approach. The integration of the four theoretical approaches, and the emergence of a new theoretical perspective, provides a means to explain resilience and sustainability for the CBC and OBI. This integrated approach also examines three potential paths of resilience and sustainability for the grass seed, specialty seed, and organic growing traditions.

Path A predicts long-term resilience and sustainability for grass seed growers and canola cropping, but collapse for the specialty seed and organic growing traditions. Path B predicts that a proposed regulated canola cropping compromise will only prolong the inevitable collapse of the specialty seed and organic growing traditions. Along both Paths A and B, diversity is lost from the sociocultural system as specialty seed and organic growing traditions decline. Canola cropping increases the potential for energy security, but food security is reduced. Path C suggests how to maintain the current sociocultural system of grass seed, specialty seed, and organic growing traditions and promote long-term resilience and sustainability.
Local Resilience, Canola Cropping, and Biodiesel Production

by

Christopher Allen Bates

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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.

Christopher Allen Bates, Author
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I express sincere appreciation to Court Smith for sharing his valuable wisdom and guidance to help me to find the resilience, connectedness, and potential within myself. I express sincere appreciation to Ken, Darlene, Kim, and Laurie for challenging me, believing in me, and providing invaluable love and support throughout my life. I express sincere appreciation to Carol and Don for going above and beyond to help me in times of need. Also, I express sincere appreciation to all of my family and friends that have helped me to develop a new understanding, willingness, and capacity to find my way home.
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Local Resilience, Canola Cropping, and Biodiesel Production

1 Introduction

The rising ecological, social, economical, and political costs of using petroleum oil have inspired the search for fuel alternatives. One such alternative is biodiesel. Locally, the Corvallis Biodiesel Cooperative and the Oregon State University Biodiesel Initiative have pioneered biodiesel innovation by recycling restaurant waste grease into fuel. Researching these two groups has provided valuable insight into the development of biodiesel within the local community.

Recently, the interest of growing canola in the Willamette Valley as a rotational crop for grass seed has surfaced. Canola, which is grown primarily for vegetable oil, could provide a local resource for biodiesel production. At first glance, the introduction of canola cropping appears to be a simple matter of course to promote engineering and economic progress. However, the matter is truly a complex study of human social and environmental interactions. In essence, the choices that people make to interact with each other and utilize resources plays a large deterministic role for the longevity of a society. Proponents suggest that canola cropping is the most efficient resource to drive the biodiesel market while simultaneously benefiting the grass seed industry as a rotation crop. This research identifies concerns of the local community regarding canola cropping as a potential vegetable oil resource for biodiesel production. Local values provide insight about whether and how to proceed with a community effort to produce and use biodiesel.

This study seeks to identify some of the values of the local community in and around Corvallis, OR toward canola cropping. In particular, values are expressed through a set of concerns within the agricultural component of the community. A concern of specialty seed growers and organic farmers centers on the perceptions of markets toward product purity and food security. The attitude is that large-scale canola production, genetically modified or traditionally bred, introduces a threat that
could devastate the specialty seed and organic farming traditions via crop cross-contamination. A concern of grass seed growers is low economic viability of canola cropping. These concerns of specialty seed growers, organic farmers, and grass seed growers suggest the need for being good neighbors and the necessity of cooperation.

1.1 Background

The growing concern that the end of oil’s reign as an inexpensive resource is drawing near is addressed by such internet websites as Hubbertpeak.com (2006), Peakoil.com (2006), Peakoil.net (2006), and Peakoil.org (2006). At this point, the supply of oil is such that it can still be sold rather inexpensively. Nevertheless, it is becoming increasingly difficult to manage the world’s growing demand for oil and maintain relatively peaceful relationships between nations. Wars and political maneuvering are occurring to secure petroleum resources.

The United States is still the world’s leading consumer of oil. However, the rise of industrialization in China has quickly made the Chinese major consumers as well. Also, ordinary Chinese are now accumulating enough wealth to buy cars (The Economist 2005:21). For those aspiring in the global economy, the automobile is the ultimate symbol of status and freedom even though it perpetuates mankind’s addiction to oil (The Economist 2005:22).

Projections suggest that by 2025, the Chinese could be using ten million barrels per day and worldwide inflation of oil prices (Appenzeller 2004:89). The United States already consumes about 20 million barrels per day. The United States’ oil consumption is expected to grow nearly 50% over the next 20 years (Appenzeller 2004:88) so that by 2025 the United States could consume 30 million barrels per day. In the last six months of 2004, oil prices climbed from an average of $30 to well over $50 per barrel (Shein and Sampson 2004).

Experts disagree as to how long the economically viable supplies of oil will last. Dr. M. King Hubbert of the Shell Oil Company and the United States Geological Survey (USGS) predicted that oil production would peak in 1995 (Harris 1977:283).
The USGS now predicts that by 2023, the world oil producers outside of the Middle East and North Africa will have peaked while the Middle East and North Africa are expected to peak by the year 2040 (Appenzeller 2004:90). It is generally accepted that the United States peaked in production in the early 1970’s. While the search for and extraction of oil continues, Middle East production is more efficient and less costly.

Yet the USGS remains optimistic. They predict that new technologies will wring additional supplies from existing fields and that vast new reserves remain to be found (Appenzeller 2004:108). Many economists argue that countries of the Middle East have had no incentive to drill for more (Appenzeller 2004:108).

However, Matthew Simmons, president of the Houston energy-investment advisory bank, Simmons and Company, expresses concern. He reports that Saudi Arabia has not found a big new field for decades (Appenzeller 2004:108). Additionally, Simmons is seeing signs of trouble as Saudi Arabian technical reports are starting to show that water is starting to come up oil wells indicating that the well’s productive life is over (Appenzeller 2004:108).

Marvin Harris argues that the harder we have to search for oil, “the more costly all industrial operations become (1977:283).” As oil becomes more expensive to acquire, its costs and the costs of everything associated with it will increase. As a result, “inflation will steadily reduce the ability of the average person to pay for the goods and services now regarded as essential for health and well-being (Harris 1977:283).

Leonardo Maugeri argues that the world is not running out of oil (2004:1114). He points out that knowledge and technology have made it possible several times to show that more oil exists to be economically harvested than previously anticipated. Maugeri states that the “Age of Coal began when declining supplies of wood in Great Britain caused its price to climb (2004:1115).” Two hundred years later, oil replaced coal because of its convenience and high flexibility in many applications. Yet, coal was neither exhausted nor scarce, argues Maugeri. As for oil, “substitution is simply a matter of cost and public needs, not of scarcity (Maugeri 2004:1115).”
Maugeri also argues that cries of a dwindling oil supply create hysteria. This panic serves to perpetuate “a misguided obsession with oil security and control that is already rooted in Western public opinion (2004:1115).” As a result, Western political circles employ imperialism to assert direct or indirect control over oil-producing regions. The West’s obsession to control oil “historically has invariably led to bad political decisions (Maugeri 2004:1115).”

As demand for oil increases in China, India, and other countries, in part, to produce low cost goods for the United States, friction could develop over the coming decades among major oil consumers. The growing economy of China is threatening worldwide inflation of oil and, in turn, commodities (Broder 2004). Competition for oil between the United States, China, and India cannot be good for vital development, fostering friendship and cooperation, or for the prospects of a peaceful and prosperous world community (Lovins et al. 2004:27). If friction leads to war over dwindling Middle East oil, the costs to the United States will greatly increase as it attempts to maintain its stake in the Middle East.

Averting geopolitical confrontations is a powerful reason for governments to promote alternatives to petroleum. According to *The Economist* (2005:21), every official forecast shows that the Middle East’s share of the oil trade will continue to grow over the next two decades. The expectation is that the risk of terrorist attack, embargo or economic shock is bound to rise. This creates a “fear premium” and a highly volatile oil world. However, the “fear premium” has yet to put an end to the desire for geopolitical control over the Middle East’s petroleum resource.

Because the United States’ economy depends greatly on oil, a lack of efficient petroleum consumption measures and substitutions will severely impact the standard of living. Harris argues, “How fast and how low standards of living in the industrial nations will fall depends on how long conversion to alternative energy sources is delayed (1977:283).” The Rocky Mountain Institute non-profit organization has developed a comprehensive plan that begins to address the issue of oil substitution. Lovins et al. (2004) suggest a myriad of technologies that could make current oil
consumption more efficient as well as provide substitutions. Ideally, substitutions will help to slow the demand and rising costs of oil. In conjunction, rising oil prices and competitive substitutions could spark a quest for more efficient technology that burns less oil. This, in turn, could slow the rise of oil costs by slowing the rate of consumption. Just as the Age of Oil replaced the Age of Coal, an age of increased efficiency and diverse energy alternatives is necessary to offset petroleum’s increasing demand (The Economist 2005:22).

Biofuels are one such technology that could both make current oil consumption more efficient and provide a substitution. Ethanol can be added to or substitute for gasoline, and biodiesel can be added to or substitute for diesel fuel. Lovins et al. argue, “Rural and small town America can gain enormously in income, jobs and stability through biofuel production and related revenues—while the country gains half a Saudi Arabia’s worth of stable, uninterruptible, all-domestic fuel supplies (2004:162).”

Lovins’ approach to biofuel technology, however, does not discuss the impacts of innovation on pre-existing social and ecological infrastructures. He argues that biofuel technology will help to liberate the United States from being highly dependent on importing petroleum oil. But, Lovins does not discuss the holistic implications that introducing new crops may have on existing cultural ecology. The culture and ecology of rural and small town America is too variable and sensitive to simplify the introduction of biofuel crops. Thus, cultural as well as technological change is needed to reduce negative social and ecological impacts (Smith 1995:480).

New structures for social institutions must be adapted concurrently with technological innovation in order to approach a sustainable system. Marvin Harris suggests, “Only by decentralizing our basic mode of energy production—by breaking the cartels that monopolize the present system of energy production and by creating new decentralized forms of energy technology—can we restore the ecological and cultural configuration (1977:288)” that upholds true democracy. Local decision makers are more apt to make decisions that reduce the chance of negative impacts on
resilience (the measure of adaptability to change in order to approach a sustainable system) than decision makers located outside and far away from the local community.

With a technology such as biodiesel, Harris’ argument can be taken a step further than Lovins’. Democratic control could be put into the hands of a particular rural area and small town America as they produce and use their own fuel. Scheer favors such decentralized, small-scale solutions to energy production in what he describes as a “solar economy” (2002). Biodiesel is one technological aspect of the “solar economy” that could be adapted along with new, decentralized social institution structures.

Brazil is currently experiencing great success with its biofuels program. Brazil meets some of its fuel needs while exporting to a global market. The success of the Brazil program’s infrastructure has drawn the attention of Japan. A bilateral program has been inspired between Brazil’s Ministry of Agriculture, Livestock and Supply and the Japan Bank of International Cooperation (greencarcongress.com 2005). The bilateral program intends to increase the production of ethanol and biodiesel in Brazil and its supply to the Japanese Market. Regulatory action by the Japanese government in 2003 prompted an immediate increase in demand for biofuels. The resilience and long-term sustainability of Brazil’s biofuels program to meet its own needs as well as the growing demands of a global market has yet to be determined.

Biodiesel is a biofuel made from a combination of vegetable oil, alcohol (also an agricultural derivative), and a catalyst. It can be used with a mixture of petroleum diesel or in a 100% form. Tickell (2003:29) reports that engine modifications are not necessary to use biodiesel and that it can be poured straight into the fuel tank of a Diesel vehicle. Rudolph Diesel had created his engine with the belief that vegetable oil would provide fuel into the future (Korfhage 2004:10). It was after Diesel’s death that cheaper, more abundant fossil fuel oil was used in his engines. However, the average cost of diesel fuel increased 65.1 cents (about a 44% increase) per gallon in the 2004 (Shein and Sampson 2004) reinvigorating an interest in diesel fuel made from vegetable oil.
Biodiesel has developed growing support in the western United States. In Colorado, students of the University of Colorado have been using biodiesel on campus. They have even traveled to Colombia to share their knowledge of biodiesel production (Edstrom 2004: 26). Also in Colorado, Blue Sun is an upstart LLC that produces biodiesel from oil seed crops grown by a farmer-investor cooperative that includes partners from Colorado, Wyoming, Nebraska, and Kansas (gobluesun.com 2004; wapa.gov 2004). Interest in biodiesel production also exists in Idaho (thehudsonco.com 2004) and Washington (sccd.org 2005). Also in Washington, students from Evergreen State University have created a small-scale biodiesel production facility for two tractors at the student-run organic farm (Dodge 2004).

In Oregon, biodiesel has grown in popularity throughout the Willamette Valley. Interest in biodiesel has been expressed by Sequential Fuels as well as Daryl Ehrensing of Oregon State University (egov.oregon.gov 2005, tidepool.org 2004). The City of Corvallis uses B20 (a 20% blend of biodiesel with 80% petroleum diesel) for its diesel fleet vehicles. Also in Corvallis, community biodiesel initiatives are promoted by the Corvallis Biodiesel Cooperative (Kennedy 2003; Cummins 2004:24) and the OSU Biodiesel Initiative (OSUstainability 2004; Nealon 2005; GT 2005) for B100 (100% biodiesel) and blends with petroleum diesel. These two groups were represented at the Biofuels Lobby Day (Taylor 2005) in Salem on Wednesday, March 2, 2005. Biodiesel supporters lobbied at the State Capitol to encourage the passage of bills proposed by Representatives Jeff Kropf and Jackie Dingfelder (Cole 2005). Support for biodiesel in recent years has revolved around environmental concerns. These concerns still exist regarding global warming and air quality (Tickell 2003; Shein 2004; Matthews 2005). Recently, concerns and values regarding the reduction of oil imported from the Middle East (gazettetimes.com 2005) and the role of agriculture growing oil seed crops for biodiesel production have been expressed (Shein and Sampson 2004; Edstrom 2004:28). A recent article made a connection between global warming and Oregon’s agricultural community (Associated Press 2004). Jean Wilkinson, speaking on behalf of the Oregon Farm Bureau, expressed
that farmers are eager to help. She also suggested that incentives for supporting biodiesel production or to keep carbon out of the atmosphere are important to farmers.

1.2 My Research Begins

I started my research in the fall of 2003 with Grease Works that is now known as the Corvallis Biodiesel Cooperative (CBC). The initial intention behind my research was to learn more about how and why a particular group of people made the decisions that enabled them to substitute biodiesel for petroleum diesel. Certainly, ecological values are present that supersede purely economic values since biodiesel has been, and currently still is, more expensive than petroleum diesel. I attended meetings to learn as much as I could about how values guided the structural formation of this group into a cooperative. I learned about their values not just to use biodiesel, but their desires to obtain it from local resources. Since the creation of the cooperative was based on collecting used vegetable oil from local restaurants, it could be easily understood why the group desired a local system of grease collection or oil seed production for biodiesel.

The information I gleaned from Grease Works in October of 2003 alone inspired me to investigate a new student organization forming on the Oregon State University campus. This group quickly became know as the OSU Biodiesel Initiative (OBI). By attending meetings with this group, I soon became a behind-the-scenes advocate. During one meeting, a presentation by Crop and Soil Science professor Daryl Ehrensing introduced the idea of canola cropping as a means to tie the agricultural component of the local community to biodiesel production. Canola is suggested because of its high oil content, which leads to higher yields for industrial processing. Perhaps because of my own family’s ties to an agricultural heritage in Ohio, I immediately took an interest in the idea of local farmers growing canola as a rotation crop for grass seed. I was curious to learn what the locals thought about the idea.

I knew very little about canola or agriculture in Oregon when I started my research. I believed that the only farmers that were stakeholders regarding canola
cropping were grass seed growers. I suspected that the major determining factor was simply a matter of economics for grass seed growers. However, through the research method of interviewing informants I discovered important information. It was during one of my first interviews that I learned canola cropping not only raises economic concerns for grass seed growers, but other agricultural traditions as well. Early in the interview I was told that grass seed growers did not want to pursue canola as a rotation crop because it did not make economic sense for them to do so. Research by a graduate student from Oregon State University’s Agricultural and Resource Economics supports this claim (Freeborn 2004). Later in the interview, I learned that grass seed growers are not the only agricultural stakeholders that could be impacted by canola cropping. Due to the nature of canola, it has the ability to contaminate the crops of specialty seed growers and organic growers. Oregon State University horticulturalist, James Myers, confirms that traditionally bred canola and genetically modified canola present contamination risks to vegetable crops due to shared species affinity (2005). The specialty seed industry, in particular, has voiced concerns (Schmitz 2005). The specialty seed and organic traditions are both close neighbors to the grass seed tradition in the local community. Thus, the idea of canola cropping is not just a social-economic issue for grass seed growers, but an ecological as well as social-economic issue for specialty seed and organic growers.

All three agricultural traditions are present in Benton and Linn Counties of Oregon’s mid-Willamette Valley. Mark Melby of the Oregon State University Extension Service reports that there are approximately 300 grass seed growers in Linn County and about 45 in Benton County. According to the 2004 Oregon County and State Agricultural Estimates (2005), grass seed farms cover 232,540 acres within these two counties. According to the Oregon Tilth, there are about 20 certified organic farms in Benton and Linn Counties. These farms cover about 900 acres. Estimates for the number of specialty seed growers and farm acreage are not readily available. However, located at the Oregon State University Extension office in Albany is a map for pinning the locations of specialty seed crops. By counting flags pinned on the
board for the 2005 season, I determined an estimate for the number of specialty seed plantings. In Benton County, there are 18 specialty seed plantings. These crops are located primarily in the northeast and southeast corners of Benton County. There are 43 specialty seed plantings throughout Linn County. The number of growers and acreage cannot be determined by this map. Still, the map indicates that specialty seeds are grown near riparian areas and are within close proximity of major highways such as 99W, 99E, 20, 226, and 228.

Learning of the concern that canola cropping poses a potential risk of cross-contamination, I redirected my research to include and address this issue as well as to evaluate the values of the CBC and OBI. Values and concerns surrounding canola cropping appeared to me to be the most responsible thing I could investigate for my research. The support for biodiesel is expanding beyond the Corvallis Biodiesel Cooperative and the Oregon State University campus to the Oregon State Legislature. Two Oregon State Legislators have introduced bipartisan bills to encourage market growth of biodiesel production in Oregon. With the rising costs of petroleum oil, it appears to be only a matter of time before growing oil seeds to produce biodiesel become a reality. Therefore, I shifted my research focus to determine if the community’s value base could encourage the careful management of canola cropping. Proposed amendments to the Oregon Department of Agriculture’s rules for Rapeseed Control Areas (2005) attempt to address issues for the careful management of canola, an edible type of rapeseed. I believe the community’s value base to be the key to promoting the resilience and long-term sustainability of the local community as a whole.

1.3 Designing My Research Around the Local Community

My research design consists of the four theoretical approaches described in Chapter 2 and the methodological approaches described in Chapter 3. Through my research design, I focus on the behavior of a system of which the CBC, OBI, grass seed growers, specialty seed growers, and organic farmers are a part. I compare and
contrast the values and attitudes of these stakeholders to each other. The original intention of this research was to analyze the values that motivated the CBC and OBI to select the biodiesel innovation over cheaper petroleum diesel. The evaluation of the CBC and OBI values (Chapters 4 and 5) inspired a new interpretation of cultural materialism. In essence, the research examines the relation between values and action to suggest that cultural materialism does not take enough account of values. A new strategy to explain the impact of values on behavior emerges. I apply this strategy of mental superstructural determinism to the grass seed, specialty seed, and organic grower traditions (Chapters 6 and 7).

Chapter 7 illustrates the evolution of the research design to include the new strategy. Mental superstructural determinism is applied as a tool to test the following hypothesis: Infrastructural determinism for the canola cropping mode of production will maintain social-ecological resilience for the current sociocultural system of grass seed, specialty seed, and organic growing traditions. I feel it important to discover to what degree the local community’s values support canola cropping for the local production and use of biodiesel. If the values base does exist to support canola cropping, how does the local community system desire to proceed to manage this mode of production? What cooperative decisions can be made to enhance resilience (the ability to adapt and diversify in order to maintain the current structure and function) within the system? The elements of behavior, values, and resilience are integrated and explained within the theoretical framework of cultural materialism.
2 Preview of Theoretical Approaches

Throughout my research design, four anthropological approaches are applied. These approaches are described in subsequent sections of this chapter. One is the holistic approach described by Weaver (1985:200). This approach provides the behavioral element. The second is values analysis (Applebaum 1987). The recognition of values provides the mental element. The third approach is the social-ecological approach described by Walker et al. (2004), Gunderson and Holling (2002), and Berkes et al. (1998; 2003) regarding system resilience. This approach will be a major focus for analysis and emerges from the holistic and values analysis approaches. The fourth approach is a theoretical framing within cultural materialism (Harris 1979; 1999). The holistic, values analysis, and social-ecological approaches complement the theoretical framing that integrates the whole design. This chapter provides a general discussion of theory. Detailed uses of theory are discussed in an early section of Chapter 5 to address the Corvallis Biodiesel Cooperative and the Oregon State University Biodiesel Initiative and an early section of Chapter 7 to address the impact of canola cropping.

2.1 A Holistic Focus on the Community

The holistic approach aids the conceptualization of the larger picture surrounding the use of biodiesel in the local community. Because there are many stakeholders within a community with different social, economic, and cultural behavior, mapping linkages helps to illustrate the system components. Weaver (1985) describes this approach and Ervin (2000) indicates the continued relevance of a holistic focus.

The holistic approach provides a framework for looking at different parts of a whole society and for assessing their interrelationships and functions (Weaver 1985:200). This framework illustrates the linkages between decision making, social problems, culture, and environment to provide contextual understanding. The holistic approach is an important first step to visualize how a particular problem is
interconnected with other elements of society. Ideally, potential negative impacts of new innovations and policies can be recognized early and weighed against alternative solutions.

There is at least one shortcoming of the holistic approach. As Weaver (1985:200) indicates, this approach "is only a perspective which provides a context and not the solution to the problem." By itself, the holistic approach suggests a system within which the elements behave and work together harmoniously to maintain themselves without changing or evolving (Harris 1999:134). Yet conflicting interests are a source of dynamic tension that often leads to new social and cultural arrangements (Harris 1999:134). The conflict that surrounds the growing of canola is no different. The canola conflict is a source of tension that presents great potential for new social and cultural arrangements to arise. Determining this potential from the holistic approach requires the assistance of other anthropological approaches to evaluate the values of stakeholders, community resilience to new technology, and a theoretical framework to explain causality.

The purpose of the holistic approach is to illustrate the behavioral framework of a sociocultural system. The interconnectedness of the system, however, does not relate solely to behavior. Values play a critical role to indicate the mental components within the sociocultural system as well. The holistic and values analysis approaches provide the behavioral and mental foundation for the social-ecological approach and cultural materialism. These design elements are described in subsequent sections.

2.2 Values Analysis

Values are the mental components of a sociocultural system. They provide insight into the complementary thoughts to the behaviors within a system. Values are an integral part of cultural philosophies, traditions, structural ideologies, and production patterns.

Many modern mentalist concepts of culture contain a basic orientation to culture similar to that of Clyde Kluckhohn who viewed values as a mental construct.
Applebaum summarizes Kluckhohn’s concept of the integrative nature of culture as one that contains a fundamental structure and organization that relates to psychological processes operating within a value context. The nature of culture appears to the observer as a stream of behavior. The components of behavior take form and order from the value premises shared by the sociocultural system. Culture is not behavior, as such, but mental constructs and ideas about what is considered ideal behavior. Kluckhohn’s concepts were articulated more than a half a century ago (Parsons and Shils 1951), but they are still relevant today (Parsons and Shils 2001).

Values analysis provides the mental components of a sociocultural system. Recognition of values allows a deeper understanding of the behavioral components illustrated by the holistic approach. In combination, the behavioral and mental components are the foundation for further analysis. These elements provide the means to determine the resilience of a sociocultural system via the social-ecological approach to explain causal relationships via cultural materialism.

2.3 The Social-Ecological Approach

The social-ecological approach centers on the resilience of systems. According to Berkes et al. (1998), systems are complex, non-linear, multi-equilibrium, and self-organizing; they are permeated by uncertainty and discontinuities. These characteristics of systems make resilience the focus of the social-ecological approach. Resilience determines whether or not a complex system can maintain its current structure and function in the face of changing conditions and uncertain outcomes. The measure of resilience is the magnitude or scale of disturbance that can be absorbed before a system changes in structure and the processes that control behavior (Berkes et al. 1998:12). Thus, as Berkes et al. (1998) explain, resilience “is a measure of robustness and buffering capacity of the system to changing conditions.”
2.3.1 Resilience and Panarchy Theory

Berkes' definition of resilience is illustrated by Holling et al. (2002) via panarchy. Panarchy refers to the idea that the resilience of a system at a particular focal scale is influenced by cross-scale interactions. Panarchy allows a holistic visualization of the interconnectedness of multiple factors and the impact they have on the sustainability of a system. The foundation of panarchy is the adaptive cycle.

Figure 2.1, adapted from Holling et al. (2002), illustrates the flow of a system through the adaptive cycle. The adaptive cycle provides a means to visualize the potential, connectedness, and resilience of a system. Potential is represented on the Y axis and connectedness is represented on the X axis. Potential refers to the accumulated resources. The degree of connectedness is determined by controlling variables. Low connectedness consists of diffuse elements loosely connected to each other whose behavior is dominated by outward relations and outside variability. High connectedness refers to closely connected elements whose behavior is dominated by inward relations. The relations of highly connected elements control or mediate the influence of external variability. The Z axis, which extends outward toward the reader from the two-dimensional figure, represents resilience.

Figure 2.1 The adaptive cycle.
There are four distinct stages of the adaptive cycle: 1) growth, the r stage, 2) conservation, the K stage, 3) collapse or release, the Ω stage, and 4) renewal or reorganization, the α stage. The adaptive cycle has two major transitional phases that occur sequentially. The first, from the r stage to the K stage, is a slow phase of growth and resource accumulation in which connectedness, stability, and resilience increases. The potential for possible futures also gradually increases. The consequences of this phase are predictable with high degrees of certainty. The objective of this phase is to maximize production and accumulation. The second, from the Ω stage to the α stage, is a rapid phase of reorganization and renewal that occurs following a breakdown of stability from the previous phase. The consequences of this phase that result from a system collapse are unpredictable and highly uncertain. The objective of this phase is to maximize invention and re-assortment. As the phases of the adaptive cycle proceed, social-ecological resilience expands and contracts as properties of the system slowly change.

Resilience can be influenced by ecological or social factors. The determining values and behavior mean the difference between averting a social-ecological crisis and adapting to one. The values and behavior of a society determine social resilience, which in turn can influence ecological resilience. However, ecological resilience is the determining factor of the possibilities of social structure and function in the first place. Values and behavior that favor building resilience can positively influence ecological resilience.

2.3.2 Building the Principles of Social-Ecological Resilience

Berkes et al. (2003) suggest that recognizing four principles and their interactions between society and the environment is necessary for enhancing resilience and directing society toward sustainability. Building resilience includes: 1) learning to live with change and uncertainty; 2) nurturing diversity for reorganization and
renewal; 3) combining different types of knowledge for learning; and 4) creating opportunity for self-organization.

These four principles interact and are interdependent to build social-ecological resilience. They can do this in the form of an adaptive cycle. Learning to live with change and uncertainty is a necessity to endure the system collapse that occurs in the $\Omega$ stage. Nurturing diversity for reorganization and renewal occurs in the $\alpha$ stage. Combining different types of knowledge for learning takes place in the growth and exploitation $\gamma$ stage. Then in the $K$ conservation stage, creating opportunity for self-organization increases the potential and connectedness of the system as it approaches a new resilience equilibrium.

Still, Holling et al. (2002:99) state that the interactions between cycles within a panarchy of adaptive cycles combine learning with continuity. The cross-scale interactions of revolt and remember conserves the capacity to create, test, and maintain adaptive capability. The interconnectedness of the panarchy preserves, accumulates, and transforms the potential created by the revolt and remember cross-scale interactions.

With this in mind, the four principles for building resilience can occur without system collapse. Principles for building resilience can result from cross-scale revolt and remember interactions that introduce novelty (Holling et al. 2002) which provides opportunities for change. For novelty to occur there must be a strong values structure for the understanding, willingness, and capacity to create opportunities for change. A cultural materialism theoretical framing illustrates the significance of values as determining factors to behavior.

2.4 The Cultural Materialism Paradigm

The holistic focus on the community illustrates just how complex a system behavior can be with its various stakeholders and cultural realities. Values analysis addresses the attitudes and concerns that are the community's mental foundation. Additionally, the social-ecological approach illustrates the need to respond with
experience based on accumulated knowledge to determine the adaptive changes necessary to lessen or avoid a crisis. These three approaches are integrated within the theoretical framework of the cultural materialism paradigm. The holistic approach provides the behavioral components of the framework while values analysis provides the mental components. Through the social-ecological approach, the behavioral and mental components interact to determine resilience. Within the additional framework of cultural materialism, behavioral and mental components address cultural causality and "primacy of infrastructure."

Harris (1999:144) points out that the causality embraced by cultural materialism corresponds to the concept of "selection by consequences" suggested by B.F. Skinner. Innovations arise from many sources and are constantly tested for their contributions to the health and well-being of society. Some innovations are propagated while others are selected against and eliminated. As in natural selection, "neither cultural materialism's system nor the actors necessarily know where they are going" (Harris 1999:144). As a result, sociocultural selection is largely opportunistic.

Harris describes three components of sociocultural systems. The first component is the behavioral "infrastructure." This component "is a vast conjunction of demographic, technological, economic [the predominant production practices and modes of subsistence (1999:142)], and environmental variables (1979:74)." The behavioral infrastructure revolves around modes of production. This is akin to the "potential" dimension of the adaptive cycle. Harris (1979:52) defines mode of production as "the technology used to expand or limit subsistence production, especially food and energy, given the restrictions and opportunities of a specific technology in a specific habitat."

The second component is the behavioral "structure," which is akin to the "connectedness" dimension of the adaptive cycle. This component of a sociocultural system contains the organizational features that Harris (1979:53) describes as the domestic economy and the political economy. Domestic economy refers to the organization of production, exchange, and consumption within groups. Political
economy refers to the organization of production, exchange, and consumption between groups. Economy, in this sense of the word, describes “the social relations of production—relations governed by such institutions as private or communal property and wages or other forms of compensations and exchange (1999:142).”

The third component that Harris describes is the behavioral “superstructure.” This component is “the symbolic and ideational sector (1999:141).” The superstructure contains elements of creative, ritualistic, recreational, and scientific expression. The behavioral superstructure is akin to the “resilience” dimension of the adaptive cycle.

Running roughly parallel to the behavior components of a sociocultural system are infrastructure, structure, and superstructure mental components. However, Harris simply lumps these components together into a mental superstructure. Harris describes the mental superstructure as “conscious and unconscious cognitive goals, categories, rules, plans, values, philosophies, and beliefs about behavior elicited from participants or inferred by the observer (1979:54).” The mental superstructure is akin to the “resilience” dimension, too.

According to Harris (1999:151), “cultural materialism embraces a form of determinism best described as probabilistic.” The behavioral modes of production probabilistically determine the behavioral domestic and political economy, which in turn probabilistically determine the behavioral and mental superstructures. Harris refers to this principle as “infrastructural determinism” (1979:56). He also refers to it as the principle of the “primacy of infrastructure” (1999:142). The principle holds that innovations that arise in the infrastructure “are likely to be preserved and propagated if they enhance the efficiency of the productive and reproductive processes that sustain health and well-being and that satisfy basic human biopsychological needs and drives (1999:142).” The primacy of infrastructure does not assert that the behavioral infrastructure is the most indispensable part of the sociocultural system, but that “infrastructure is the most important locus of selection for and against sociocultural innovations (Harris 1999:147).”
Being that infrastructure, structure, and superstructure constitute a sociocultural system, Harris (1979:71) suggests that a change in any one of the system's components usually leads to a change in the others. This is due to feedback within the system. The outcome of any innovation—whether it arises in the infrastructure, structure, or superstructure—is system maintaining feedback. The feedback results either in the extinction of the innovation or "changes in the other sectors, changes which preserve the fundamental characteristics of the whole system (Harris 1979:71)." Holding with the primacy of infrastructure, behavioral infrastructure asserts priority over the behavioral structure and superstructure. In turn, behavioral conditions and processes assert priority over mental conditions and processes (Harris 1979:56). In an inverse relationship, Harris's mental superstructure, behavioral superstructure, and behavioral structure shape the final outcome through negative and positive feedback processes. Figure 2.2 illustrates the flow of the infrastructural determinism with broad arrows and feedback with thin arrows.

![Figure 2.2 Flow chart of infrastructural determinism.](image_url)

The principles of cultural materialism are explicitly scientific (Lett 1987:89). According to Lett, "The theories, predictions, and retrodictions of cultural materialism are falsifiable or aspire to be so; the knowledge gained under the auspices of cultural materialism is self-correcting to a significant degree (1987:91)." The principles of cultural materialism seek to explain phenomena that are knowable via methods that can be reproduced by independent observers (Harris 1979:27).
In this research, I have used Harris’s strategy for behavioral and mental components of sociocultural systems (1979:51-54). Harris suggests that the universal structure of sociocultural systems rest on the biological and psychological constant of human nature, and on the distinction between behavior and thought. Each society must cope with the problems of production and social-ecological potential by behaviorally satisfying minimal requirements for subsistence. Table 2.1, modeled after Harris (1979:52-54), illustrates Harris’s scheme to analyze the infrastructure, structure, and superstructure of a sociocultural system.

<table>
<thead>
<tr>
<th>TABLE 2.1</th>
<th>Components of Sociocultural Systems</th>
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<tbody>
<tr>
<td><strong>Behavioral Infrastructure</strong></td>
<td><strong>Mental Infrastructure</strong></td>
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<tr>
<td>Mode of Production:</td>
<td>Subsistence Lore</td>
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<tr>
<td>Technology of Subsistence</td>
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<tr>
<td>Techno-Environmental Relationships</td>
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<td>Ecosystems</td>
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<tr>
<td>Work Patterns</td>
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<tr>
<td><strong>Behavioral Structure</strong></td>
<td><strong>Mental Structure</strong></td>
</tr>
<tr>
<td>Domestic and Political Economy:</td>
<td>Political and Economic Ideologies</td>
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<tr>
<td>Production</td>
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<td>Exchange</td>
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<td>Consumption</td>
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<td>Political Organization, Clubs,</td>
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<td>Corporations, Rural Hierarchies</td>
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<tr>
<td><strong>Behavioral Superstructure</strong></td>
<td><strong>Mental Superstructure</strong></td>
</tr>
<tr>
<td>Rituals and Science</td>
<td>Philosophies, Symbols, and Myths</td>
</tr>
</tbody>
</table>

2.5 Approaches to Methods

The holistic and values analysis approaches provide the behavioral and mental components for a sociocultural system. The behavioral response to values determines social-ecological resilience. Integrated with cultural materialism, the holistic, values
analysis, and social-ecological approaches explain resilience in terms of cultural causality.

Descriptive methods and materials are necessary to support the anthropological approaches of the holistic focus on the community, values analysis, the social-ecological approach, and cultural materialism. The methods and materials used to support my research design are participant observation, interviews, and public records and media. These methods and materials, used to show the underlying circumstances and values of the local community, are described in the next chapter.
3 Preview of Methodological Approaches

How and what data are collected determines the analysis that can be conducted. Thus, methods must elicit the general values that impact biodiesel production and canola cropping behavior. Methods that collect the appropriate data support the integrated holistic, values analysis, social-ecological, and cultural materialism approaches to explain local resilience, canola cropping, and biodiesel production. This research design develops the connection between theory, methods, and analysis. The measurement and sampling of units of analysis are critical to this end. Additionally, triangulation and the interplay between exploratory and explanatory approaches maintain the connectedness of this research design strategy. This chapter provides a general discussion about the methods utilized. Specific details about methods are provided in an early section of Chapter 5 to address research elements for the Corvallis Biodiesel Cooperative and the Oregon State University Biodiesel Initiative and an early section of Chapter 7 to address the impact of canola cropping.

3.1 Units of Analysis

The units of analysis for the present study were selected to provide the information needed to answer a particular research question (Bernard 2002). The units of analysis are biodiesel innovators, refiners, and users such as the Corvallis Biodiesel Cooperative and the Oregon State University Biodiesel Initiative. Also, units of analysis include individual growers and cultural traditions such as grass seed, specialty seed, and organic growers. Values for each units of analysis are identified. Values, referred to as cultural data by Bernard, “are measurements of the systems of mental constructions people use to interpret themselves and the world around them and of the behavior isomorphic with those systems of meaning (2002:186).” Thus, values are measures of people’s thoughts as indicated and interpreted through their actions. Values are attached to cultural traditions as well as being attached to individuals. By measuring people and traditions according to values, this research design seeks to
understand what is observed and how the observed corresponds with what informants report. This is important to the issue of internal validity that is concerned with the approximation of truth for an individual informant (Bernard 1998:150). The research design strategy also seeks to understand what is observed and reported that goes beyond the few people who serve as informants. From informant data, the research identifies the values of cultures as systems. This deals with the issue of external validity that is concerned with the approximation to the truth generalized beyond the individual informant to the larger community (Bernard 1998:552). The selection of units of analysis is particularly important to increase external validity (Bernard 1998:152). Generalizing about a target population requires that a sample be representative of the population of interest. Further, determining values common to a culture requires knowing the cultural affiliations of the target population and the parameters of the culture. To address these concerns requires attention to sampling.

3.2 Sampling

Sampling focuses on identifying individuals with expertise in a cultural domain. Informant expertise is important to explore variations in cultural patterning (Bernard 1998:703). Informants are selected for their cultural competence rather than their statistical representativeness (Bernard 2002:187). Three types of sampling—purposive, snowball, and saturation—were used in this research design. Purposive sampling consists of deciding the purpose that informants are to serve (Bernard 2002:182). In this study, informants serve to represent biodiesel innovators and cultural traditions that canola cropping stands to impact. There is no overall sampling design that indicates how many of each type of informant is necessary for the study. The researcher accepts whatever expert informants are available.

In snowball sampling, key individuals name other likely candidates for the research (Bernard 2002:185). According to Bernard (1998:705), this technique allows the researcher to build a sample of individuals, not all of whom share the behavior or
cultural element in question. Snowball sampling plays a key role to develop the informants for cultural traditions in this research.

Saturation sampling is the process of interviewing a succession of informants until no new information is obtained from a subsequent set of interviews (Bernard 1998:703). Sufficient information is needed to identify key informants who represent the widest possible or anticipated range of views on the topic being investigated. The form of saturation sampling in this research design strategy is interviewing to what Bernard (1998:704) calls “sufficient redundancy.” This involves reviewing accumulated knowledge from interviews and deciding that key information has started to repeat. Saturation is a good indicator of when to stop purposive and snowball sampling.

3.3 Triangulation

Using multiple methodological and theoretical approaches permits triangulation of collected data. Bernard (1998:719) suggests that “the most effective way to ensure reliability and validity of ethnographic data is to obtain comparable, confirmatory data from multiple sources at different points in time, and through the use of multiple methods.” The methods of data collection utilized for this research design are interviews, participant observation, and informational media.

Data collection methods support the theoretical approaches. The purpose of interviews, observation of behavior, and review of written materials is to discover the values of individuals and traditions. Once the values of individuals are learned, common themes lead to an aggregated set of values that determines collective behavior. Interviews and participant observation provide methods to determine the extent that collective behavior holistically reflects the values of the sociocultural system. Informational media, such as books, research papers, newspapers, journals, and the internet, provide a means to verify the data. This method provides theoretical and scientific background. Informational media also provides insight into the relevance of values to the holistic behavior of the system.
Triangulation serves to validate reliability, representativeness, and accuracy by using a variety of data collection and analysis tools to address a question or issue (Bernard 1998:550). For example, participant observation at public meetings serves to validate the reliability, representativeness, and accuracy of data from interviews and informational media. The purpose of such a research design strategy is to ward off as many threats to validity as possible and to help one evaluate and possibly refute competing hypotheses (Bernard 1998:146). The intent is to create a design that shows concern for a high degree of methodological and analytical detail (Bernard 1998:138).

3.4 Exploratory and Explanatory Interplay

This research design consists of exploratory and explanatory methodological approaches (Bernard 1998:139).

Exploratory approaches are used to develop hypotheses and to probe topics to attain a deeper understanding. Ideally, exploratory research promotes the development of more meaningful theory. The exploratory approach can be the primary focus or one of many research design strategy components. Ethnographic interviews and participant observation lead to the inferences necessary to construct hypotheses and deeper understandings.

Ethnographic interviews for this research design contain elements of unstructured and semi-structured interviews (Bernard 2002:204-205). During unstructured interviews, an informant and researcher sit down and hold an interview. Both parties know why they are meeting and that the purpose of the meeting surpasses mere pleasant conversation. Unstructured interviews consist of a clear plan, but maintain little control over informants’ responses. The objective is to encourage people to express themselves in their own terms and at their own pace. The interviews for this research design strategy are semi-structured. They followed a plan (see Appendix) of open-ended questions to initiate discussion. Informants were interviewed only once rather than repeatedly. Also, informants were informed that the duration of interviews is only 1-1 ½ hours. Reoccurring themes uncovered early also direct the course of
semi-structured interview questioning to test the extent of saturation and values commonality. The rule of ethnographic interviews is to question topics of interest to the informant then let he or she disclose the information valued as important (Bernard 2002:209)

Participant observation places the researcher into the middle of the action to collect data (Bernard 2002:324). Bernard (2002:327) describes participant observers as “insiders who observe and record some aspects of life around them” or “outsiders who participate in some aspects of life around them and record what they can.”

According to Bernard (2002:333-334), participant observation 1) allows the collection of all kinds of data; 2) reduces the problem of people changing their behavior when they know they are being studied; 3) helps the formulation of sensible questions pertinent to the group being studied; and 4) provides an intuitive understanding of what’s going on in a culture and allows one to speak with confidence about the meaning of data. These characteristics of participant observation contribute to research validity.

The explanatory approach involves testing theory already proposed in literature or informed by exploratory research. The intention of this approach is to eliminate threats to validity and test hypotheses. By upholding validity, the explanatory approach illustrates whether things are what they appear to be or, at least, the closest approximation to the truth. This is achieved by applying theory (as those described in Chapter 2) to the values that exploratory research yields.

The next chapter, Chapter 4, contains the stories of the CBC and OBI that result from researching these two groups. Chapter 5 describes in more detail the theoretical and methodological approaches used to analyze the CBC and OBI. Chapter 5 also illustrates how these theoretical and methodological approaches are applied.
4 Results for Biodiesel Production

The results for biodiesel production develop from researching the Corvallis Biodiesel Cooperative (CBC) and the Oregon State University Biodiesel Initiative (OBI). The OBI was inspired by the CBC. Thus, both entities share similar values.

4.1 The Corvallis Biodiesel Cooperative

Grease Works was formed as a cooperative by Justin Soares and a few of his friends in Corvallis, Oregon. The motivation behind this cooperative has been to produce and distribute a fuel alternative to those that object to using petroleum based fuels in their vehicles. Its continued success has been based on altruistic values and its members' environmental and social consciences. It has grown since its inception in the fall of 2001 and has since been officially renamed the Corvallis Biodiesel Cooperative. Justin’s efforts have been chronicled in many local publications and nationally by The New York Times Magazine (Kennedy 2003).

Justin was a student at Oregon State University studying wildlife biology, but he found himself distracted during classes by his social conscience. He was disturbed by the fuel consumption of his own vehicle and the contributions that it made to pollution and the threat of global warming. This went against his value of leaving a smaller footprint on the earth. He searched the Internet for an alternative fuel and discovered something called “biodiesel.” From a 1996 study, Justin learned that biodiesel produces exhaust which is over 90% less carcinogenic than regular diesel fuel. This piece of information set him in motion. He was motivated to learn more and so he read From the Fryer to the Fuel Tank by Joshua Tickell (2003). Just short of completing his undergraduate degree, he dropped out of school to form Grease Works with some close friends.

From his research, Justin discovered that biodiesel is simple to make and can be produced by recycling restaurant grease. The production process began by collecting used fryer grease from local restaurants. Doing this actually benefited the businesses
because they did not have to pay someone to haul it away when Justin came to collect it at no charge. The idea of reusing waste pleased Justin because, as he put it, “there is no away to which to throw waste.”

In September 2001, Justin and two of his close friends started the cooperative. By March of 2002, they were producing approximately 200 gallons/month in the backyard. The CBC now has around 30 member units. They use biodiesel faithfully in everything from 20-year-old Volkswagens, new makes of Volkswagens, Mercedes diesels, old and new Ford F-250 trucks, a home heating oil furnace, and even an industrial landscape chipper. Backyard production can no longer keep up with the demand, so biodiesel must be imported from the Midwest soybean industry via Sequential BioFuels in Eugene.

For the first three years that the co-op existed, a pump, meter, filter, and barrel of biodiesel were supplied to the member who then dispensed his or her own fuel. During the summer of 2004, I volunteered my services to the cooperative to train and coordinate members to deliver fuel. This effort was intended to get more members involved with making the cooperative work rather than Justin taking on the responsibility of making most of the deliveries on his own. Justin already was in charge of ordering fuel and seeing that it was delivered. My efforts were steadfast, but fell short of achieving the desired outcome. Only a small number of people responded to me as having an interest in volunteering time to make fuel deliveries. Also, volunteer willingness did not always correspond to the time that deliveries needed to be made. As a result, Justin instituted his back-up plan in the fall of 2004. A centralized tank for dispensing fuel was placed outside his vehicle workshop to accommodate members’ fuel needs.

Altruism and faith for a better future were the values at work in this group of people as they sought a practical alternative to what they see as our country’s oil addiction. There were no tax incentives to inspire the use of biodiesel. So, what motivates 30 people to pay a $75 membership fee and an additional dollar or more per gallon for biodiesel rather than regular diesel or gasoline?
One motivating factor for the group is having cleaner air to breathe. It is believed that a significant switchover to biodiesel would reduce lung cancer and reduce greenhouse gas emissions. In a May 2002 newsletter to the co-op, Justin reported an Environmental Protection Agency study that found 75% of all cancer risk associated with oil contaminants relates directly to diesel exhaust which comes primarily from commercial, farming, and school bus transportation. In a March 2002 newsletter, Justin reported that biodiesel boasts a 100% reduction of sulfur dioxide, 78% reduction of carbon dioxide, and a 50% reduction of carbon monoxide compared to petroleum based diesel fuel.

A second major motivating factor for this group is living their social conscience. They feel that if fuel is provided by locally grown crops rather than imported oil, the United States might pursue a different kind of foreign policy. Those opposed to the war in Iraq now have an alternative to refueling with regular diesel and gasoline that is processed from Middle East oil. The option of biodiesel allows the members of the CBC to take action through personal responsibility.

Social conscience is also enacted by their financial commitment. In addition to paying membership dues and the higher fuel costs, each member is responsible for paying the additional road taxes associated with the dispensing of the fuel into a motor vehicle. The additional taxes are addressed when a member files his or her personal annual tax forms. Even though it may cost more and may not be as convenient as having taxes included at the fueling station, the members of this group choose to do it.

Biodiesel is a reactionary, yet progressive, response to being part of what Justin describes as the “Oil Tribe.” Soares (2002) describes the vehicles of the Oil Tribe as “insatiable economic beasts that drink refined petroleum lattes and eat motor oil porridge.” In the May 2002 co-op newsletter, it was reported that 281 million people in the United States (as of the 2000 census) consume an average 150 lbs/week of petroleum per person for the plastic we buy, the electricity we use, and the fuel we put in our vehicles. Justin laments that in spite of the health risks and national security
risks that come from the acquisition and use of it, “[petroleum] oil remains the lifeblood of our nation.”

The CBC promotes biodiesel as a practical and revolutionary solution. Biodiesel can be dispensed from the current form of pumps used at filling stations and with little or no modification to diesel engines. Additionally, biodiesel could stimulate the local economy. Oil seed crops could potentially be grown in the Willamette Valley that could be used for the production of biodiesel. In turn, biodiesel production facilities could be developed locally and the fuel could be distributed short distances to filling stations.

From January through June 2005, the CBC partnered with the Oregon State University Biodiesel Initiative to run biodiesel in a campus shuttle. Much of my volunteer efforts for the CBC have been actively done through the OBI to coordinate this effort. I have been an advocate for both groups in an effort to build a local community alliance to recycle used restaurant grease into biodiesel.

During the summer of 2005, Oberson Oil opened a biodiesel pump at one of its filling stations in Corvallis. The CBC ceased its fuel and pump providing services as it encouraged its members to support the pump at the Oberson Oil station located at 1260 SW Third Street.

The CBC now functions primarily as an advocacy group rather than a biodiesel cooperative. Members promote the use of biodiesel, just as they have in the past, through displays at local fairs and events around Corvallis.

4.2 The Oregon State University Biodiesel Initiative

The Oregon State University Biodiesel Initiative (OBI) started in the fall of 2003 by a student, Brenna Doheny, and a faculty advisor, David Hackleman, from the Department of Chemical Engineering. The OBI’s objective has been to promote the production and use of biodiesel on the Oregon State University campus and beyond. The methods of achieving this have been science, research, and local networking. In the spring of 2004, the OBI was awarded a People, Prosperity, and the Planet (P3)
$10,000 grant award from the Environmental Protection Agency. This award provided some financial backing and set the group in motion to prepare for a May 2005 presentation in Washington, D.C.

The P3 award opened more opportunities for the OBI. The chemical engineering department already had a biodiesel batch reactor that was constructed by a previous student. The reactor provided the ability to convert waste grease collected from campus restaurants into a fuel that could potentially be run in campus vehicles. The P3 award has provided funding for this project. The award has also made possible the coordination and funding of a campus shuttle demonstration project. Although the further funding was not received from the EPA, the experience has still been beneficial.

The prestige of the P3 award and the OBI’s activism has helped to peak the interest of people throughout the region. In Corvallis, the P3 award and the efforts of the OBI helped to form a partnership with Laidlaw and the campus’ Parking Services to run biodiesel in a campus shuttle. Also, students from Crescent Valley High School and Philomath High School have taken on biodiesel research initiatives. Recent presentations before the Oregon House of Representatives agricultural committee and at the Oregon biofuels lobby day have piqued people’s interest in the groups’ activities. The Hewlett-Packard Sustainability Network in Corvallis has requested an OBI presentation for their group. Also, Oregon State University alumnus and engineering consultant Henry Oman from Seattle, WA has taken an interest in the efforts of the OBI. This community building advocacy has been part of the OBI’s outreach efforts to gain the interest, if not the support, of larger local networks.

An important aspect of the OBI’s P3 efforts was the campus shuttle demonstration project. The purpose of this project was to demonstrate to the campus and local community that biodiesel is a viable fuel for diesel engines. The intention was to promote good public relations press for the OBI, the CBC, and the Laidlaw corporation (who provides the driver and shuttle maintenance services), and Oregon State University—in particular, Parking Services who owns the campus shuttles.
The project design revolved around the use of B50, a 50% mixture of biodiesel with petroleum diesel, in the large campus shuttle. Early planning and construction problems for preparing the batch reactor and fume hood set-up prevented campus fuel from being prepared to run in the shuttle. Fuel had to be ordered through the CBC and delivered to Laidlaw on February 25, 2005 for the demonstration. The demonstration period lasted three weeks from February 28 to March 18, 2005. Surveys were conducted on the shuttle during the third week of the experiment to evaluate the knowledge and attitudes of riders toward biodiesel.

An article in Oregon State University’s Daily Barometer newspaper on Monday February 28, 2005 announced that a campus shuttle was running on biodiesel. In a follow-up March 9, 2005 interview, feedback from local Laidlaw branch manager Brian Maxwell was positive. He reported that Don, the driver, believed the shuttle was performing better with the fuel mixture than with straight petroleum diesel. Maxwell seemed genuinely interested in biodiesel as a potential alternative to petroleum diesel. He expressed concern about the rising cost of diesel fuel and how the price often fluctuates. He indicated that in the past he was interested in a bulk purchase agreement with a local fuel provider, but the outlet did not agree to the proposal due to fluctuation concerns of rising petroleum prices. Maxwell offered that he believed that there is a lot of idle farm land in the United States that could grow oil for biodiesel.

Although the OBI was not able to meet on-campus production for the campus shuttle as hoped, the support and fuel from the CBC helped to draw attention to the use of biodiesel. This partnership helped to promote a successful demonstration when the OBI could not meet its objective on its own. Likewise, the partnerships forged with Laidlaw and Parking Services made the campus shuttle demonstration a reality.

The OBI developed two other key partnerships. The support of the campus sustainability coordinator, Brandon Trelstad, and the campus recycling coordinator, Justin Flemming, helped to give credence to the efforts of the OBI. Both men were
sources of key information to alleviate “red flag” issues when coordinating the shuttle demonstration project.

The partnership with Justin Flemming also contributes to the continued growth of the OBI’s campus initiative. The recycling truck will be used to pick-up barrels of waste grease from campus dining services to be delivered to the chemical engineering department for fuel production. The regular, modest production of fuel at this scale could provide the 600 gallons of fuel that the campus recycling truck consumes each year. Justin is very much in favor of using 100% biodiesel from recycled campus restaurant grease and has already been running the campus recycling truck on B20 since the fall of 2003.

In their next phase of development, the OBI intends to scale-up production to 10,000 gallons of biodiesel per year in cooperation with the campus motor pool. This prototype facility could be used to convert not only the restaurant grease of the campus to biodiesel, but that of the other nearby restaurants of Philomath and Corvallis as well. Ideally, the production of biodiesel at this facility will be done by a high pressure, non-catalytic process that eliminates the need of a base to drive the reaction between the vegetable oil and the methanol. Collaborative funding is being sought for this project.

A hope of the OBI, one shared with Justin Soares of the CBC, is that the biodiesel initiative can spread to the agricultural component of the local community. The desired outcome is that local production of oil seed crops will not only provide a consistent supply of vegetable oil for biodiesel, but that the agricultural community will benefit from growing the crops as well as the use of locally produced fuel.
5 Resilience and Biodiesel Production

The Corvallis Biodiesel Cooperative (CBC) and the Oregon State University Biodiesel Initiative (OBI) are examples of local biodiesel production and social-ecological resilience. Values analysis illustrates the impact of the CBC’s and OBI’s values toward their behavior. The manifestation of their values suggests a superstructural deterministic approach to social-ecological resilience. To understand the mental superstructural determinism perspective, there must be an integration of both behavioral and mental components throughout the cultural materialist framework. The CBC illustrates mental superstructural determinism followed by behavioral infrastructural determinism and feedback. The OBI illustrates feedback and infrastructural determinism followed by an attempt of superstructural determinism. The methods of interviews, participant observation, and informational media provide the data necessary to use the cultural materialism framework and the superstructural deterministic approach to analyze the social-ecological resilience of the CBC and OBI. The results are discussed within the framework of social-ecological resilience.

5.1 The Theoretical Approaches

Superstructural determinism suggests that values play a greater role impacting behavior than infrastructural determinism suggests. The pillars for building resilience are the categories of decision-making necessary to build social-ecological resilience. These pillars are vital to the influence of actors within a system while adapting to resilience. Superstructural determinism explains how this can occur.

5.1.1 Superstructural Determinism

From a cultural materialist perspective, the symbolic and expressive components of sociocultural systems generally adapt to behavioral infrastructure and political economy (Harris 1999:165). Cultural materialism does not deny the possibility that mental components may achieve a degree of autonomy from infrastructural
determinism. The mental sectors are not always the passive recipients of behavioral infrastructure impulses. Rather, as Harris (1979:56) explains, the primacy of infrastructure "merely postpones and delays that possibility in order to guarantee the fullest exploration of the determining influences exerted by the behavioral infrastructure." Mental components, Harris (1999:147-148) suggests, are often "stimulants that energize and mobilize people and resources on behalf of particular kinds of sociocultural change," but "only to the extent that they feed back to and are compatible with evolving infrastructural conditions." The social-ecological approach expresses this feedback network as "revolt" and "remember."

James Lett suggests that cultural materialism could be improved by including the assumption "that people will assign meanings to their activities and experiences and will invest considerable intellectual and emotional currency in the development, expression, and preservation of those meanings (1987:97)." The efforts behind preserving these meanings ultimately support existing infrastructures and superstructures, even though cultural materialism is largely unconcerned with discovering and explaining the nature of meaning. The anthropological approach of values analysis reduces this limitation of cultural materialism.

Values analysis explores the attitudes, concerns, preferences, ideas, and beliefs that support the values base of human behavior. By analyzing values from the local community, a values set can be created (Applebaum 1987). The determined values set can be applied to the mental infrastructure, structure, and superstructure. By doing this, the meanings behind the behavioral infrastructure, structure, and superstructure can be illustrated. Thus, aided by values analysis, cultural materialism can be used to explain how meanings create causal factors within the behavioral infrastructure, structure, and superstructure framework and enable superstructural determinism.

The new materialism perspective of superstructural determinism arises to explain the paradigm shift necessary for social-ecological resilience to occur as a prominent value. Cases of superstructural determinism are recognized by cultural materialists,
although cultural materialists predict that such changes will not usually persist if they are at odds with infrastructural conditions (Lett 1987:98).

Still, in order for social-ecological resilience to be a prominent value, superstructural determinism must occur. Regular feedback from the mental superstructure, to the behavioral superstructure, to the behavioral structure and finally to the behavioral infrastructure will only reinforce that the sociocultural system remain on a path of social-ecological non-resilience. Too much filtering by the behavioral superstructure and structure occurs on the way to the infrastructure for social-ecological resilience to have its full impact on infrastructural determinism and behavior. Information passed from the behavioral superstructure needs to be processed by the mental superstructure as well. When this occurs, superstructural determinism needs to occur in the mental superstructure to then influence the mental structure and then the mental infrastructure (see Figure 5.1).

![Flow chart of predicted superstructural determinism.](image)

**Figure 5.1** Flow chart of predicted superstructural determinism.

In terms of the adaptive cycle, the mental superstructure represents the resilience component, the mental structure the connectedness component, and the mental infrastructure the potential component. Once superstructural determinism has
occurred, the mental infrastructure, if not at odds with the components of production, can influence the behavioral infrastructure. The behavioral infrastructure can then influence the behavioral structure which, if it is not at odds with the original rituals, can support the behavioral superstructure (see Figure 5.1).

However, as Lett indicates, one assumption that cultural materialism does not make is that human beings are meaning-seeking and symbol using creatures (1987:96). In order to accept the flow of Figure 5.1, it is necessary to make the assumption that human beings do seek meaning which contributes to how we behave and interact with each other and our environment. The values analysis approach is crucial to support this assumption. The new materialism perspective is intended to address issues of meaning and identity as well as maintaining human life.

Science and technology on their own can not maintain or improve the fundamental quality of human life. Harris (1999:159) states that “disappointment derives directly from the unintended and unforeseen consequences of science and technology, such as environmental pollution” and, perhaps, a surprise such as global warming. Harris suggests that unintended consequences are “avoidable and remediable by improving and enlarging the anthropological science component in the assessment of the effects of technological change.” The integration of resilience from the socio-ecological approach with the concepts of cultural materialism and the new materialism perspective of superstructural determinism is a step toward improving and enlarging the anthropological component.

5.1.2 Pillars for Building Social-ecological Resilience

Gallopín suggests that the categories of decision-making necessary to build social-ecological resilience are understanding, willingness, and capacity (Holling et al. 2002:362). Political willingness is a major obstacle. The foundation of this obstacle is supported by asymmetric power structures, vested interests, and the preference of individualism over cooperation and solidarity. Even if political will is present, a lack of understanding of complex systems can be an obstacle. Failure to understand the
linkages across scales within a system promotes this lack of understanding. Scientific tradition and behavior that is reductionist impairs the development of understanding. Additionally, inadequate structure and infrastructure contribute to the insufficient willingness and capacity to perform the actions and changes necessary to build social-ecological resilience. These obstacles are illustrated in Figure 5.2 borrowed from Holling et al. (2002:362).

![Figure 5.2](image)

**Figure 5.2** Pillars of decision-making necessary to build social-ecological resilience.

5.1.3 Adapting to Social-ecological Resilience

Walker et al. (2004) define adaptability as “the capacity of actors in a system to influence resilience.” Adaptability may require a transformation of the behavior and consciousness of a sociocultural system. Scheffer et al. (2002:232) suggest that changes may require the development of social capital that supports cooperation among key actors that have not been linked before.” Linking actors with similar interests and concerns creates formative social capital. This increases the “potential” component of the adaptive cycle. The linking of actors with diverse interests and
concerns creates bridging social capital. This increases the “connectedness” component of the adaptive cycle. The creation, or not, of these linkages is a testament to a sociocultural system’s adaptability. Creating cooperative linkages illustrates the positive degree of understanding, willingness, and capacity that exists to build social-ecological resilience. These linkages are maximized at the “sweet-spot” of the adaptive cycle near the top of the K stage.

A dysfunctional array of understanding, willingness, and capacity pillars leads to an eventual system collapse. Desperation and confusion increase the understanding that social components must alter values and behavior in the release stage. Learning to live with change and uncertainty is necessary for survival. This increases the willingness to nurture diversity in the reorganization stage. Capacity increases with the combination of different types of knowledge for learning in the r growth phase. The “sweet-spot” for understanding, willingness, and capacity occurs near the top of the K stage of the adaptive cycle where resilience, connectedness, and potential are maximized. The understanding, willingness, and capacity that occur at the “sweet spot” determine the condition of social-ecological resilience for the K conservation stage.

Resilience can occur in several ways. With the four principles for building resilience, understanding, willingness, and capacity, resilience can occur without system collapse. Pillars for building resilience can also result from cross-scale revolt and remember interactions. This depends on the adaptability of the sociocultural system, the social component of the social-ecological system.

The ability of the local community to adapt to social-ecological resilience ultimately rests upon its structure of values and resulting behavior. Values determine whether a new technology is made to fit the existing values structure or whether the existing values structure adaptively changes to integrate the new technology.
5.2 Methods of Data Collection

The methods of data collection include interviews, participant observation, and informational media. The intentional use of these methods is determined by the values analysis approach. Values analysis, in turn, provides information to the social-ecological focus that is explained through the cultural materialism framework. Through interviews, participant observation, and informational media, the values analysis, social-ecological, and cultural materialism approaches reveal the degree of resilience, connectedness, and potential within the CBC and OBI.

The methods used to analyze the CBC are interviews, participant observation, and informational media. Early research with the CBC involved interviews with one of the co-founders of the group. Questions revolved around why this group philosophically finds biodiesel important, how it organized to promote a biodiesel structure, and what it does to support a biodiesel infrastructure. Participant observation during quarterly meetings, as an advocating volunteer, and informational media from periodicals provided answers to these same questions and evidence for an emerging set of values. The determined values set provides the mental components that build the mental superstructure (resilience), structure (connectedness), and infrastructure (potential) of the CBC. The values set reinforces the progress of superstructural determinism and its ensuing impact on behavior via infrastructural determinism.

The method used to determine the values set of the OBI is participant observation. The values set of the OBI is inspired by and parallels that of the CBC. The OBI initially manifested its values through feedback and infrastructural determinism. Currently, the OBI’s values set is steering it in the direction of superstructural determinism to build its resilience with connectedness and potential.

I have been an active advocate of the OBI helping them to develop community partnerships in response to a People, Planet, and Prosperity (P3) grant award received from the Environmental Protection Agency. My participation, as with the CBC, indicates my bias to see that this group succeeds in its efforts to recycle waste grease
from campus restaurants and convert it into biodiesel that can be used to power campus vehicles.

The theoretical approach of values analysis determines the use of interview, participant observation, and informational media methods. In turn, the values set determined by these methods inform the social-ecological focus explained through the cultural materialism framework. Analysis of the values set discloses the degree of resilience, connectedness, and potential within the CBC and OBI. The analytical results can then be discussed in terms of the four elements of social-ecological resilience.

5.3 Analysis: The Corvallis Biodiesel Cooperative

The CBC exists because of a persistent set of values that pervaded the co-founders mental superstructure. However, initial feedback mechanisms of infrastructural determinism did not support their values. Only after their values followed a course of superstructural determinism did the CBC come into existence.

Initially, the values of the pre-CBC mental superstructure provided feedback to the behavioral superstructure. Research suggested that the desire to pursue a driving ritual less harmful to the ecosystem could be accomplished by using biodiesel. Thus, with such a pre-existing infrastructure, the latitude for change existed without posing great risk to the resilience of the driving ritual and the pre-CBC's values. However, at the time the co-founders of the CBC desired to first use biodiesel, there was no local fuel pump distribution available. The behavioral infrastructure provided resistance. This introduced difficulty for a systematic change, even though the proposed change to biodiesel supported an existing behavioral infrastructure. The negative feedback received through infrastructural determinism introduced an element of precariousness to the resilience of the pre-CBC behavioral and mental superstructures. Table 5.1 illustrates the components of infrastructural determinism.
TABLE 5.1

Components of the pre-CBC System for Infrastructural Determinism

<table>
<thead>
<tr>
<th>Behavioral Infrastructure</th>
<th>Mental Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioral Structure</strong></td>
<td><strong>Mental Structure</strong></td>
</tr>
<tr>
<td><strong>Behavioral Superstructure</strong></td>
<td><strong>Mental Superstructure</strong></td>
</tr>
<tr>
<td>Domestic and Political Economy:</td>
<td>Science: shows pollution and global warming</td>
</tr>
<tr>
<td>No local biodiesel pumps</td>
<td>Driving ritual less harmful to ecosystem</td>
</tr>
<tr>
<td>Pay more for fuel</td>
<td>and society using biodiesel alternative</td>
</tr>
<tr>
<td>Behavioral Infrastructure</td>
<td>Mental Infrastructure</td>
</tr>
<tr>
<td>Mode of Production:</td>
<td>Subsistence Lore:</td>
</tr>
<tr>
<td>Diesel Engines</td>
<td>Desire to Reduce and Reuse</td>
</tr>
<tr>
<td>Biodiesel</td>
<td></td>
</tr>
<tr>
<td>Behavioral Structure</td>
<td>Mental Structure</td>
</tr>
</tbody>
</table>

The development of the CBC can be explained via the flow of superstructural determinism. Values build the resilience of the mental superstructure via the connectedness of the mental structure and the potential of the mental infrastructure. In turn, the values components of the sociocultural system influence the behavioral components. As superstructural determinism proceeds through the behavioral components, actions build the potential of the behavioral infrastructure via the connectedness of the behavioral structure and the resilience of the superstructure. Table 5.2 illustrates the behavioral and mental components (social consciousness) of the CBC for superstructural determinism and subsequent infrastructural determinism.

TABLE 5.2

Components of the CBC System for Superstructural and Subsequent Infrastructural Determinism

<table>
<thead>
<tr>
<th>Behavioral Infrastructure</th>
<th>Mental Infrastructure</th>
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<tbody>
<tr>
<td><strong>Behavioral Structure</strong></td>
<td><strong>Mental Structure</strong></td>
</tr>
<tr>
<td><strong>Behavioral Superstructure</strong></td>
<td><strong>Mental Superstructure</strong></td>
</tr>
<tr>
<td><strong>Mode of Production:</strong></td>
<td><strong>Subsistence Lore:</strong></td>
</tr>
<tr>
<td>Diesel Engines</td>
<td>Desire to Reduce and Reuse</td>
</tr>
<tr>
<td>Recycle grease into biodiesel</td>
<td></td>
</tr>
<tr>
<td>Behavioral Infrastructure</td>
<td>Mental Infrastructure</td>
</tr>
<tr>
<td>Domestic and Political Economy:</td>
<td>Political and Economic Ideologies:</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Formation of the CBC</td>
<td>Cooperation</td>
</tr>
<tr>
<td>Pay more for fuel</td>
<td>Collaboration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behavioral Superstructure</th>
<th>Mental Superstructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science: shows pollution and global warming</td>
<td>Ecological and social resilience</td>
</tr>
<tr>
<td>Driving ritual less harmful to ecosystem and society using biodiesel alternative</td>
<td>Resistance to economic reductionism</td>
</tr>
</tbody>
</table>

The values of the mental superstructure represent resilience. Resilience is strengthened in the mental structure with the connectedness that comes from the values of cooperation and collaboration. The co-founders of the CBC realized that if they worked together, they could better address the values of their mental infrastructure. The potential offered by the mental infrastructure and the values of connectedness within the mental structure strengthen the resilience of the mental superstructure. By increasing resilience, the flow of superstructural determinism increases latitude and reduces resistance and precariousness.

Subsequently, the mental components influence the behavioral components. In the behavioral infrastructure, connectedness and potential promote resilience as local restaurants donate their waste grease for biodiesel production. The restaurants, otherwise, must pay for grease disposal. In the behavioral structure, connectedness increases potential as a cooperative system takes form to provide a biodiesel fueling structure. The desired outcomes of biodiesel use are realized in the behavioral superstructure reinforcing the values of the mental superstructure. The connectedness of the behavioral structure and the resilience of the superstructures stabilize the potential of the infrastructure once again infrastructural determinism resumes.

Over time, as feedback returns toward the behavioral infrastructure, an increase in the number of people that share the values and behaviors of the superstructure disrupts the CBC’s behavioral structure and infrastructure. The CBC’s capacity to produce biodiesel from local waste grease can no longer keep up with demand. Connectedness with local restaurants is lost in the behavioral infrastructure, but regained by collaborating with a regional distributor from whom biodiesel can be purchased. In
the behavioral structure, a willingness to pay more for biodiesel continues to build the infrastructural potential and reinforces the behavioral and mental superstructures. Table 5.3 illustrates this sociocultural system.

**TABLE 5.3**

Components of the CBC System for Infrastructural Determinism

<table>
<thead>
<tr>
<th>Behavioral Infrastructure</th>
<th>Mental Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode of Production:</strong></td>
<td></td>
</tr>
<tr>
<td>Diesel Engines</td>
<td></td>
</tr>
<tr>
<td>Biodiesel (provided by regional distributor)</td>
<td></td>
</tr>
<tr>
<td><strong>Behavioral Structure</strong></td>
<td><strong>Mental Structure</strong></td>
</tr>
<tr>
<td>Domestic and Political Economy:</td>
<td></td>
</tr>
<tr>
<td>Purchase fuel and supply service</td>
<td>Political and Economic Ideologies:</td>
</tr>
<tr>
<td>Pay more for fuel</td>
<td>Cooperation</td>
</tr>
<tr>
<td></td>
<td>Collaboration</td>
</tr>
<tr>
<td><strong>Behavioral Superstructure</strong></td>
<td><strong>Mental Superstructure</strong></td>
</tr>
<tr>
<td>Science: shows pollution and global warming</td>
<td>Ecological and social resilience</td>
</tr>
<tr>
<td>Driving ritual less harmful to ecosystem and society using biodiesel alternative</td>
<td>Resistance to economic reductionism</td>
</tr>
</tbody>
</table>

As the potential of biodiesel as a mode of production has grown, a local fueling station now has a biodiesel pump. Members of the CBC have been encouraged to support biodiesel by purchasing fuel at the local pump. Infrastructural determinism has nullified the need for the CBC’s values of cooperation and collaboration with this change of the behavioral structure. The connectedness provided the CBC’s mental structure is no longer desired. The post-CBC now functions primarily to advocate its behavioral and mental superstructures to support the use of biodiesel (see Table 5.4).

**TABLE 5.4**

Components of the post-CBC System for Infrastructural Determinism

<table>
<thead>
<tr>
<th>Behavioral Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode of Production:</strong></td>
</tr>
<tr>
<td>Diesel Engines</td>
</tr>
<tr>
<td>Biodiesel (provided by fueling station)</td>
</tr>
</tbody>
</table>
Behavioral Structure

Domestic and Political Economy:
- Purchase fuel from fueling station
- Pay more for fuel

Behavioral Superstructure
- Science: shows pollution and global warming
- Driving ritual less harmful to ecosystem and society using biodiesel alternative

Mental Superstructure
- Ecological and social resilience
- Resistance to economic reductionism

With the mental infrastructure and structure absent, the direction of flow from the mental superstructure changes directions (see Figure 5.3). The dominant values of the mental superstructure put pressure on the behavioral superstructure, structure and infrastructure. In this case, a self-reinforcing system emerges.

Figure 5.3 Self-reinforcing flow of the mental superstructure on infrastructural determinism.

In essence, the mental superstructure determines and reinforces the behavioral infrastructure that Harris suggests is the driving force for infrastructural determinism. Ultimately, it is values that determine behavior rather than behavior determining the
values of the mental superstructure. Infrastructural determinism reinforces the values introduced by superstructural determinism.

5.4 Discussion: The Corvallis Biodiesel Cooperative

Values analysis illustrates the impact of the CBC’s values on its behavior. The selected values and behaviors of the CBC demonstrate its responsiveness to the latitude, resistance, and precariousness components of resilience (Walker et al. 2004). Its values also enabled the CBC to build the principles of resilience, utilize pillars of resilience, and to adapt to resilience. Superstructural determinism played the key role for the development of the CBC and its values. Infrastructural determinism ultimately leads to the collapse of the CBC’s cooperative system. The CBC introduces novelty via feedback to provide an opportunity to create a new sociocultural system without the collapse of a previous system (Holling et al. 2002).

The process of building the principles of resilience and the pillars of resilience follow the same flow through the sociocultural system as superstructural determinism. Feedback from the behavioral superstructure to the mental superstructure indicates that pollution and global warming create change and uncertainty. To address learning to live with change and uncertainty, the philosophy of social-ecological resilience provides the pillar of understanding to the behavioral superstructure. Feedback from the mental superstructure to the mental structure indicates the need to nurture diversity for reorganization and renewal in order to support social-ecological resilience. Feedback from the mental structure back to the mental superstructure provides connectedness built upon the pillar of willingness to cooperate and collaborate. Feedback from the mental structure to the mental infrastructure indicates the need to combine different types of knowledge for learning. The ideas to reduce and reuse waste combined with the knowledge to make biodiesel provide the pillar of capacity to the mental structure. Feedback then crosses back over to the behavioral infrastructure.

The impact of superstructural determinism influences the behavioral components of the CBC. In order to accomplish the biodiesel mode of production, the resilience,
connectedness, and potential provided by the values within the mental components must be transformed into action. Within the behavioral structure, acting out the mental structure values of cooperation and collaboration is required among key actors. Cooperation initially occurs when the CBC is formed. Superstructural determinism ends and infrastructural determinism resumes. Over time, feedback indicates the need for collaboration with a biodiesel distributor to maintain the CBC’s cooperative structure. As the behavioral infrastructure changes to include a biodiesel fueling station, the CBC’s cooperation and collaboration is no longer necessary. As potential from the mental infrastructure and connectedness from the mental structure diminished, the CBC cooperative system collapsed. However, the resilience of the mental superstructure remains high. First introduced by the CBC as novelty, social-ecological resilience and resistance to economic reductionism currently serve as feedback that supports the biodiesel behavioral infrastructure.

5.5 Analysis: The OSU Biodiesel Initiative

Similar to the CBC, the OBI has a persistent set of values within its mental superstructure. The OBI, too, faced feedback mechanisms of infrastructural determinism that did not support its values. In response, the OBI is now following a course of superstructural determinism.

The OBI’s mental superstructure provided feedback to the behavioral superstructure. Responding to its values, the OBI applied for a P3 grant from the EPA. The EPA, within the behavioral structure, awarded the grant to the OBI. The grant provided the OBI with latitude to purchase biodiesel to run in the campus shuttles and promote awareness. Eventually, the OBI met resistance from the behavioral structure and the grant money was no longer provided. This decreased the latitude while increasing the precariousness of the OBI system. Infrastructural determinism, at first, provided a venue to build resilience. Over time, though, it resulted in a temporary set-back to the resilience of the OBI’s behavioral and mental superstructures. Table 5.5 illustrates the components of infrastructural determinism.
TABLE 5.5
Components of the OBI System for Infrastructural Determinism

<table>
<thead>
<tr>
<th>Behavioral Infrastructure</th>
<th>Mental Superstructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Production:</td>
<td>Ecological and social resilience</td>
</tr>
<tr>
<td>Diesel engines on campus</td>
<td>Resistance to economic reductionism</td>
</tr>
<tr>
<td>Biodiesel (provided by CBC)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behavioral Structure</th>
<th>Mental Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic and Political Economy:</td>
<td></td>
</tr>
<tr>
<td>Receive, then later lose, EPA funding to promote awareness and buy biodiesel</td>
<td></td>
</tr>
</tbody>
</table>

| Behavioral Superstructure | Mental Infrastructure |                |
|---------------------------|-----------------------|
| Apply to receive P3 grant money |                |
| Driving ritual less harmful to ecosystem and society using biodiesel alternative |                |

The OBI has since taken a superstructural determinism approach. The values structure of the OBI is inspired by and reflects that of the CBC. Superstructural determinism occurs as described for the CBC. The resilience of the mental superstructure builds upon the connectedness of the mental structure values of cooperation and collaboration. Furthermore, resilience builds upon the potential of the mental infrastructure values to reduce and reuse. The OBI is currently in the early stages of the behavioral components as superstructural determinism continues. Whether or not the biodiesel infrastructure continues to promote the behavioral potential depends upon the connectedness that results from the cooperative and collaborative actions within the behavioral structure. Table 5.6 illustrates the behavioral and mental components of superstructural determinism.

TABLE 5.6
Components of the OBI Sociocultural System

<table>
<thead>
<tr>
<th>Behavioral Infrastructure</th>
<th>Mental Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Production:</td>
<td>Subsistence Lore:</td>
</tr>
<tr>
<td>Diesel engines on campus</td>
<td>Desire to Reduce and Reuse</td>
</tr>
</tbody>
</table>
Recycle grease into biodiesel

<table>
<thead>
<tr>
<th>Behavioral Structure</th>
<th>Mental Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic and Political Economy:</td>
<td>Political and Economic Ideologies:</td>
</tr>
<tr>
<td>Cooperative facility with motor pool</td>
<td>Cooperation</td>
</tr>
<tr>
<td>Obtain collaborative funding</td>
<td>Collaboration</td>
</tr>
<tr>
<td>Behavioral Superstructure</td>
<td>Mental Superstructure</td>
</tr>
<tr>
<td>Science: shows pollution and global warming</td>
<td>Ecological and social resilience</td>
</tr>
<tr>
<td>Driving ritual less harmful to ecosystem and society using biodiesel alternative</td>
<td>Resistance to economic reductionism</td>
</tr>
</tbody>
</table>

5.6 Discussion: The OSU Biodiesel Initiative

As with the CBC, values analysis illustrates the impact of the OBI’s values on its behavior. The OBI’s responsiveness to the latitude, resistance, and precariousness components of resilience allows it to be flexible. The OBI’s values build the principles of resilience, utilize pillars of resilience, and to adapt to resilience. Just the same as the CBC, superstructural determinism plays the key role for the development of the OBI and its values. Novelty allows the creation of a new sociocultural system that avoids the collapse of the OBI.

The adaptability of the OBI preserves its resilience. The lack of willingness of the EPA within the behavioral structure diminishes the connectedness and potential of the OBI. As a result, direct feedback via infrastructural determinism fails to support the system. By changing course, the OBI designs connectedness and potential throughout the mental components of its system to build resilience. This occurs via superstructural determinism and reflects the process described for the CBC to build the principles of resilience upon the pillars of resilience.

Superstructural determinism continues as feedback crosses over to the behavioral infrastructure. The impact of superstructural determinism influences the actions of the OBI as it builds the potential of the behavioral infrastructure with the connectedness that comes from cooperating and collaborating with the campus motor pool. The success of this venture stands to reinforce the resilience of the OBI’s behavioral and mental superstructures.
The flexibility of the CBC and OBI permits them to adapt to social-ecological resilience. As with the CBC, the demand for biodiesel will grow for the OBI. As illustrated in Figure 5.3, the superstructural determinism that drives infrastructural determinism will challenge the OBI to maintain its mode of production. Recycling campus waste grease into biodiesel alone will not meet the fuel demands of the OBI cooperative venture with the motor pool. Canola cropping is the mode of production being considered to increase the amount of vegetable oil available to produce biodiesel. However, canola cropping presents a complex and difficult challenge to maintaining the potential and connectedness necessary for social-ecological resilience.

The next chapter, Chapter 6, provides background research regarding the canola cropping aspect of biodiesel production. Chapter 6 discloses the issues that surround canola cropping for grass seed, specialty seed, and organic growers. Chapter 7 describes in more detail the theoretical and methodological approaches used to analyze the social and ecological impacts of canola cropping as it pertains to grass seed, specialty seed, and organic growers in the local community. Chapter 7 also illustrates how these theoretical and methodological approaches are applied.
6 Issues for Canola Cropping

The integrated superstructural determinism and social-ecological analytical approach has been tested on the Corvallis Biodiesel Cooperative and the Oregon State University Biodiesel Initiative. Yet, the big piece to the biodiesel production system is the proposal to use canola as an oil seed crop. In terms of short-term versus long-term social-ecological resilience of the local community, this is the issue that must be addressed.

The oil seed crop that has been researched by Oregon State University's Department of Crop and Soil Science to introduce into the local community for biodiesel production is canola. Canola is proposed as a rotational crop to be introduced into the grass seed growers' tradition. The introduction of canola cropping raises concerns about the impact canola will have on two other traditions—specialty seed crops and organic growers. The values and interactions of these three agricultural traditions contribute to understanding the future social-ecological resilience of canola cropping.

The major themes that this chapter explores are the values surrounding economic viability and cooperation. The theme of economic viability is based on the assumption that a monetary profit, or in the least breaking even, is an important value to farmers. The theme of cooperation is based on the assumption that collaborating with neighbors may be a venue to achieve new forms of economic success while maintaining old forms as well.

6.1 Concerns about Being a Good Neighbor

The fertile lands within the local community provide ideal conditions for the grass seed, specialty seed, and organic growing traditions. Maintaining the integrity of the land and these traditions is vital to promoting the agricultural viability of the local community. Informants raised concerns about the harmful effects that growing traditionally bred or genetically modified canola can have on the specialty seed and
organic traditions. For the specialty seed crop growers, their way of life is directly tied to an important global market. Asian markets are important buyers of specialty seeds. These markets are very particular about seed purity. The local markets that support organic growers are also very particular about food purity. The specialty seed and organic traditions must be considered along with the grass seed tradition in regards to the social-ecological resilience of canola cropping.

Because canola is of the genus *Brassica*, it is viewed as a threat to the specialty seed crop industry. If canola is permitted to flower and produce seeds, this increases the risk that it may contaminate other *Brassicas* (such as cabbages, greens, radishes, and turnips) being grown for specialty seeds. A specialty seed farmer may grow rapeseed (a potential oil seed crop such as mustard) as a cover crop, but works it into the soil before it goes to seed. Also, care is taken not to have specialty crops and rapeseed flowering at the same time to discourage the occurrence of cross-pollination.

Local farmers have concerns regarding the introduction of genetically modified (GM) canola. Moses, Gale, and Brad are concerned that if GM canola is going to be the crop used in the Willamette Valley, this could be detrimental to food crops and specialty seeds. Fred admits that GMO’s [genetically modified organisms] make the issue of developing a canola industry more complicated. “There is no law that stops round-up ready canola that could screw-up organics.” Gale reported hearing a report that GM crop and cross-pollination problems already exist in the seed industry. Neil stated that there are no GM crops in the Willamette Valley. “GMO’s ultimately end up in food.” As for specialty seeds, “The perception in Asian markets is pretty paranoid about GMO’s.” For instance, “The Japanese use radish [seed] for sprouts,” reported Neil. Dan reported that Oregon State University did not bring in GMO’s for research because of local concerns and opposition to GM crops. Instead, “Traditional breeding and selection crossing crops have been brought in.”

The scenario of contamination by volunteers and cross-pollination brings ill feelings to the specialty seed and organic growers. Ron believes that there are “many other specialty seed crops around here for ODA [Oregon Department of Agriculture]
to be concerned about and to be leery of large-scale canola.” One fear is that canola grown on a large-scale commodity basis could present a risk during on-road transportation of oil seeds to a crushing facility. Spilled seeds could lead to volunteers that would threaten specialty seed purity. Also, it is felt that machinery, such as combines, used for oil seed crops would need to be isolated from on-road travel near specialty seeds. They, too, could present the risk of seed contamination. Gale stated that he would “hate to lose the specialty seed industry to the acres required for a commodity crop” such as canola which poses potentially great risk to contaminating the specialty seed industry. “A large acre farmer may have the crop benefit to do so, but I'd hate to sacrifice the industry for that.” Joe echoed the concern about large acres of canola crowding around the specialty seed crop industry. He has no qualms about someone growing canola as long as they “stay the heck away from me.”

Luke remarked about how particular the Japanese market can be regarding the purity of specialty seeds. Contamination will jeopardize contracts with seed companies. Gale echoed this by saying that “Specialty seeds must be pure for market. Any contamination will render it useless.” There are concerns about disease, cross-pollination, and genetically modified canola that could devastate the specialty seed industry. Referring to the seed companies, Gale stated that “the industry is not going to put up with seeds being grown in canola areas due to disease and contamination” and that “seed companies will feel uncomfortable about the proximity of canola.”

Luke offered two suggestions regarding the growing of oil seed in the local community. The first suggestion is not to grow canola. This suggestion is as much about preserving the purity of the specialty seed industry as it is about suggesting that the soil of the local community would be better used for other crops. Oil seed crops are currently being grown in locations where they do not have too many options for crop viability such as dry-land situations. The specialty seed farmer believes that canola is best left for these areas that have large acreages that can be set aside for oil seed production that can compete in a large-scale market. Informant Cyrus agrees. “Canola isn’t that profitable and there are better varieties suited for the Valley.”
second suggestion offered by Luke is to explore better oil seed alternatives that would not create contamination problems for the specialty seed industry. Luke suggests that industrial flax would be an ideal crop. This suggestion concurs with one made by informant Moses. Both referred to the historical value of flax to the local community’s agricultural past.

Luke feels that it will be a long time before oil seed will compete with regular diesel. He admits that it would be nice to have our own supply of fuel, but right now it is cost prohibitive. Ron agrees. “If you can tell the [foreign country] to go stick it that is fine with me.” But Ron cautions, growing oil seed must be economically viable. Luke believes that someday it will be. This suggests a different value structure from that of the Corvallis Biodiesel Cooperative. For the CBC, the monetary cost of using biodiesel does not supersede the values that encourage its use. For farmers, growing oilseed crops for biodiesel production depends on economic viability.

6.2 Concerns Regarding Economic Viability

The growing of canola as a rotational crop for grass seed farmers is appealing for three reasons. First, no new equipment is needed by the grass seed farmer to tend to canola. Second, canola could allow a break in rotation for grass seed farmers to use a variety of chemicals that it can not use growing grass seed season after season. Third, canola could relieve pressure on the grass seed market.

Oscar reported that no new equipment, but perhaps “moderate modifications would be required” to prepare equipment for canola. He stated that “the closer they [crops] are to current patterns the more likely they are to be adapted.” In regards to farm equipment, growing canola would not bring significant change to current patterns.

Irvin reported that the use of chemicals is a big part of the grass seed industry since field burning is no longer allowed. A rotation crop, such as canola, can ease some of the pressure. Oscar reports that a rotational crop “breaks up the chemical monopoly used on grass seed.” Chemicals needed to improve the viability of the grass
seed industry could be applied to canola. These chemicals are used to kill the broadleaf plants. They cannot be applied while growing grass seed because they would kill the grass as well. So more and different chemicals must be designed in an attempt to keep grass seed a competitive crop when it is grown on the same field year after year.

Growing canola could ease the pressures of a flooded grass seed market. If it is profitable, then those growing the canola benefit as well as those grass seed farmers that are not. Oscar reports that “rotated acres raise the value of grass seed acres.” He suggested that, in the least, a revenue neutral crop is needed for rotation to help “clean-up the ground” for the next crop. Simply cleaning up the ground could make the next grass seed crop flourish and more profitable. Ron feels that “Looking at the whole picture, it is viable for other grass seed farms [with large acreages suited to rotate canola] than it is for this farm” to ease the pressure on a flooded market that drives down the prices of grass seed.”

In addition to rotational variety, farmers are looking for any economically viable crop. This may or may not be an oil seed variety. As Ron put it, “Somebody has to prove that it’s economically viable.” The idea of biodiesel as a positive contribution to society is appealing, but “if you can’t pay the bank it’s not going to happen.”

The production of biodiesel at this point is not viewed by farmers as a profitable venture in terms of oil use. There are other uses that provide more return for seed oil than biodiesel does. For example, meadowfoam (an oilseed crop grown in Lane County, Oregon) produces a high cost oil that is used for cosmetics production. It is believed that biolubricants (alternatives to petroleum based lubricants) made from vegetable oil will be one of the profitable new markets. Biodiesel could be lumped into this category in 2006 when petroleum diesel will be required to have lower sulfur content. Whatever will provide the best monetary return to farmers is likely the avenue that will be followed. Ron stated that farmers “try to get the value out of all byproducts up front. Biolubricants offer a higher dollar value to start. Biodiesel is low on the value list.”
Sam argued that “People can ship seeds, oil, and fuel into the area cheaper than we can grow it.” Sam and Joe both doubt the local community could possibly compete with these large-scale price driven markets. Joe sees the Canadians as having the canola commodity price market covered. He believes “the Canadians are going to wave on their way by.” Sam suggested that less than 10% of his acreage could produce canola. Ron reported the same amount of available acreage to produce canola, which he said “must be grown on wheat ground.” Sam described his soil as poorly drained which would cause canola to be a failure under such wet conditions. “We’re in a world where money drives,” he said. “If it could work, we would have been doing it. I can’t afford to grow a loser. I’d rather leave ground idle than grow a loser.”

Ron argues that no one has hard numbers to show that growing oil seed for biodiesel is economically viable. The numbers he had heard so far are breaking even at best. “You can’t spend $250 an acre to get back $100,” he said. “You must make enough money to support society” such as schools and other elements of infrastructure. “You can want a lot of things socially, but somehow you ‘gotta’ make ends meet.”

Joe is in favor of people growing what they want as long as they are careful about it. Still, he questions the economics of targeting a biodiesel industry locally. “We can’t target manufacturing because the economics don’t work out here in the valley.” Joe continues, “I hate to see a plant go in that [oil seed] acres can’t keep up with and that negatively impacts pockets of specialty seeds.... I just don’t see it—hate to see people lose a lot of money.”

Joe also expressed concerns about agendas and motives for growing oil seed for biodiesel. “Kropf [Oregon State Representative] and Coba [Director of ODA] are saying we are going to make all this money, but people are growing oil seed all over and not making any money... The state level seems to have stars in their eyes about oil seed production.” Joe also expressed suspicions about the motives of researchers. “I’m more apt to believe a private researcher, than a researcher whose job it is to find
another crop for the valley,” Joe said. Still, he expressed a curious interest that if Oregon State University research “pans out” that it would be okay to put out test blocks in carefully selected areas.

All the farmers interviewed reported no qualms about using biodiesel if it is cost competitive. Sam stated that if it is economically viable “it doesn’t matter what we run in our engines. But Sam strongly believes that “it still has to compete with the petroleum market for cost viability.” Ron reported that a recent tanker truck delivery of diesel fuel cost $1.45/gallon for a tanker truck load of 10,000 gallons of fuel. “Can [biodiesel] fuel get in the tank for $1.50 [per gallon] without government subsidies?” he questions. He believes that biodiesel would be used if it becomes cost competitive. However, he cautions that the BTU’s from biodiesel are not as good as petroleum and that this should be factored into the cost. “I have no problem using or being part of it, but it just needs to be economically feasible.”

6.3 Attitudes toward Cooperatives

Attitudes toward cooperatives as a venue for economic viability varied among informants. Some see the need to form cooperatives as a means to achieve economic viability and individual benefit. Others have very negative associations toward cooperatives and prefer to attain economic viability and individual benefit by maintaining the separateness of their private enterprise.

Cyrus believes that a formal cooperative could benefit from dividends. He sees the marketing of biodiesel produced from canola as an open market opportunity. The farmers would pay the same price for fuel as others. Doing so, they could then benefit as part of a guaranteed biodiesel market and from the dividends received from fuel sales. Cyrus also sees the benefit of having a local crushing facility that could supply livestock feed as well as oil from the crushed canola seed. He feels the Willamette Valley could successfully support one with an oil seed industry that can pay for itself. His vision of a cooperative union includes a series of about 10 small-scale biodiesel production plants around the Willamette Valley.
Irvin sees a cooperative as something that could and should exist. He made reference to a biodiesel plant in the Midwest. There, a cooperative had purchased shares to support the facility. He sees the need for large-scale production to be efficient and cost effective. “One farm couldn’t produce enough,” Irvin predicted. A cooperative network of farmers could have a better chance of producing at a scale large enough to support a local crushing and production system.

Still, Irvin has his reluctance to moving forward with such a system due to what he referred to as the “meadowfoam bomb.” Meadowfoam harvested by the Oregon Meadowfoam Growers Association cooperative is shipped out of state to be crushed into oil for processing into cosmetics. Yet Eric reports that “meadowfoam is high priced so it can be shipped” to a crushing facility while “canola would need close by crushing technology.” Ron sees a problem with the meadowfoam cooperative because they do not have proprietary control over their crop. The harvested meadowfoam “goes to the meadowfoam growers’ marketing association.” Ron stated, “The growers have no control over where the oil goes and what it is used for.” Oscar reported that the Oregon meadowfoam growers “formed a co-op to produce for a Chicago market that requested more acres than a market existed”, thus taking advantage of local agricultural exuberance. Oscar suggests that meadowfoam has tempered some people’s attitudes toward new crops and, perhaps, perpetuated ill feelings toward cooperatives.

Oscar suggests that a negative stigma is attached to the idea of cooperatives. One stigma he suggests is that cooperatives are akin to “communism.” Partly because of this, “Cooperatives seem to be a last ditch effort for local farmers.” The appearance to farmers is that those that are loners are the ones that have all the capital while cooperatives have difficulty accumulating capital. Hearsay and farmers’ actual experiences regarding failed cooperatives increase the stigma against forming them.

Sam reports that the risk perception regarding cooperatives is high. He does not see the gross revenue and net income accumulated by cooperatives as a means to make a lot of money. “Bigger is better,” he stated. “Ten people don’t make a strong co-op.”
Sam also reported that farmers cannot pay enough to attract the management they need for a co-op. “Co-op’s all struggle—look at history... Struggle does not sound appealing.”

Fred echoes the same concerns reported by Ron, Oscar, and Sam. “Co-op’s work, but do not work here,” he stated. He reported that farmers view them as “socialist”, everybody’s been “burned” by a co-op, and that they are a “disaster” for growers to manage. Fred referred to local cooperative history as a “mixed bag.” “Some big company takes over management and screws co-op.” Eric suggests that stock in a Limited Liability Corporation (LLC), that provides personal liability protection and the tax benefits of a partnership, would be more favorable with “professional management.” Cooperative style management has been “seat of the pants, unprofessional management.” Local farmers remain eternal optimists, but “have long memories about bad things that happen.” The failure of the Agripac Cooperative vegetable cannery in Oregon and distrust that cooperatives will be taken advantage of by outsiders are examples that fuel this folklore. A Chicago business encouraging a southern Willamette Valley meadowfoam cooperative to ambitiously overproduce and flood the market with oil lingers fresh in many growers’ minds. The outside business reaps the benefit of excess oil while the growers suffer.

6.4 Attitudes toward Cooperation

Although attitudes are primarily unfavorable toward cooperatives, informants do favor some form of cooperation. Attitudes toward cooperation favor taking care of the local community first to avoid dependency on or victimization by outside sources. Attitudes toward cooperation also favor being a good neighbor, particularly in light of the risks posed by canola cropping. Neighborly values suggest the pinning map system, currently used by specialty seed growers to reduce outcrossing risk, as a solution to the canola cropping issue.
6.4.1 Taking Care of Ourselves

Fred sees Oregon as having a "colony mentality" which ultimately paralyses farmers. According to Fred, this mentality believes that "someone will come from the outside to rescue us." He suggested that "we're not willing to take a risk with our own hard earned money... Farmers either don’t have the resources or aren’t willing to put forth capital to collaborate." Fred also suggested that farmers see each other as competitors rather than collaborative stakeholders which results in much infighting for agricultural success. Still, Fred recommends that farmers “must connect to the end product somehow to recover profits lost to the market.” This he suggests be done through some form of cooperation or a LLC.

However it is done, Moses believes “private enterprise needs to work cooperatively for rapid change.” We need to reduce the monopolistic marketing philosophy for collaboration and cooperation. He suggests that “the federal government is too deep in corporations” to help us and that we must take care of the local community ourselves. Then, eventually, it will trickle up. He sees the local community as conservative and supportive. “If you’re doing something real—not just a fad, but a sustaining power that works—it will keep.” He also sees the community as a good size to work with for interactive behavior. Moses worries that “people may be forced to change if they first don’t decide to change.”

Oscar sees the local community coming together to produce fuel to meet its own needs as a good thing. He questions, “When are the wheels going to come off the corporate machine?” Instead, he suggests that “the closer a producer can get to the customer, the better off he is.” Moses suggests that the means of producing fuel and energy could be done by the “common man” as opposed to the oil industry. To do this, people must encourage legislation at the upper institutions (federal and state government) and financing from banks. Once the opportunities are there, Moses believes it is in the best interest of people to collaboratively succeed at the local level.
6.4.2 The Pinning Map System

Fred suggests that perhaps the pinning system at the OSU Extension Services office in Albany could be used as the means to minimize the risk of contamination. The OSU Extension provides this neutral party service that is important to maintaining high quality seed production. The pinning map system has been used by the specialty seed industry to protect itself from contamination with other specialty seed crops and canola in the past. Avoiding contamination to ensure seed purity is a critical factor in the success of the specialty seed tradition. On a large map of the local community, farmers pin which crops they are growing at particular locations. The map consists of numerous tiny colored flags that correspond to a color-coded chart that lists different seed crops being grown in the area. The pinning map has a grid system to indicate the township, range, and section of land a crop is planted. This allows neighbors to know where and what each other is growing so that concerns about cross-pollination and seed contamination can be dealt with during the planting season. Under current Oregon Department of Agriculture (ODA) rules, Brassica crops (which include canola and many specialty seed and vegetable crops) can not be grown within three miles of one another.

Luke suggested that it will take cooperation between neighbors to grow canola for oil as well as specialty seeds in the local community. The pinning system already serves as an informal mechanism of cooperation within the specialty seed industry. Ideally, this system could be used to incorporate canola as well. Luke admitted that small amounts could be okay, but it is believed that a substantial volume of thousands of acres of canola being grown in the local community for economic viability is problematic. The attitude toward this is that it will increase the chance of specialty seed invasion and contamination by canola volunteers. Luke is truly concerned that this would “foul up a lot of other people.” Ron sees the need for about 5 miles between canola and specialty seed crops. “If you decide to grow canola, 5 mile circles start affecting a lot of people,” he said.
6.5 The "Pro's and Con's" Meeting

On Tuesday February 8, 2005, a public meeting took place at the Linn County Fairgrounds and Expo Center in Albany, OR. The meeting was organized by the OSU Extension Service. The event brought together farmers, researchers, government officials, politicians, specialty seed industry representatives, and oil seed supporting entrepreneurs. An estimated 200 people filled the meeting room that originally only had about 100 chairs arranged for seating.

Tom Chastain of the Oregon State University Crop and Soil Science Department opened the presentations to describe the potential benefits of growing canola to grass seed farmers. He jokingly brought up canola as an alternative to meadowfoam as a rotational crop as he stated that “canola can accommodate grass seed needs for diversification.”

Chastain reported that canola has a strong taproot system that can penetrate soils that fibrous-rooted grasses cannot. This is an advantageous break to grass seed growers because long-term traffic in grass seed fields has produced dense soil layers that reduce the rooting capability of grasses. Additionally, by using canola as a rotational crop, a farmer can reduce herbicide damage to grass seed crops. He also reported that there are very little volunteer problems with new canola varieties.

According to Chastain, the yield potential for a winter canola crop to be around 2,300 pounds per acre and admitted that the better drained soils will have the best yields. Spring canola yields can be expected to be about half of the winter yields.

Chastain believes that the canola and specialty seed crop industries can co-exist. He suggests that the winter and spring canola variety *Brassica napus*, with difficulty, will cross with cabbage, turnip, and Chinese cabbage seed crops. To avoid this, he recommends designating specialty districts for the production of specialty seed crops and canola. This would supplement the already existing pinning system. He suggests the success of the two industries co-existing will require cooperation and vigilance from all farmers.
Daryl Ehrensing, also of the Oregon State University Crop and Soil Science Department, provided information regarding the potential growth of biodiesel throughout the Willamette Valley. He reported that crushed canola seeds could provide meal for livestock and oil for such commodities as biodiesel, food, biolubricants, and hydraulic fluids. Ehrensing suggested that expensive commodities need to subsidize fuel.

Ehrensing reported that the status quo approach to oil seed processing has revolved around large-scale thinking. A large-scale, centralized plant could cost over $15 million dollars to build to achieve economic viability. Such a plant requires the use of hexane as a solvent for the extraction of oil from the seed. Hexane is quite volatile and raises “not in my backyard” issues for the local community.

A second possibility that Ehrensing suggested is that of a smaller production scale. This system would require a screw press operation that could crush canola seeds into meal and oil on the farm. Although not as efficient for oil production, this method would eliminate the use of a hazardous solvent and its potential for water pollution. According to Ehrensing, the cost of this processing system would be around $200,000. He suggests that the economic viability of small-scale processing requires further exploration.

OSU Extension agent Mark Melby introduced Oregon State Representatives Jeff Kropf and Jackie Dingfelder by stating that the biodiesel “economics are marginal at best without legislation.” Rep. Kropf opened by asking, “Can we make money if not break even?” He suggests that “creativity can make this work.” He sees opportunities coming in the future, so he believes the time is now to lay the foundation for construction and market growth. He sees biodiesel succeeding on both community and large scales. Rep. Kropf believes that Oregon can take the best from existing industries to fit its own needs. He cited the successes of Minnesota’s farmers’ cooperatives where “for every dollar of public investment in Minnesota, $12 comes back.”
Rep. Dingfelder supports biodiesel as something that is “good for the environment, economy, and farmers.” As a representative from Portland, Dingfelder stated that the “urban area is concerned about the rural economy” and that they have an “interest in using biodiesel.” She put forth a request to the farmers to promote biodiesel by calling their state representatives.

Rep.'s Kropf and Dingfelder proposed the Renewable Fuels Act of 2005 legislation which, in part, consisted of intended benefits toward creating the market and demand for biodiesel. One piece of legislation intended to set renewable fuel standards for biodiesel mixed into petroleum diesel at 2% by 2006. The percentage of biodiesel required for mixture with petroleum diesel was to be set at 5% and ethanol for 10% by 2010. Another piece of legislation intended to retrofit and clean-up older school buses that currently run on petroleum diesel only. A proposed incentive to affect purchases at the fuel pump was a reduction of the fuel tax on biodiesel. Also, a property tax exemption of 50% was proposed for biodiesel production, crushing, and commodities facilities.

An incentive to farmers was a proposed 5 cents per gallon produced tax credit for biodiesel. Literature provided by Chastain suggests that about 19 pounds of canola are necessary to produce the 1 gallon of oil necessary to make 1 gallon of biodiesel. Chastain’s estimated yield of 2,300 pounds renders about 121 gallons per acre. The resulting incentive would have been $6.05 per acre. The Renewable Fuels Act of 2005 did not come to fruition.

Both Rep.’s Kropf and Dingfelder warned that the oil industry will lobby against biodiesel. They predict that the oil lobbies will argue that free market capitalism does not exist if the government is involved. They believe the oil industry will claim that if capitalism does not exist on its own free from government intervention, we should not do it because it denies local creativity and thought of privatized entrepreneurship.

OSU Extension agent Bob McReynolds introduced the concerns for specialty seed growers in the Willamette Valley. He reported two major concerns regarding the use of canola as a rotational crop. One is weed control due to Brassica volunteers. The
fear is that canola seed may fall from trucks and lead to weed contamination of specialty crop fields. Another concern is the threat of disease that canola may bring to the Willamette Valley and specialty seed crop industry.

Skip Gray presented concerns, but not before venting his frustration about the departure of the Rep.'s Kropf and Dingfelder. The two Legislators left the meeting early to return to Salem for a legislative session. Before leaving, they agreed to a separate meeting time to hear the concerns of the specialty seed growers. “I thought this meeting was about Legislators hearing concerns,” Skip stated in response. He expressed his disappointment to what he perceived as Rep.'s Kropf and Dingfelder providing “hype” to influence canola rotation then leaving the meeting.

Skip then turned to his concerns. He questioned the profitability of canola crushed for biodiesel and whether or not it could survive without subsidies as the specialty seed industry does. He also questioned whether or not canola could produce 1,800 pounds per acre according to what he has heard about farmers around the world. At 19 pounds of seed per gallon, this yield renders about 94 gallons per acre. With a 5 cents per gallon produced tax credit, the resulting incentive is $4.70 per acre. He sees a critical mass required for the use of canola as a commodity crop. The amount of canola necessary makes him worry about the future of the specialty seed industry being contaminated by disease and GMO's. For Skip, specialty seeds are an established industry that he does not want to lose. He concluded with a request that for any rotational crops introduced into the Willamette Valley that responsible, respectful, and rational thought be included.

Nick Tichinin of the Universal Seed Company also spoke on behalf of the specialty seed industry. He believes that direct contamination is the least worry if the Willamette Valley acres of canola remain at about 40,000-50,000. However, he suggests that canola will have to be grown on such a large scale to meet mandated demands that it will obliterate the specialty seeds industry. He argues that the climate and land prices of eastern Oregon are better suited for growing canola than the Willamette Valley. Until the market demands it, he believes that canola should be
kept out of the Willamette Valley. If and when canola is introduced, he strongly recommends proceeding with caution. He echoed arguments that canola yield does not make the crop profitable for biodiesel, roadside seed spills lead to weed infiltration and possibly contamination, and disease that will require more cost inputs by farmers to combat.

Nick also echoed the concern regarding GMO’s, which he referred to as “unleashing the specter.” He related a conversation with a client from Japan that questioned him about whether or not canola was being grown in the Willamette Valley. This client had pulled out of the Yuma market because of GMO contamination of cabbage. The client moved all seed purchasing business to the Willamette Valley because of the purity of seed that is available. Nick worries that if canola is introduced, the fear factor will chase away business.

Tom Chastain concluded the meeting by pointing out how some retorts to the information he provided were incorrect. He restated that he believed that 2,300 pounds of canola seed per acre is attainable. He also restated that no GMO’s have been into the Willamette Valley for testing, but traditional hybrid varieties. He responded to the farmers present, “I don’t care if you grow canola or not.” He assured the farmers that the final decision belongs to them, but that research is being done by Oregon State University which is trying to keep up with the changing times and keep farming viable in the Willamette Valley.

6.6 The “Science Experts” Meeting

On Monday March 14, 2005, another public meeting took place at the Linn County Fairgrounds and Expo Center in Albany, OR. On this occasion, science researchers provided information regarding potential negative consequences of canola cropping. Again, the meeting was organized by the OSU Extension Service. Although not as well attended as the “pro’s and con’s” meeting, approximately 100 people were present.
Amy Dreves, an OSU Extension Service horticulture assistant, reported the insect populations that canola cropping is likely to increase. Populations of cabbage maggots, seedpod weevils, flea beetles, and aphids are all likely to increase. Her report indicated that winter canola, grown from November to February, may be advantageous to minimize insect problems.

Nancy Osterbauer reported on the soil diseases that canola can potentially increase. She suggested that the risk of disease is greatly minimized by using treated canola seeds, chemical applications, and a canola rotation of one planting every six years.

Jed Colquhoun and Ed Peachey from the OSU Extension service discussed the potential of canola as an invasive weed. They reported that 25% of yield falls out of combine harvesters. This poses a risk of uncollected seeds starting volunteers. Once in the soil, canola can persist for 5-10 years. Seeds that are buried by cultivation persist for the longest time. But if seeds are exposed to light before tillage, less viable seeds are buried. The weed science researchers also reported that canola is the 10th most common weed in western Canada. A study from Quebec reveals volunteer canola in 90% of 131 fields following a single canola crop planting. Additionally, it is suggested that at least 80% of Canadian canola is a GM variety.

Carol Mallory-Smith, a professor of crop and soil science at Oregon State University, addressed issues surrounding GM canola. She pointed out that to maximize the added monetary value for grass seed growers, GM canola needs to be the crop of choice. Grass seed growers will want to select herbicide resistant GM varieties to complement the necessary herbicide applications for grass seed production. Mallory-Smith then echoed concerns of some growers regarding GM contamination, cross pollination, and volunteers. In order for contamination and cross pollination to happen, there must be compatibility between species, the species must occur together, and flowering periods must overlap. Mallory-Smith warned that gene flow will happen beckoning the open-ended question, “What will be the consequences?”
6.7 The “Proposed Rules” Meeting

On Friday April 29, 2005, the Oregon Department of Agriculture ODA held a public meeting to discuss proposed rules for canola cropping. The meeting took place at the ODA building in Salem, Oregon and was attended by about 50 people. The ODA revealed its proposed rules. In response, those attending the meeting repeated concerns discussed at previous public meetings.

Katy Coba, the ODA director, explained why canola cropping has become an issue. Growing interest in biofuels inspires the potential desire to grow canola. As the price of petroleum oil rises, growing oil seeds in Oregon becomes more attractive.

The proposed rules encourage the use and upgrading of the current pinning system. This system will facilitate the proposed separation of canola and specialty seeds by six miles. Disease measures will remain the same including the use of certified seed, fungicide treatment, and a rotation of canola once every four years. Transportation security will require that canola loads will be securely contained and covered. For GM canola varieties, dedicated equipment will be required.

In a letter submitted to the ODA that was read aloud, Tom Chastain suggested that 2 kilometers is adequate isolation between canola and specialty seeds. In rare instances, 4 kilometers of separation is necessary. Therefore, 3 miles of separation is sufficient isolation between canola and specialty seeds. Chastain recommends growing winter canola since it yields more than spring canola. He also recommends excluding GM canola altogether. Chastain questions, “Why would any sane grower plant GMO?”

GM issues aside, canola still causes concern. Bob McReynolds of the Oregon State University Extension office warns that cases across the world show invasive problems of canola. McReynolds suggests that just because we can grow a crop does not mean that we should do it.
6.8 Mental Superstructure of Canola

The attitudes expressed in the interviews and meetings represent the mental superstructure associated with the introduction of canola. Prevalent are the values of economic and scientific reductionism, such as the proposal to introduce canola cropping, to pursue the short-term social-ecological resilience of the current agricultural system. Also prevalent are values that favor being a good neighbor and cooperation, such as the proposal of canola cropping rules and the use of pinning maps, to pursue the long-term social-ecological resilience of the current system.

Reductionism is prevalent in values that suggest the driving importance of money and efficiency. Farmers value economic viability, but they do not value cooperatives as a means to achieve it. Scientific evidence suggests that canola is a highly efficient and relatively cost-effective way to produce vegetable oil and that a three mile separation from specialty seed crops is ample. These scientific suggestions support canola cropping as an economically viable option. Canola cropping appears to be a quick and easy solution as a rotation crop for grass seed growers.

Still, scientific evidence also suggests that contamination will occur. This threatens the specialty seed and organic growing traditions. The threat of contamination fuels the values for being a good neighbor and cooperation in some form. The pinning map and ODA canola rules are a logical step to attempt a compromise. At first glance, the pinning map and canola rules provide a structural balance between economic viability and being a good neighbor. However, in time, predominate values of economic reductionism (decisions based solely on monetary profit margins) will challenge this structural balance and most likely lead to the collapse of the current system of agricultural traditions.
7 Resilience and Canola Cropping

The holistic, values analysis, and social-ecological approaches are integrated with cultural materialism to explain the resilience of canola cropping. These theoretical approaches are informed by the methods used to gather data. Interviews, participant observation, and informational media serve as the means to collect information. The methodologically informed theoretical integration is used to analyze three potential paths of canola cropping to explain short term versus long term resilience.

7.1 The Theoretical Approaches

Four theoretical approaches are used to explain the resilience of canola cropping. The holistic approach illustrates the behavioral components and values analysis describes the mental components of a sociocultural system. These components are integrated into the cultural materialism framework. Panarchy is also integrated into the cultural materialism framework. Whereas values analysis provides one-scale analysis for the CBC and OBI via superstructural determinism, panarchy represents cross-scales analysis of multiple values sets via panarchical superstructural determinism. The result is a holistic analysis of key actors within the local community.

7.1.1 The Holistic Approach

The holistic approach identifies the behavioral components of a sociocultural system. The components represent the behavioral infrastructure, structure, and superstructure of the cultural materialism framework. The holistic approach is the first step to identifying key components to integrate via values analysis, panarchy, and cultural materialism.

With the aid of other research approaches, the holistic approach illustrates how a technology such as biodiesel or canola cropping might fit or be in disharmony with the community. Biodiesel appears to be a good fit into the local sociocultural system and
a venue to encourage the inclusion of agriculture. However, seen through a holistic lens, potential impacts within the community, seen as a whole, can be predicted as connections to existing cultural traditions, polices, and the environment are mapped. In effect, a web-like vision may reveal unexpected linkages and discoveries. Whereas biodiesel may still be a good technological fit, canola cropping poses risks within the sociocultural system. Thus canola cropping may not be the appropriate technology to accommodate a more complete picture of the values that integrate the current sociocultural system of agricultural traditions. Figure 7.1 illustrates a holistic view of this system.

Figure 7.1 Holistic mapping of the local community.

The holistic approach is effective for anticipating potential consequences of particular actions. A seemingly innocent decision to introduce new technology, such as biodiesel, might have costly, unexpected, negative consequences to components of the community’s system. The ritual of using motorized vehicles drives consumption.
of fuel and enables efficient farming behavior. A growing demand for biodiesel increases the demand for vegetable oil resources. Scientific research indicates that canola seeds are an efficient producer of vegetable oil. Political action is taken at the state level to promote biodiesel. Yet, scientific knowledge also indicates that growing canola for vegetable oil in the local community poses crop contamination risks to specialty seed and organic farmers. Government intervention imposes rules for canola production. The lines to each behavioral element represent the interconnectedness of the system depicted in Figure 7.1. Each behavioral element is connected to the “local community” hub which represents the collective behavior of the functioning system. No behavioral element is exempt from impacting another part of the sociocultural system. For example, although canola cropping may be beneficial to fuel consumption, it poses a risk to food consumption of specialty seeds and organic crops.

The idea to grow canola to produce vegetable oil for biodiesel production has been proposed for the local community. Considering the holistic approach, I became curious as to the values and attitudes of local farmers toward growing canola. I soon learned that concerns about canola having negative impacts on other crops are widespread. Figure 7.2, illustrates particular farming traditions that canola cropping can potentially impact. Canola introduced into the grass seed tradition, in turn, affects the organic and specialty seed traditions.

**Figure 7.2** Farming traditions that face potential impacts from canola.
The aforementioned farming traditions result from a set of values that is integral to the character of the tradition and its cultural patterns. The resulting cultural tradition is not behavior, but mental constructs and ideas about what is ideal behavior (Applebaum 1987:143). The important relationships that allow these farming traditions to coexist are not between the stakeholders and their actions. Grass seed, specialty seed, and organic growers are unified into a community because of mental relationships that allow their collective behavior to coexist. Values analysis explores the resilience of this relationship.

Good intentions are behind the idea to use biodiesel and to diversify agricultural production by growing canola. However, using the holistic approach and values analysis can help to anticipate any unintended and harmful consequences. As a result, decisions can be made that simultaneously benefit several subgroups.

7.1.2 Behavior and Values within Cultural Materialism

The holistic and values analysis (described in Chapter 5) approaches can be inserted into the cultural materialism framework. The term “local community” from Figure 7.1 refers to behavioral components within the sociocultural system. These components are inserted into the behavioral infrastructure, structure, and superstructure. Values analysis provides the mental components to be inserted into the mental infrastructure, structure, and superstructure. Table 7.1 depicts the framework of a potential canola sociocultural system.

<table>
<thead>
<tr>
<th>TABLE 7.1</th>
<th>Components of a Canola Sociocultural System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioral Infrastructure</strong></td>
<td><strong>Mental Infrastructure</strong></td>
</tr>
<tr>
<td>Mode of Production:</td>
<td>Subsistence Lore:</td>
</tr>
<tr>
<td>Vegetable oil and seed/food crops</td>
<td>Canola vs. other crop(s)</td>
</tr>
<tr>
<td>Grow oil, grass, specialty, and organic</td>
<td>Monoculture vs. diversity</td>
</tr>
<tr>
<td>Crop(s) appropriate to ecosystem</td>
<td></td>
</tr>
<tr>
<td>Preferred labor and equipment</td>
<td></td>
</tr>
</tbody>
</table>

| **Behavioral Structure** | **Mental Structure** |
Analyzing the behavioral and mental components exposes potentially harmful and unintended consequences of technological innovations. The panarchy component of resilience within the social-ecological approach provides another layer of support to filter unintended and harmful consequences to the community and its environment.

### 7.1.3 Integrating Panarchy with Cultural Materialism

Panarchy is a nested set of adaptive cycles that serves to stabilize a system (Holling et al. 2002). Panarchy integrates the holistic and values analysis approaches across scales. This integration can be taken one step further and placed within the framework of cultural materialism. In cultural materialism, the superstructure and structure play a vital role in the feedback processes responsible for the conservation of the system (Harris 1979:72). The system stabilizing and conserving similarities of panarchy and cultural materialism make them ideal for integration. The cultural materialism framework provides the foundation to integrate panarchy.

Within panarchy, adaptive cycles are nested. This serves to stabilize the system. Windows of experimentation can open without triggering a cascade of instabilities throughout the system. It is within the nested adaptive cycles that the extents of latitude, resistance, and precariousness are determined. Larger and slower adaptive cycles provide memory to allow recovery of smaller and faster adaptive cycles that revolt. "Revolt" is a process that propagates upscale and includes the social contagion associated with surprise. A surprise bestows consequential changes to social or
ecological components of a system. Revolt processes create access to larger-scale resources that cascade down-scale. The counter flow of revolt is called "remember." Revolt (broad arrows) and remember (thin arrows) processes are illustrated in Figure 7.3.

![Figure 7.3 Revolt and remember between nested adaptive cycles.](image)

A revolt could occur if an ecological surprise such as a hurricane destroys oil drilling and processing facilities. The oil mode of production supply will decrease while the demand for oil remains high. This revolt will propagate up-scale to the oil policy level which includes options such as raise the price of oil or tap into oil reserves in an effort to artificially deflate the cost of oil. Subsequently, this adaptive cycle will revolt upscale to decision makers who will choose the policy to enact. The resources provided by each larger scale cascades in the form of remember in an attempt to stabilize the nested system. Revolt occurs from the $\Omega$ release stage of a smaller cycle to an area of optimal resilience, connectedness, and potential in the $K$ conservation stage of a larger cycle. Remember occurs from an area of optimal resilience,
connectedness, and potential in the K conservation stage of a larger cycle to the α reorganization stage of a smaller cycle. Thus, resilience, connectedness, and potential are transferred by the remember mechanism of cross-scale dependencies. This occurs in response to the social contagion of surprise transferred by the revolt mechanism.

The integration of panarchy to a cultural materialism framework (Figure 7.4) is vital to avoidance or remediation of technological consequences and surprises. Still, how the resilience, connectedness, and potential components of panarchy are interpreted within that framework makes a difference to possible futures.

![Diagram](Figure 7.4 Panarchy integrated with infrastructural determinism.)

Resilience, connectedness, and potential can simply be interpreted in terms of superstructural feedback to the behavioral structure that enhances the efficiency of the
behavioral infrastructure. Indeed, revolt moves upscale from smaller, faster renewal cycles to larger, slower ones in search of resources. Remember produces a downscale flow of resources in an attempt to maintain the structure and function of the smaller, faster scale. The directional flow of revolt corresponds to the directional flow of determinism. The directional flows of revolt (broad arrow) and remember (thin arrow) complement the cultural materialism processes of infrastructural determinism and feedback very well. Figure 7.4 illustrates potential (behavioral infrastructure), connectedness (behavioral structure), and resilience (behavioral and mental superstructures) in the form of panarchy, integrated with infrastructural determinism. Within panarchy and the adaptive cycle, resilience, connectedness, and potential are analogous to the pillars of resilience: understanding, willingness, and capacity.

Cultural materialism suggests that changes initiated in the infrastructure are more likely to influence deviations throughout the structure and superstructure than vice versa. Harris (1979:72) explains that innovations initiated in the behavioral structural sectors "are less likely to produce system-destroying changes" and innovations arising in mental superstructures "are still less likely to change the entire system (due to their progressively remote functional relationships with the crucial infrastructural components)." Innovations that increase the efficiency of production are likely to be selected for, even if there is a contradiction between them and preexisting aspects of the other behavioral and mental components of the sociocultural system Harris (1999:143). Therefore, the resolution of incompatibility will consist of substantial changes in the behavioral structure and superstructure, and the mental sectors. In contrast, innovations arising from outside of the behavioral infrastructure "are likely to be selected against if there is any deep incompatibility between them and the infrastructure (Harris 1999:143)." Innovations that arise from the behavioral structure, behavioral superstructure, or mental sectors must maintain or increase the efficiency of productive processes that sustain health, well-being, and satisfy basic human needs and drives. Cultural materialists see the threat of disorder arising primarily within the behavioral infrastructure (Harris 1979:51). Thus, it is here that the infrastructural
determinism of canola’s impact on behavioral structure, and therefore, superstructure will take root.

However, infrastructural determinism relegates the importance of mental components and the values they hold to merely feedback mechanisms rather than crucial determining factors. Basing a sociocultural system almost entirely on behavioral components trivializes the values that can prevent unintended or avoidable negative consequences of technology. Values feedback is filtered as it passes through the behavioral superstructure and structure en route to the infrastructure. The filtered values are compliant with meeting efficiency over the short term rather than the long term. Behaving in this manner produces collateral damage to be dealt with at a future time, most likely by future generation.

Still, while insisting that human will and consciousness are dominated by behavioral infrastructure conditions, “cultural materialism claims to be compatible with conscious attempts by individuals to control their own destinies and to construct a progressive social order (Harris 1999:151).” This is due to the probabilistic character of determinism. Harris (1999:151-152) suggests,

> If the influence of consciousness on history thus far has been negligible, it is not because of an implacable determinism, but because of our failure to understand the causes of sociocultural evolution and to consciously and intelligently optimize our welfare in the light of that understanding.

Nonetheless, Harris does not discuss the role that consciousness and values can play to optimize our welfare. Just as Harris does not speak in terms of superstructural determinism, Holling does not speak in terms of revolt occurring from a larger scale to a smaller scale within panarchy. Yet, for panarchical superstructural determinism to occur, revolt must occur from a larger scale to a smaller scale.

Integrating panarchy with superstructural determinism enables values to filter and evaluate innovations for potentially harmful consequences. This literally allows a sociocultural system to think holistically about values before it acts.
Panarchical superstructural determinism begins in the mental superstructure. As with infrastructural determinism, the directional flow of revolt (thick arrow) is imperative to superstructural determinism. Panarchical superstructural determinism starts with a cross-scale revolt from the behavioral superstructure to the mental superstructure (see Figure 7.5). During this revolt, surprise transfers from the behavioral superstructure’s Ω release stage to the mental superstructure’s K conservation stage. A remember flow (thin arrow) returns from the mental superstructure’s K conservation stage, but in panarchical superstructural determinism, back to the behavioral superstructure’s Ω release stage. Thus, the mental component is remembered as a resource of new understanding to increase social-ecological resilience throughout the adaptive cycle.

Figure 7.5 Initiation of superstructural determinism.

Figure 7.6 illustrates the revolt and remember processes of panarchy integrated with superstructural determinism. As panarchical superstructural determinism occurs, revolt flows through the mental components. However, revolt transfers the social contagion of novelty, rather than surprise, as it follows the path of panarchical superstructural determinism. To build resilience, the mental superstructure sends a revolt from its Ω release stage to the K conservation stage of the mental structure to seek connectedness. A remember flow returns to the α reorganization stage of the mental superstructure to provide connectedness. To continue the process of building resilience, a revolt seeking potential occurs from the α reorganization stage of the
mental structure to the K conservation stage of the mental infrastructure. A remember flow returns to the r exploitation of the mental structure to provide potential to support the connectedness to build resilience. The process of building resilience enters the behavioral components as a cross-scale revolt occurs from the r exploitation stage of the mental infrastructure to the K conservation stage of the behavioral infrastructure. This revolt contains the accumulated novelty of resilience, connectedness, and potential from the mental components. During this phase of panarchical superstructural determinism, the mental infrastructure potential seeks potential from the behavioral infrastructure. A remember flow returns from the r exploitation stage of the behavioral infrastructure to the r exploitation stage of the mental infrastructure indicating available potential. The confirmation of the mental infrastructure’s potential indicates that the behavioral infrastructure deems the new mode of production acceptable to the maintenance of the existing infrastructure.

For the novelty of panarchical superstructural determinism to impact social-ecological resilience, the subsequent round of infrastructural determinism must reinforce the potential, connectedness, and resilience introduced by the mental components. This is accomplished by stabilizing the behavioral potential with novel connectedness and resilience throughout the behavioral components. A revolt of novelty occurs from the r exploitation stage of the behavioral infrastructure to the K conservation stage of the behavioral structure. The revolt seeks connectedness that will support the behavioral infrastructure based on the resilience, connectedness, and potential introduced by the mental components. Remember provides connectedness from the α reorganization stage of the behavioral structure back to the K conservation stage of the behavioral infrastructure. A revolt occurs from the α reorganization stage of the behavioral structure to the K conservation stage of the behavioral superstructure seeking resilience to help the connectedness build the potential of the behavioral infrastructure. The original resilience introduced to the behavioral superstructure is transferred to the behavioral structure to complete the bridge of understanding that builds social-ecological resilience.
The flow of revolt and remember across scales corresponds with the flow of determinism. Infrastructural determinism consists of revolts that carry surprises that seek resources and remembers that return resources in an effort to stabilize disrupted scales. Although the initial revolt of superstructural determinism carries a surprise, subsequent revolts carry novelty that seeks to build and stabilize social-ecological resilience. Remembers return the resilience, connectedness, and potential needed to
build social-ecological resilience throughout the mental components and stabilize throughout the behavioral components of a sociocultural system.

7.2 Methods

The methods of data collection for the canola cropping piece of this research also include interviews, participant observation, and informational media. The use of these methods provides a means by which to triangulate the collected data. Two methods in conjunction validate the reliability, representativeness, and accuracy of the third method. The methods provide the tools to inform the theoretical approaches. The holistic approach determines the local community to whom the methods are applied. The methods inform the values analysis. In turn, the holistic and values analysis approaches support the social-ecological focus of panarchy that is integrated with and explained through the cultural materialism framework.

The focus area for this study is primarily Benton and Linn counties. However, some data were collected from sources outside of this focus area. Benton and Linn Counties represent the “local community” evaluated for the potential, connectedness, and resilience of canola cropping. It is imperative to understand the behavioral and values components that surround the canola cropping mode of production and its potential social-ecological impacts on the local community.

Determining the social-ecological resilience of canola cropping starts with the operationalization of key behavioral components. In this study, farmers or growers refer particularly to those that grow grass seed, specialty seed, or organic crops. Researchers are those who may be exploring new technologies or social arrangements for oil seed production. Innovators are those that have an existing stake or desire to have a stake in biodiesel production. The CBC and OBI are examples of innovators within the local community. Consumers are those in the local community who may or may not create a market for biodiesel use. Consumers also consist of international and local markets that may have concerns regarding the contamination of food crops by canola. Government agents, in this study, are those that work for a government
agency that oversees agriculture or energy development and use in some capacity. Politicians are policy decision makers that affect formal laws and regulations. Laws and regulations refer to formal, or informal, constraints put in place to control societal behavior. Rituals are the behaviors associated with modes of production. Rituals include innovating modes of production such as biodiesel, driving vehicles powered by biodiesel, researching or growing canola, or consuming organic crops. Grass seeds are a mode of production for livestock forage and turf for athletic playing surfaces and household lawns. Specialty seeds and organic crops are modes of production for vegetable food consumers that prefer food that is free from genetic contamination by closely related species or by genetically modified organisms. Canola cropping is a mode of production that presents risks that disrupt the genetic purity of specialty seed and organic crops.

The system components involve key actors that will project the environmental, social, and economic values that will determine the local resilience to canola cropping. The attitudes and concerns of these key actors are what will drive the acceptance or rejection of canola cropping. Three methods of research are employed to triangulate information discerned about these system components: interviews, informational media, and participant observation.

Interviews are a primary method of information gathering to evaluate key variables. Twenty-four key actors who are politicians, government agents, researchers, business people and farmers were interviewed in person or by telephone. Confidentiality and anonymity were offered and maintained when requested by informants during private interviews. The informants, interviewed in person, that requested confidentiality and anonymity signed consent forms that are stored in a secure location. Confidentiality and anonymity were also provided to informants interviewed by telephone. Interviewed informants are provided pseudonyms to disguise their identities. Informants that provided public information are identified by name.
The sampling process initially began with calls to local farm bureaus and researchers. Later in the research, the Oregon State University Extension Office in Albany became an important resource to the sampling process. Snowball sampling through these sources provided many key actors to serve as informants. If the person initially reached did not feel he or she was the best person to talk to about growing oil seeds locally for biodiesel, I was often referred to other potential informants. Many times, the initial contact provided values to consider as well as other potential informants. Snowball sampling was a very effective method to acquire informants as nearly everyone that was contacted consented to an interview.

Snowball sampling led to several occasions when an informant suggested that I speak to another potential informant. Occasionally, during an interview, an informant passed along attitudes or concerns reported to them through correspondences. This information then led me to another interview source to verify the claims.

Interview questions focused on attitudes and concerns that local growers might have regarding canola and cooperation. General, open-ended questions were used to start interviews in order to allow the informant to answer questions as he or she interpreted them and understood them to mean. A general question might start out asking about a grower’s feelings toward growing oil seeds in the local community to produce biodiesel. Then, more specific questions were asked to discern attitudes and concerns regarding the issues that developed as most important to each informant. The same approach was taken when inquiring about cooperation. A general question might start out asking about a grower’s feelings toward cooperatives, and lead to completely different attitudes and concerns than if one was simply asked about his or her feelings toward cooperation.

The second method employed to collect data is participant observation. Three public forums focused on canola cropping. Public forums occurred on Tuesday February 8 and Monday March 14, 2005 at the Linn County Fairgrounds and Expo Center in Albany, OR. The meetings were organized by the Oregon State University Extension Service. The purpose of the meetings was to discuss the positive and
negative attributes of growing canola in the local community. Growing canola potentially stands to benefit grass seed farmers as a rotational crop, but poses risks to the specialty seed and organic traditions. Researchers from Oregon State University spoke of the potential benefits to the grass seed industry and the risks to specialty seeds and organic crops. The third forum occurred on Friday April 29, 2005. At this meeting, the ODA revealed its proposed rules for canola cropping. Those in attendance repeated concerns discussed at the previous public forums.

The third method to illicit values is informational media. This information may come in the form of books, magazines, newspaper articles, journals, academic papers, the Internet, and other forms of printed information. The information from these resources is used to compare whether or not what people say is what people are really doing. This indicates to what extent reported values impact behavior. The variety of publications illustrates the wide array of audiences now being reached with the idea of growing crops to support energy alternatives such as biodiesel. By revealing values and behavior, publications provide information to support the theoretical framework of this study.

Interviews, participant observation, and informational media provide the data for the resilience of the local community to canola cropping. The application of these methods is determined by the holistic and values analysis approaches. The methods inform the holistic and values analysis approaches to build the social-ecological focus of panarchy integrated with cultural materialism. Through the triangulation of interviews, informational media, and participant observation, the holistic, values analysis, social-ecological, and cultural materialism approaches reveal the degree of resilience, connectedness, and potential associated with canola cropping.

Three approaches to canola cropping are analyzed according to the components of resilience. Path A represents an approach to social-ecological resilience that only considers the values of the dominant agricultural tradition. Path B represents the current approach to social-ecological resilience by the local community to consider the values of multiple traditions. Path C represents an alternate, holistic approach to
social-ecological resilience through values analysis. The three potential paths are analyzed in terms of resilience, connectedness, and potential. The three paths are discussed in terms of building resilience, the pillars of resilience, and adapting to resilience.

7.3 Path A

Path A represents values heavily influenced by reductionism within its approach to social-ecological resilience. The intention toward social-ecological resilience exists because canola cropping is an economically efficient way to produce biodiesel.

7.3.1 Path A Analysis

Table 7.2 represents the sociocultural system of Path A.

<table>
<thead>
<tr>
<th>Components of the Path A Canola Sociocultural System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Infrastructure</td>
</tr>
<tr>
<td>Mode of Production:</td>
</tr>
<tr>
<td>Biodiesel</td>
</tr>
<tr>
<td>Grow canola and grass seed</td>
</tr>
<tr>
<td>Behavioral Structure</td>
</tr>
<tr>
<td>Domestic and Political Economy:</td>
</tr>
<tr>
<td>Organization of biodiesel production</td>
</tr>
<tr>
<td>Consumption of local fuel</td>
</tr>
<tr>
<td>Two crop farming structure</td>
</tr>
<tr>
<td>Behavioral Superstructure</td>
</tr>
<tr>
<td>Driving ritual less harmful</td>
</tr>
<tr>
<td>Scientific research suggests canola</td>
</tr>
<tr>
<td>Mental Superstructure</td>
</tr>
<tr>
<td>Grass seed tradition</td>
</tr>
<tr>
<td>Resilience via reductionism</td>
</tr>
<tr>
<td>Social-ecological resilience via biodiesel</td>
</tr>
</tbody>
</table>

The course of infrastructural determinism of the biodiesel mode of production seeks feedback to maintain the biodiesel behavioral infrastructure. This feedback is sought in the dominant agricultural tradition of the grass seed growers. Referring to
Figure 7.4, the behavioral infrastructure sends a revolt of surprise that cascades upscale via the K conservation stages of the behavioral structure and behavioral superstructure, to the K conservation stage of the mental superstructure in search of resources. The mental superstructure sends a remember back to the α reorganization stage of the behavioral superstructure that suggests values to consider. The behavioral superstructure responds and indicates that canola is an ideal selection for biodiesel production and the values of traditional grass seed growers. The resilience component cascades to the α reorganization stage of the behavioral structure in the form of remember. The behavioral structure welcomes the resilience component and contributes connectedness. The concept of canola cropping suggests a means for the behavioral structure to support biodiesel production and suit the needs of grass seed growers' culture for crop rotation. Resilience and connectedness remember cascade back to the α reorganization stage of the behavioral infrastructure. The behavioral infrastructure welcomes the resilience and connectedness resources. The third component of potential is added in the form of canola cropping to support biodiesel production. For this sociocultural system, social-ecological resilience is produced through the resilience of the mental and behavioral superstructures, the connectedness of the behavioral structure, and the potential of the behavioral infrastructure to maintain the biodiesel mode of production.

7.3.2 Path A Discussion

Along Path A, the cross-scale interactions of panarchy between agricultural traditions are not considered. Thus, grass seed growers enjoy a high degree of latitude, low resistance, and a low degree of precariousness for a two crop system.

The building of social-ecological resilience along Path A takes a monolithic form. Grass seed growers learn to live with the change of the biodiesel infrastructure by considering the positive impact that canola cropping rotation can have on the practice of their agricultural tradition as well as biodiesel production. This builds the pillar of understanding necessary for the resilience component of the sociocultural system. The
grass seed growers further build social-ecological resilience by nurturing the diversity needed to reorganize for biodiesel production. This supports the pillar of willingness as grass seed growers are willing to introduce canola cropping rotation into their tradition. Connectedness increases within the sociocultural system. By combining different types of knowledge for learning, the canola mode of production provides the vegetable oil resource needed to support the biodiesel mode of production. This sets the pillar of capacity in place to provide the potential necessary to build social-ecological resilience. By transforming their behavior, grass seed growers create opportunity to improve their own self-organization as well as that of biodiesel production.

Canola cropping stands to be an adaptive (Harris 1999:145) sociocultural trait for grass seed growers. Canola can be produced within the existing farm equipment infrastructure used for grass seeds. Scientific research suggests that canola is a high oil content crop suitable to grow in the local ecosystem’s climate. Deep tap roots can overcome years of compacted grass seed roots. Also, canola cropping rotation reduces harmful herbicide application. This serves to increase the productivity of grass seeds. Far surpassing specialty seed and organic growers in numbers and acreage, grass seed growers are the dominant group in the local community. Harris states, “In the presence of groups with conflicting interests, selection for or against innovations depends on the relative power that each group can exert on behalf of its own interests (1999:143).” Thus, if grass seed growers want to grow canola, then canola is the choice for oil seed production. As a result, cost-benefits accrue unequally placing some groups in the position to be dominated and exploited by others (Harris 1999:146).

Path A is the ultimate success story of resilience via reductionism for grass seed growers of the dominant agricultural tradition. Neighbors are out-competed for land and income as specialty seed and organic growers are eliminated due to contamination caused by canola. The “market drives” and “winner takes all” attitudes of individualism and non-regulation decrease the diversity of crops and agricultural
traditions within the system. Ignoring the values of specialty seed and organic growers increases the latitude and decreases the resistance to a large-scale, indiscriminate introduction of canola cropping. A monolithic form of “diversity” develops as grass seed and canola create a two crop system.

However, regarding the local community holistically in terms of social-ecological resilience, canola cropping that follows Path A is maladaptive (Harris 1999:145) to the health and well-being of the sociocultural system. Path A introduces a high degree of precariousness due to the risk canola cropping presents to specialty seed and organic growing traditions. Precariousness results from rigid values of reductionism and a lack of good-neighbor values.

Rigid values of reductionism reduce social-ecological resilience. Research from the behavioral superstructure suggests that canola is a high oil content crop relative to other oil seed crops. Canola also fits well into the behavioral structure to support biodiesel production organization and crop rotation for grass seed growers. Growing canola requires little or no change to the modes of production of the behavioral infrastructure of grass seed growers, even though the introduction of canola presents risks to the mode of production of specialty seed and organic growers. Social-ecological resilience succumbs to resilience via economic reductionism that only supports grass seed growers and biodiesel production.

The absence of good-neighbor values toward specialty seed and organic growers reduces the resilience of the mental superstructure. Values for collaboration or cooperation are missing. This eliminates connectedness from the mental structure and potential from the mental infrastructure. Thus, the feedback that the behavioral components receive from the mental components is that of scientific and economic reductionism from the metal superstructure. Even though the intention behind canola cropping is to support the social-ecological resilience of biodiesel production, Path A leaves the social-ecological resilience of the sociocultural system, as a whole, in an impoverished state.
The maladaptive approach of Path A results in a poverty trap. According to Holling et al., the eradication of potential and diversity leads to an impoverished state of low potential, low connectedness, and low resilience creating a poverty trap (2002:95). The indiscriminate introduction of canola eliminates any connectedness between grass seed, specialty seed, and organic growing traditions. All further potential of specialty seed and organic growers is eliminated by canola cross-contamination. The resilience of agricultural traditions is reduced as potential and connectedness diversity is lost from the sociocultural system.

As a result, a two crop sociocultural system emerges with its own resilience connectedness, and potential. For as long as canola cropping potential builds connectedness and resilience, this system sustains itself. As long as viable land is available to grow canola, potential remains high. As long as canola and grass seed remain viable rotation partners, connectedness remains high. And as long as canola cropping meets the value demands of economic reductionism, resilience remains high. Yet, this system is maladaptive.

According to Holling et al. (2002:96):

The high resilience would mean a great ability for system to resist external disturbances and persist, even beyond the point where it is adaptive and creative. The high potential would be measured in accumulated wealth. The high connectedness would come from efficient methods of social control whereby any novelty is either smothered or sees its inventor ejected. It would represent a rigidity trap.

Holling et al. (2002:95) describe a rigidity trap as “a system with high potential, connectedness, and resilience” that is “suggestive of maladaptive conditions present in hierarchies, such as large bureaucracies.” Agricultural traditions are subject to this when “command and control have squeezed out diversity and power, politics, and profit have reinforced one another (Holling et al. 2002:98).”

The local community is pursuing an alternative to the Path A canola cropping approach to social-ecological resilience. This alternate path considers the values of grass seed, specialty seed, and organic growers.
7.4 Path B

Path B represents the values of the local community discerned from interviews, participant observation, and informational media. The Path B approach attempts to achieve social-ecological resilience via economic reductionism.

7.4.1 Path B Analysis

Table 7.3 represents the sociocultural system of Path B.

<table>
<thead>
<tr>
<th>TABLE 7.3</th>
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</thead>
<tbody>
<tr>
<td><strong>Components of the Path B Canola Sociocultural System</strong></td>
</tr>
</tbody>
</table>

**Behavioral Infrastructure**

<table>
<thead>
<tr>
<th>Mode of Production:</th>
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</thead>
<tbody>
<tr>
<td>Biodiesel</td>
</tr>
<tr>
<td>Grow canola, grass seed, specialty seeds, and organic crops</td>
</tr>
</tbody>
</table>

**Behavioral Structure**

<table>
<thead>
<tr>
<th>Domestic and Political Economy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization of biodiesel production</td>
</tr>
<tr>
<td>Consumption of local fuel</td>
</tr>
<tr>
<td>Diverse crop farming structure</td>
</tr>
<tr>
<td>Government intervention canola rules</td>
</tr>
<tr>
<td>Crop locator pinning map</td>
</tr>
<tr>
<td>Reduce risk to local food security and specialty seed exports</td>
</tr>
</tbody>
</table>

**Behavioral Superstructure**

<table>
<thead>
<tr>
<th>Mental Superstructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving ritual less harmful to ecosystem</td>
</tr>
<tr>
<td>Scientific research suggests canola despite risks to current system</td>
</tr>
<tr>
<td>Grass, specialty, and organic traditions</td>
</tr>
<tr>
<td>Resilience via reductionism</td>
</tr>
<tr>
<td>Social-ecological resilience via biodiesel</td>
</tr>
</tbody>
</table>

Path B attempts a more inclusive approach to social-ecological resilience via infrastructural determinism (Figure 7.4). The biodiesel behavioral infrastructure sends a revolt of surprise upscale via K conservation stages seeking feedback resources to maintain it. A revolt of surprise from the behavioral superstructure indicates to the mental superstructure that a biodiesel driving ritual is less harmful to the ecosystem.
The revolt also suggests that canola can provide the vegetable oil resource necessary to provide resilience to biodiesel production and use. The mental superstructure responds with remember feedback to the α reorganization stage of the behavioral superstructure regarding social resilience provided by agricultural traditions, the desire to maintain resilience via reductionism, and the desire to support social-ecological resilience via biodiesel. The behavioral superstructure in turn sends this resilience feedback, via remember, to the α reorganization stage of the behavioral structure. In the behavioral structure, the canola rules and crop locator pinning map provide connectedness to build social-ecological resilience. The pinning map attempts a compromise between the grass seed, specialty seed, and organic growing traditions to maintain a diverse crop farming structure. The risks to local food security and specialty seed exports are reduced while the organization of biodiesel production is supported. Subsequently, a remember from the behavioral structure passes along the accumulated resilience and connectedness resources to the α reorganization stage of the behavioral infrastructure. The resilience and connectedness build the canola cropping potential for biodiesel production while maintaining the specialty seed and organic crop modes of production.

7.4.2 Path B Discussion

Along Path B, the mental superstructure values of specialty seed and organic growing traditions are considered in conjunction with the grass seed growers’ tradition to maintain social and economic resilience. In the behavioral structure, developing the necessary connectedness for Path B is more complex than Path A. Prior values of individualism and informal cooperation are already present in the behavioral structure. These values attempt to reconcile competition and connectedness between grass seed, specialty seed, and organic growers.

The pivotal aspects of the behavioral structure are the Oregon Department of Agriculture’s (ODA) canola rules and the crop locator pinning map. The crop locator pinning map is adopted from the system that the specialty seed growers use to let each
other know what types of crops are being grown and where the crops are being grown. This reduces the risk of crop contamination among specialty seed growers. The crop locations are recorded on pinning maps at the appropriate Oregon State University County Extension Office.

The canola rules strengthen the connectedness of the crop locator pinning map. Benton and Linn Counties are part of the District 4 protected area of Oregon. As a protected area, a petition process to grow canola for oil must occur before crops are planted. If the petition succeeds, the rules require that canola cropping be recorded at appropriate extension offices. To reduce contamination risks, canola must be isolated from other crops by no less than three miles. During transportation, loads of canola must be securely contained and covered to prevent seed loss that leads to volunteers. The rules also require certified seeds and rotation of canola no more than one year in every four years on the same plot to reduce the risk of disease.

The rules and the crop locator pinning map increase the latitude and reduce the resistance and precariousness of the sociocultural system. The rules and pinning map serve to reduce resistance to the introduction of canola cropping. By increasing connectedness, Path B, unlike Path A, extends the threshold of maintaining the resilience of diverse agricultural systems. This serves to increase latitude and reduce precariousness.

Along Path B, the sociocultural system attempts to build social-ecological resilience. The values within the mental superstructure provide remember feedback to the behavioral superstructure that supplies resilience to dealing with the change and uncertainty of proposed canola cropping. This provides the pillar of understanding. Remember feedback flows to the behavioral structure where nurturing diversity for reorganization and renewal takes place to provide connectedness. This primarily occurs via the canola rules and crop locator pinning map. These elements of the behavioral structure contribute to the pillar of willingness. Resilience and connectedness flow to the behavioral infrastructure via remember. Combining different types of knowledge for learning occurs to contribute potential to grass seed,
canola, specialty seed, and organic crop modes of production. Knowledge regarding each mode of production contributes to its successful co-existence with other crops. Potential provides the pillar of capacity. Understanding, willingness, and capacity create opportunity for self-organization among the various modes of production. The cooperation that results from the rules and pinning map transforms behavior toward adapting to the introduction of canola cropping. Ultimately, cooperation contributes to social-ecological resilience by maintaining the diversity of agricultural traditions within the local community.

Unfortunately, the true extent of the inclusiveness of the behavioral structure is uncertain. The rules and crop locator pinning system are inclusive of specialty seed growers, but no mention is made of organic growers. The behavioral structure attempts to reduce risks of contamination by canola to specialty seeds, but the inclusion of organic growers is unclear or non-existent.

The rules assume that three miles of separation will be suitable to reduce risks to other growers. Managing a separation of three miles from specialty seeds will exclude crop land from potential oil seed rotation. If the excluded land is viable for oil seed crop rotation, not growing canola is disadvantageous to the grass seed grower. Including organic growers under the protection of the rules and pinning map creates a more complex matrix of available land to grow canola.

The rules also assume that measures to secure loads will ensure that volunteers will not occur along transportation corridors. This may or may not be the case. The only way to know is to test the system over time. According to the crop locator pinning map at the extension office in Albany, most specialty seed growers are located along the 99W, 99E, 20, 226, and 228 highway corridors in Benton and Linn Counties. It is highly likely surprise canola volunteers that result from seed lost during transportation will occur within three miles of specialty seed crops. The potential risk to organic growers is unclear. Risk is reduced, but it is not eliminated.

The rules and crop locator pinning system does not provide flexibility to surprise. There is no anticipation for surprises “in which reality departs qualitatively from
expectation (Berkes 1998:353).” Other than the minority of specialty seed and organic growers, there is no speculation in the behavioral structure as to what the impact will be to the behavioral infrastructure when surprise canola volunteers and contamination occurs. It is assumed that the rules and pinning system will maintain social, ecological and economic harmony within the sociocultural system. Without flexibility, rigidity will ultimately lead to the system’s collapse.

According to Berkes (1998:8), the failure of a system can occur as the result of a technological change, especially if the change occurs too rapidly for the local system to absorb. An overzealous superstructural drive to promote biodiesel (in order to reduce pollution and slow global warming) inadvertently contributes to such a collapse. The good intentions of a rapid, large-scale influx of canola cropping to meet consumer demand for biodiesel may serve to slow one crisis, but rapidly ignite a crisis among agricultural traditions. As Path A illustrates, neglect of a holistic view at cross-scale interactions leads to a loss of resilience, connectedness, and potential. These losses result in a system collapse and an impoverished state. Path B is not exempt from this scenario of overexploitation.

A dominant value of the Path B mental superstructure is obtaining resilience via economic reductionism. Beliefs that support economic reductionism include unlimited material progress that is achievable through economic growth and technological progress (Berkes 1998:343). Thus, the idea of unlimited material progress that biodiesel supports throughout the behavioral structure and superstructure is dependent upon the technological progress of canola and its economic development and growth. The economic growth of biodiesel and canola cropping is directly proportional to the other. In turn, the economic fates of specialty seed and organic growers are indirectly proportional to the success of biodiesel and canola cropping.

Smith points out that Western economic values have traditionally favored growth and productivity. Smith observes, “Economic growth forces come from the basic assumption that satisfaction increases with quantity. Increased productivity—getting more outputs with fewer inputs—in western cultural beliefs is key to improving
people’s well-being (1996a:14).” He suggests that these values favor the short-term returns of material gain at the expense of long-term sustainability (1996a:13-14). However, increased production of canola in the local community beyond the cooperative limits of the pinning maps would not improve the well-being of the specialty seed and organic growers. Such growth of the canola industry, driven solely by economic forces, benefits the farmers that grow it, but destroys the traditions and livelihoods of their neighbors who support food security.

Thus, the economic growth of biodiesel is part of a larger causal matrix that leads to the intensification of canola cropping and cross-scale risk. As the market driven values of economic reductionism proceed, the canola rules and crop location pinning map are rendered useless. Such shortsightedness maintains resilience for a short-term but not over the long run as it leads to overexploitation and system collapse.

The canola rules and crop locator map create a rigidity trap as the market demand for canola cropping grows. As the “market drives,” the mental superstructure value of economic reductionism will test the high resilience, connectedness, and potential of Path B. The demand to plant in protected areas and to plant canola on the same plot more than once in every four years will increase. Acting on this value demand challenges the risk of cross-contamination and disease in order to increase the economic efficiency of the canola behavioral infrastructure. The potential, connectedness, and resilience of specialty seed and organic growers are put at risk.

Berkes (1998:353-354) suggests that as a consequence of seemingly successful management, the social-ecological system becomes more vulnerable to surprise and crisis as resilience decreases. In tandem, management institutions either become more rigid or less responsive to feedback. In time, the ODA will be forced to make a decision regarding the feedback that it receives from the sociocultural system. The ODA will either have to enforce the canola rules or ignore them. Either way, the ODA puts itself in a position that increasingly impedes and degrades the performance of the sociocultural system.
If the ODA chooses to maintain the course of Path B and enforce the canola rules, potentially viable land to grow canola at first causes rigidity as the canola industry meets resistance and decreased latitude. The ODA restrains the expansion and transformation of the canola cropping behavioral infrastructure. A rigidity trap develops as specialty seed and organic crops are protected. The enforcement of the canola rules maintains connectedness among grass seed, specialty seed and organic growers. However, this action is incompatible with the value of reductionism that selected canola in the first place. Resilience decreases as canola cropping potential leaks from the sociocultural system. Canola cropping succumbs to a poverty trap as it is restricted from further growth. The loss of potential leads to the loss of resilience. The canola cropping component no longer has the capacity to support the mental superstructure value of economic reductionism and limitless economic growth.

If the ODA chooses to ignore the canola rules, it becomes less responsive and fails to protect the social-ecological resilience of specialty seed and organic growers. Harris (1999:178-179) predicts,

Innovations that arise in infrastructure are likely to be preserved and propagated if they enhance productive and reproductive efficiency under specific environmental conditions—even if there is a marked incompatibility between them and preexisting structural relationships and/or ideologies. Moreover, the resolution of any deep incompatibility between an adaptive infrastructural innovation and the preexisting features of the other sectors will predictably consist of substantial changes in those other sectors. In contrast, innovations of a structural or symbolic-ideational nature are likely to be selected against if there is any deep incompatibility between them and the infrastructure.

Thus, less responsiveness diminishes resistance to the infrastructural determinism of canola cropping. Potential remains to build the resilience of canola cropping. As Harris (1979:73) suggests, the “behavioral infrastructure determines the nature of the structure and superstructure.” The canola rules and the crop locator pinning map, elements of the behavioral structure, are selected against. Also, the specialty seed and organic growing traditions, which are elements of the mental superstructure, are
selected against. In essence, the ODA chooses Path A to maintain the burgeoning two crop canola and grass seed tradition. The understanding, willingness, and capacity of Path B are revoked. Resilience, connectedness, and potential are lost as the specialty seed and organic crop traditions collapse into a poverty trap. As Path A illustrates, grass seed and canola cropping succumb to a rigidity trap.

Harris (1979:73) states, "cultural materialism holds that innovations are unlikely to be propagated and amplified if they are functionally incompatible with the existing modes of production." Yet, canola cropping meets initial resistance in all three sectors of superstructure, structure, and infrastructure. The canola behavioral infrastructure is still selected despite its incompatibility with existing modes of production for the specialty seed and organic crop traditions. Canola cropping is selected because it is compatible with the existing behavioral infrastructure of the grass seed tradition. As the dominant tradition, grass seed growers benefit from the power, politics, and profit that reinforce each other. The collapse of Path B results from the influences of economic reductionism on the sociocultural system.

The four principles to building social-ecological resilience that Berkes et al. (2003) suggest are paramount to transforming a sociocultural system to prevent or recover from a collapse. This transformation requires the pillars of superstructural understanding, structural willingness, and infrastructural capacity. These pillars allow the sociocultural system to recognize the interactions between society and the environment to express the adaptability necessary for social-ecological resilience.

The first principle for building resilience, learning to accept change and uncertainty, is critical to the introduction of new technology. Since the introduction of canola as a resource for biodiesel production presents potential for crisis, how the local community responds to the growing of canola will determine just how big the crisis will become. Response develops through the next three principles for building resilience. Nurturing diversity for reorganization and renewal depends on the values of the local community toward its neighbors and environment. Good neighbor values help to facilitate the combination of different types of knowledge and experience that
lead to the creation of opportunities for self-organization. New opportunities, in turn, facilitate adaptive changes of social structure and technology to produce resilient responses. The choice of adaptive changes determines the degree to which a potential canola crisis is lessened or avoided. Figure 7.7, modified from Berkes et al. (2003), illustrates this process via generic responses to a canola cropping crisis.

**Figure 7.7** Generic responses to a potential canola crisis.

Path A is represented on the left side of Figure 7.7. The introduction of canola regarding only the values of grass seed growers results in an unsustainable response. Indiscriminate canola cropping is non-resilient toward specialty seed and organic growers. As a result, the sociocultural system faces an increasing risk of collapse. Represented on the right side of the diagram are choices more resilient and thus possibly more sustainable toward maintaining the social-ecological resilience of grass seed, specialty seed, and organic growing traditions. Path B starts with values that
nurture diversity. Knowledge and experience suggest that canola cropping poses risks to specialty seed and organic growers. So, in order to maintain and promote the self-organization of diverse agricultural traditions, the canola rules in conjunction with the crop locator pinning map provide a venue to adaptive change. The result is a temporary resilient solution. In time, however, the underlying value of economic reductionism creates a larger scale crisis that renders the canola rules and crop locator pinning map an unsustainable response.

Both Path A, as an individualistic approach, and Path B, as a cooperative approach, have strong pillars of willingness and capacity toward each one's intended social-ecological resilience. However, the willingness and capacity of each approach is diminished by economic reductionism over the long term. The dominance of this mental superstructure value is incompatible with the holistic social-ecological resilience of the current sociocultural system. Berkes (1998:354) states,

Policies that assume smoothly changing and reversible conditions, and limitless ability of the economy to adapt and substitute, lead to reduced options, limited potential and perpetual surprise. The political window that drives "quick fixes" for quick solutions simply leads to more unforgiving conditions for decisions, more fragile natural systems, and more dependent and distrustful citizens.

A canola crisis can be avoided if values reflect the knowledge base regarding the harmful impacts of canola on the existing behavioral infrastructure. Heeding this knowledge promotes values of social-ecological resilience over economic reductionism. Values must be open to the combining of different types of knowledge for learning. This is necessary to create new opportunities for self-organization while concurrently nurturing social and ecological diversity for reorganization and renewal. A more cooperative, less individualistic, set of values alleviates the difficulty of learning to live with change and uncertainty. These values need to be determined by the mental superstructure, structure and infrastructure rather than solely by the "immutable natural laws governing the acquisition of life-sustaining energy (Lett 1987:91)" that drives the infrastructural determinism of our collective behavior. The
determined values will reflect the degree of understanding, willingness, and capacity the sociocultural system has to transform into a socially and ecologically resilient system.

The intention of Path B is to avoid a crisis with values that reflect the knowledge base that canola cropping increases risk to the current sociocultural system. However, this intention is tempered by the dominance of economic reductionism over social-ecological resilience. If an economically viable alternative to canola is proposed that does not pose risks to other growers, then social-ecological resilience can be achieved via economic reductionism. In this case, infrastructural determinism proceeds to the benefit of grass seed growers without the ill effects toward specialty seed and organic growers. Yet, no proposal for an economically viable alternative to canola exists.

Path C offers an alternative approach to build resilience, connectedness, and potential for social-ecological resilience. Along this path, social-ecological resilience is the dominant superstructural value over economic reductionism.

7.5 Path C

Path C represents the introduction of oilseed crop alternatives to canola. Along this path, holistic and values analysis approaches build resilience for biodiesel production and oilseed cropping by favoring social-ecological resilience over economic reductionism.

7.5.1 Path C Analysis

Table 7.4 represents the sociocultural system of this path.

<p>| TABLE 7.4 |</p>
<table>
<thead>
<tr>
<th>Components of the Path C Oilseed Sociocultural System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Infrastructure</td>
</tr>
<tr>
<td><strong>Mode of Production:</strong></td>
</tr>
<tr>
<td>Biodiesel</td>
</tr>
<tr>
<td>Grow oilseed, grass seed, specialty seeds,</td>
</tr>
</tbody>
</table>
Path C attempts a holistic and values analysis approach to social-ecological resilience via superstructural determinism. Along Path C, the revolt that delivers surprise from the behavioral superstructure to the mental superstructure receives remember information that favors social-ecological resilience over economic reductionism. In terms of the adaptive cycle (see Figure 7.5), the remember is delivered to Ω release stage of the behavioral superstructure rather than the α reorganization stage like it is during infrastructural determinism. The exchange between the behavioral and mental superstructures begins the process of panarchical superstructural determinism.

As panarchical superstructural determinism proceeds (see Figure 7.6), the mental superstructure sends a revolt of novel resilience from its Ω release stage to the K conservation stage of the mental structure. The mental superstructure seeks connectedness to maintain the resilience of the current sociocultural system. A remember from the K conservation stage of the mental structure returns to the α reorganization stage of the mental superstructure to provide connectedness to build resilience. From the α reorganization stage of the mental structure, a revolt of novel connectedness is sent to the K conservation stage of the mental infrastructure seeking potential. The mental infrastructure returns a remember from its K conservation stage
to the r exploitation stage of the mental structure to provide potential. The potential and connectedness of the mental infrastructure and structure build the resilience of the mental superstructure.

As panarchical superstructural determinism continues (Figure 7.6), a revolt of novel potential from the r exploitation stage of the mental infrastructure seeks potential from the K conservation stage of the behavioral infrastructure. From the r exploitation stage of the behavioral infrastructure, a remember returns to the r exploitation stage of the mental infrastructure to provide potential. To build resilience for its innovation, the behavioral infrastructure sends a revolt of novel potential from its r exploitation stage to the K conservation stage of the behavioral structure. A remember of connectedness returns from the α reorganization stage of the behavioral structure to the K conservation stage of the behavioral infrastructure to support the new mode of production. Subsequently, a revolt of novel connectedness occurs from the α reorganization stage of the behavioral structure to the K conservation stage of the behavioral superstructure. The revolt seeks resilience from the behavioral superstructure that supports the connectedness of the behavioral structure that, in turn, supports the potential of the behavioral infrastructure’s mode of production. From the Ω release stage of the behavioral superstructure, a remember of resilience returns to the K conservation stage of the behavioral structure. The process of building new behavioral potential is complete. Thus, panarchical superstructural determinism serves to build social-ecological resilience to maintain the current sociocultural system.

7.5.2 Path C Discussion

Social-ecological resilience is maximized by seeing the local community through the lens of holistic and values analysis approaches. Social-ecological resilience is not just seen socially in economic terms or ecologically in environmental terms. Some may support the use of biodiesel because they believe it to be environmentally beneficial. Others may support biodiesel because they believe canola to be an
opportunity to diversify crop rotation and improve the value of the grass seed industry. Yet, if producing biodiesel means growing a crop that has negative ecological and social impacts due to cross-contamination, then values are denying a holistic social-ecological approach.

Through the lens of social-ecological resilience, canola is not just seen in terms of economic benefit as a rotation crop for the grass seed industry or environmental benefit for biodiesel production. These issues are only part of the complex system of the local community and do not fully recognize additional relationships. Canola is also viewed in terms of social impact to all farming traditions in the local community as well as ecological impact in terms of food security. For, just as rising oil prices lead to fuel insecurity, transportation and production costs lead to food insecurity as well. When food insecurity arises, maintaining the diversity of specialty seed and organic traditions in conjunction with fuel seed production contributes to the resilience of the local community.

Social-ecological resilience conflicts with the economic reductionism of the current sociocultural system. During infrastructural determinism, remember returns the mental superstructure value of social-ecological resilience to the K conservation stage. Here, social-ecological resilience is tied to the constraints of the behavioral components already heavily impacted by economic reductionism. The value of economic reductionism is the overwhelming remember feedback that impacts behavior. Paths A and B illustrate this. Infrastructural determinism does not select social-ecological resilience and the sociocultural system collapses. To avert Paths A and B, panarchical superstructural determinism is necessary and must occur.

Although Harris does not speak of superstructural determinism, he does speak to infrastructural transformation. Harris (1979:72) states that “ideologies and political movements which lessen the resistance to an infrastructural change increase the likelihood that a new infrastructure will be propagated and amplified instead of dampened and extinguished.” As Paths A and B illustrate, the value of economic reductionism from the mental superstructure, the increasing influence of biodiesel on
behavioral superstructure rituals, and the canola rules and crop locator map of the behavioral structure greatly increases the selection of canola cropping. Yet, Harris (1979:72-73) questions, “to what extent can fundamental changes be propagated and amplified by ideologies and political movements when the modes of production and reproduction stand opposed to them (Harris 1979:72-73)?” As the integrated social-ecological and cultural materialism approaches indicate for Paths A and B, the propagation and amplification of canola cropping is not without cost. The selection of canola cropping reduces the resilience, connectedness, and potential of the current sociocultural system. A mode of production that conserves local resilience to oilseed production requires that the value of social-ecological resilience dominate the value of economic reductionism. Panarchical superstructural determinism lessens resistance of infrastructural change to an oilseed crop innovation that favors social-ecological resilience.

Panarchical superstructural determinism maximizes social-ecological resilience. This occurs through a systemic change of the mental components. Although Harris (1999:151) maintains “human will and consciousness are dominated by infrastructural conditions,” he adds that “cultural materialism claims to be compatible with conscious attempts by individuals to control their own destinies and to construct a progressive social order.” Path C serves as an alternative to Path B “not to allow indefinite expansion but to find arrangements of culture, institutions, and technology that lessen environmental impact (Smith 1996b:6).”

Path C maintains diversity by building the resilience of the mental superstructure. Building resilience requires the connectedness of the mental structure and potential from the mental infrastructure. By introducing oilseed production via panarchical superstructural determinism, a values reevaluation takes places to determine adaptive changes to lessen or avoid a crisis. Regarding the behavioral infrastructure’s modes of production, the value of social-ecological resilience must be selected over economic reductionism to maintain the current infrastructure. A mental superstructure that favors social-ecological resilience strengthens resilience for the entire sociocultural
system. A disturbance can enter at a scale that does not disrupt the structure and function of the system and the services that it provides (Berkes 1998:415-416).

Panarchical superstructural determinism begins between the behavioral and mental superstructures (Figure 7.5). A revolt of surprise from the Ω release stage of the behavioral superstructure to the K conservation stage of the mental superstructure suggests that canola cropping is an economically expedient vegetable oil resource for biodiesel production. The revolt seeks supporting resources to maintain the current course of infrastructural determinism. However, the mental superstructure recognizes the impacts and risks that canola cropping will have on the long-term social-ecological resilience of the sociocultural system. When the mental superstructure remember returns to the Ω release stage rather than the α reorganization stage of the behavioral superstructure, new information begins to develop a new approach to building resilience. The remember is a catalyst that introduces the value to favor social-ecological resilience over economic reductionism. The remember information introduces a new type of understanding and, initially, a small degree of precariousness to the behavioral superstructure. The precariousness is necessary to increase the latitude and decrease the resistance within the behavioral superstructure to the new understanding of social-ecological resilience. Precariousness motivates the learning required to live with change and uncertainty. The new pillar of understanding remains in the Ω release stage of the behavioral superstructure. It can not proceed as a resource to the behavioral structure until the connectedness that favors social-ecological resilience is in place. The needed connectedness develops in the mental structure.

The novelty of social-ecological resilience that the mental superstructure sends from its Ω release stage to the K conservation stage of the mental structure seeks connectedness(Figure 7.6). The concepts of cooperation and collaboration are already present in the K conservation stage of the mental structure. Yet, new ways to cooperate and collaborate between previously unlinked agricultural traditions are necessary. Creative linkages are needed to build connectedness for social-ecological
resilience. The innovative linkages nurture the diversity of agricultural traditions and their modes of production for reorganization and renewal. Newly devised connectedness increases latitude while decreases resistance and precariousness. A remember from the K conservation stage of the mental structure returns to the α reorganization stage of the mental superstructure indicating that the pillar of willingness to build social-ecological resilience is in place. However, for the mental structure to build connectedness, potential must be available within the mental infrastructure.

The mental structure sends a revolt of novelty from its α reorganization stage to the K conservation stage of the mental infrastructure to seek potential that favors social-ecological resilience (Figure 7.6). In the mental infrastructure, the combining of different types of knowledge for learning occurs to suggest appropriate modes of production for long-term resilience. Potential comes in the form of oilseed crops that do not pose a cross-contamination risk to other agricultural traditions. The potential to grow such crops returns from the K conservation stage of the mental infrastructure in the form of remember to the r exploitation stage of the mental structure. Available potential further increases the latitude of social-ecological resilience while it further decreases resistance and precariousness. The pillar of capacity joins willingness and understanding to build social-ecological resilience. Grass seed growers plant oil seed crops that can be grown locally and pose no cross-contamination risks to specialty seed and organic crops. This is the critical element that Path B does not address. An economically viable alternative to canola cropping is not recommended or even mentioned. The understanding, willingness, and capacity of social-ecological resilience generate economic viability rather than being dictated by economic reductionism.

The building of social-ecological resilience is complete within the mental components. A strong foundation of values is in place to determine the mode of production for the behavioral infrastructure. The mental infrastructure sends a revolt of novelty from its r exploitation stage to the K conservation stage of the behavioral
infrastructure (Figure 7.6). The novelty introduces new potential for a mode of production. Pre-existing modes of production, as long as risks are reduced or become a non-issue, do not stand opposed to oilseed crop alternatives to canola. As long as the local ecology supports the growth of the oilseed crop alternatives, a viable mode of production exists. Innovation based on social-ecological values creates opportunities for self-organization. A remember returns from the r exploitation stage of the behavioral infrastructure to the r exploitation phase of the mental infrastructure that indicates the introduction of social-ecological values into the behavioral components. To continue to create opportunities for self-organization, the behavioral infrastructure seeks connectedness from the behavioral structure.

The behavioral infrastructure sends a revolt of novelty from its r exploitation stage to the K conservation stage of the behavioral structure (Figure 7.6). The novelty introduces a new mode of production and seeks connectedness to build resilience. Connectedness, for example can develop via a network between grass seed, specialty seed, and organic growers that form a cooperative guild. The guild builds itself around the social-ecological values that support cultural, ecological, and economic diversity. Culturally, diverse agricultural traditions continue to co-exist by maintaining the already existing crop diversity. Maintaining crop diversity by growing an oilseed crop alternative eliminates the ecological risks of canola cropping. Economically, maintaining the diversity of already existing agricultural traditions promotes food, fuel, and monetary security.

The economic viability of oilseed cropping for fuel depends on an altruistic guild structure. The oilseed crop alternative is grown rotationally to improve the monetary value of the grass seed tradition and preserve the cultural and monetary values of the specialty seed and organic traditions. Market perceptions of food purity are upheld. As a bonus, alternative oilseed cropping provides a resource to produce fuel for the local community, if not beyond.

In the behavioral structure, connectedness is built with altruistic social capital. The concept of social capital focuses on the value of relationships for the individuals
and groups that participate in them (Scheffer et al. 2002:231). Connectedness requires the high-power actors (grass seed growers) and low-power actors (specialty seed and organic growers) to develop the social capital that supports cooperation among key actors that have not been linked before (Scheffer et al. 2002:232) and in ways not previously considered. According to Harris (1979:61), “Altruism, to be successful, must confer adaptive advantages on those who give as well as on those who take.” Altruism is generated and maintained via reciprocity.

Each participating group seeks to benefit from the development of social capital. Harris (1979:61) explains,

Cultural evolution, like biological evolution, has (up to now at least) taken place through opportunistic changes that increase benefits and lower costs to individuals... sociocultural systems survive or not as a consequence of the adaptive changes in the thought and activities of individual men and women who respond opportunistically to cost-benefit options.

Path B seeks outside management of individual thought and activities as a compromise is made between good neighbor values and economic reductionism. However, constraints are placed on the sociocultural system and crisis ensues. Social-ecological resilience suffers and freedom to grow a variety of crops is lost. Harris states that “the enhancement of freedom depends in large measure on the conscious examination of the material constraints and opportunities, costs well as benefits, in the long as well as the short run. A dominant value of economic reductionism favors cost-benefit choices for the short term (Path B), while a dominant value of social-ecological resilience favors cost-benefit choices for the long term (Path C).

Path C maintains the long-term freedom to grow a variety of crops based on social arrangements developed by the growers independent of outside management. A system develops to reduce or eliminate contamination based on minimal or no regulations. By creating social capital with high-power actors, the low-power actors stand to gain considerable resilience. The level of cooperation and reciprocity determines the willingness toward social-ecological resilience.
Whether it is Path B or Path C, the high-power actors are willing to sacrifice potential to be a good neighbor. Along Path B, outside intervention by the ODA encourages grass seed growers to be a good neighbor by following the canola rules and using the crop locator pinning map. Along Path C, the grass seed growers choose to cooperate on their own accord, which offers them more freedom of choice. The decision to build social capital with specialty seed and organic growers expresses a long-term commitment to be a good neighbor. The potential for their own individual social-ecological resilience via canola cropping is exchanged for the potential that develops from the collaborating guild of growers.

From the behavioral structure, a revolt of novelty from the α reorganization stage seeks the support of resilience from the behavioral superstructure (Figure 7.6). Entering at the K conservation stage, the behavioral superstructure taps into the understanding for social-ecological resilience that is stored in the Ω release stage. A remember of understanding returns to the K conservation stage of the behavioral structure. The resilience of the behavioral superstructure and connectedness of the behavioral structure combine to maintain the potential of the behavioral infrastructure. The panarchical superstructural determinism process to implement the understanding of social-ecological resilience over economic reductionism is complete. This does not mean that economic viability is ignored. It means that willingness exists to develop new solutions that benefit all growing traditions to maintain the whole system. In this sense, Path C relies on altruistic values.

Even though Path C builds a holistic social-ecological resilience, is not exempt from collapse. Because the behavioral infrastructure is the interface between the environment and human interactions, social organization must remain flexible to changes in local ecology and new modes of production. A system collapse can occur due to forces of nature or forces of human innovation. The values that determine the behavioral infrastructure determine the extent of social-ecological resilience.

In the local community, individualism is highly valued over cooperation. This does not mean that cooperation is not desired. Good neighbor values do exist. These
values contribute to the efforts of Path B. However, to create the willingness necessary for Path C, it is critical that a new understanding develops in the mental superstructure. This understanding considers the impacts a mode of production such as canola will have on the ecology and social fabric. Understanding develops through a holistic approach and values analysis just as Path B. However, long-term cost-benefit choices are elected over short-term cost-benefit choices. This is reflected in the mode of production chosen for the sociocultural system’s infrastructure. Ultimately, the choice of innovation determines the degree of resilience for the local community. An understanding that favors social-ecological resilience over economic reductionism inspires the willingness to harvest the capacity for long-term resilience.
8 Conclusion

The design for this research is based on the integration of four theoretical approaches. The holistic approach provides the behavioral components and the values analysis approach provides the mental components that are integrated into a cultural materialism framework. These components are evaluated by the social-ecological approach. The social-ecological approach, illustrated by panarchy theory, is also integrated into the cultural materialism approach. The integration of the four theoretical approaches provides a means to explain the resilience and sustainability for the Corvallis Biodiesel Cooperative (CBC) and Oregon State University Biodiesel Initiative (OBI) and three potential paths of resilience and sustainability for the grass seed, specialty seed, and organic growing traditions. Especially significant is the linkage between the values analysis approach and cultural materialism discovered while exploring the CBC and OBI. Values impact cultural materialism more than previously believed. The research findings for the CBC indicate that values determine behavior (superstructural determinism). This changes the interpretation of cultural materialism which suggests that behavior determines values (infrastructural determinism).

Values that support the biodiesel mode of production are increasing among many groups in the southern Willamette Valley. The CBC and OBI consist of people who want to protect the environment and see biodiesel as a way to accomplish this goal. The values expressed by the CBC and OBI determine behavior that increases the demand for vegetable oil resources to supply a growing demand for biodiesel.

One way to increase vegetable oil resources is through oilseed cropping. The proposed mode of production for oilseed cropping is canola. However, strong values among the specialty seed and organic growers currently reject canola. The specialty seed and organic growers are concerned by the outcrossing risks that canola cropping poses to their agricultural traditions. Grass seed growers, who stand to benefit from canola cropping rotations, currently feel that the economics are not right for growing canola to make biodiesel. Still, as petroleum prices rise, growing canola becomes
economically more appealing as a vegetable oil resource. Similar to the values of the CBC and OBI that determine their actions toward biodiesel, the dominant values that surface among the grass seed, specialty seed, and organic growing traditions will determine their actions toward oilseed cropping.

This research suggests three potential paths of resilience and sustainability for the grass seed, specialty seed, and organic growing traditions. Paths A and B illustrate the influence of infrastructural determinism on resilience and sustainability. Path A demonstrates the impact of values that support unrestricted canola cropping. Path B proposes a compromise between values via regulations and pinning maps. Path C suggests values for innovative social networks to support oilseed cropping that alleviates risk among agricultural traditions. Path C illustrates the influence of superstructural determinism on resilience and sustainability.

Paths A and B illustrate that the infrastructural determinism of canola cropping does not maintain the social-ecological resilience of the current sociocultural system. Thus, the research hypothesis is refuted: Even though Path B proposes a compromise between agricultural traditions, the selection of canola cropping indicates that economic reductionism is a more important value than the long-term social-ecological resilience of the local community. The value of economic reductionism dominates other values such as being a good neighbor, being sustainable, and taking a long-term perspective. The infrastructural determinism of canola cropping leads to the collapse of the current system and the development of a new system that is less diverse. The primacy of infrastructure is clear because the choice for mode of production determines the impact of human-environmental interactions with respect to dominant values.

As the demand for biodiesel increases, the demand for canola cropping acreage increases, too. In terms of economic reductionism, this benefits grass seed growers over the long term. Canola cropping may benefit specialty seed and organic growers over the short term in terms of fuel, but increasingly puts them at risk to outcrossing over the long term. The ensuing crisis results in the demise of the specialty seed and
organic farming traditions. The flexibility and long-term resilience of the system as a whole decreases as the diversity of food crop traditions are simplified. As the cost of petroleum oil rises, canola seed and grass seed become the dual crop rotation system.

If the need arises to reintroduce flexibility and diversity for food security, the range of choices is limited. The persistence of canola cropping volunteers five to ten years after initial planting reduces the potential of crop diversity. Ultimately, ecological resilience is the determining factor to the possibilities of social structure and function. Thus, the values that influence human-environmental choices determine the options for possible futures. The determining values and behavior mean the difference between averting a crisis and adapting to one. Values and behavior that favor building social-ecological resilience positively influence the ecological resilience necessary to sustain social systems.

In order for oilseed cropping to sustain the local community over the long term, superstructural determinism must impact the primacy of infrastructure. Simply relying on the positive and negative feedback mechanisms of the behavioral structure and superstructure over the short term will prove harmful to the crop diversity and agricultural traditions of the local community. The value of economic reductionism supersedes the values necessary for oilseed cropping to coexist with the specialty seed and organic growing traditions. Social-ecological resilience of the current sociocultural system can occur if an economically viable alternative to canola cropping is introduced into the behavioral infrastructure that does not pose a risk to other modes of production. However, this is not the case. Therefore, the value of economic reductionism conflicts with the long-term social-ecological resilience of the local community.

Path C illustrates that superstructural determinism promotes the social-ecological resilience of the current sociocultural system. Superstructural determinism is necessary to encourage values that favor social-ecological resilience over economic reductionism. Instead of molding social-ecological resilience to accommodate economic reductionism, Path C transforms values from economic reductionism to
support social-ecological resilience. The transformation requires linkages between grass seed, specialty seed, and organic growers to develop a social network that supports the long-term resilience of the local community.

Values for social-ecological resilience are difficult to attain in the face of dominant values of economic reductionism. Because an economically viable and non-threatening alternative to canola cropping has not been proposed, infrastructural determinism does not promote the long-term resilience of the current sociocultural system. Social-ecological resilience of the local community is diminished if economic reductionism predominates. Unless superstructural determinism occurs, the values necessary for the long-term social-ecological resilience of the current system will not surface.

The next step is to inform farmers. Collectively, farmers can weigh out their important values to see how they want to proceed. Focus groups can serve as a venue to bring forth values and ideas. Values may suggest that continuing along the Path B compromise is perfectly acceptable. Or, values may suggest altering course to Path C to develop social networks that encourage oilseed cropping that does not pose risks to each others' growing traditions. While canola cropping is currently not allowed in the local community, there is no better time than the present to open dialogue via focus groups. The information gathered will assist the direction of oilseed policy and management based on the predominant shared values of the local agricultural traditions.

The values and behavior of the CBC and OBI demonstrates how farmers can transition to Path C. The CBC and OBI have already changed their mental superstructures to favor values of social-ecological resilience to use biodiesel. This change is based on their values to reduce negative environmental and social impacts. A similar change in the mental superstructure of farmers encourages values of social-ecological resilience toward Path C. Such a change reflects the values of farmers to reduce negative environmental and social impacts among each other.
This research project interfaces the values of the CBC, OBI, and grass seed, specialty seed, and organic growing traditions. It demonstrates, holistically, how the values and actions of one group can inspire and challenge the values and actions of other groups. The applied aspect of this project is that it illuminates the choice before us: to continue values of economic reductionism or to choose new values of social-ecological resilience. The choice provides the opportunity to decide between short-term and long-term resilience and sustainability.
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Open-ended Questions for Semi-structured Interviews

Are you familiar with biodiesel?
Do you use biodiesel?
Why do you use biodiesel?
Have you considered using biodiesel?
Do you have any concerns related to biodiesel?

How do you feel about growing canola?
How do you feel about your neighbors growing canola?
Do you have any concerns related to canola?
Are there other oilseed options to consider?

How do you feel about cooperatives?

How do you feel about cooperation?