Farmers' Local Ecological Knowledge in the Biotech Age: A Multi-Sited Ethnography of Fruit Farming in the Okanagan Valley

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ABSTRACT

In this Master of Arts Thesis in Anthropology I examine the controversy in the Okanagan Valley over the introduction of GM seed technologies into local agricultural processes. I explore via a multi-sited ethnography how local fruit farmers in this region view GM seed technologies and their perception of how these technologies will impact their farming practices. I argue that (a) the use of GM seeds as currently regulated in Canada threatens to erode farmers' local knowledge of plant breeding and that (b) this erosion is of consequence not only to local farmers but to society generally because the environmental knowledge and skills possessed by local farmers is crucial to the protection of biodiversity, environmental sustainability, and food security.

RÉSUMÉ

En cette thèse d'anthropologie la question à l'étude est la controverse dans la vallée Okanagan sur l'introduction des nouvelles technologies des graines GM (génétiquement modifiées) en méthodes de culture local. En particulier, j'explore par une ethnographie "multi-sited" comment fermiers locales en cette région pensent les nouvelles technologies des graines GM peut-être avoir un effet sur fermiers et les méthodes de culture locales. Je suggére que (a) la décision d'introduire les nouvelles technologies des graines GM en la vallée Okanagan est une menace pour les connaissances locales d'élevage des plantes, et (b) cette menace et perte de connaissance local est important pour les fermiers locales et aussi pour société en général parce que la connaissance écologique de fermiers locales est crucial pour la protection de la biodiversité, l'environment, et le sécurité de la provision de nourriture.

Introduction: What Happens To Alistair's Apples in the Biotech Age?

The final stretch of highway 97 leading into Summerland, British Columbia runs through lush farmland and past the western shore of Okanagan Lake. Driving along this scenic piece of road in early August, I see that the tourist season is at its peak. The curving lakeshore is humming with activity. Colorful beach towels and sun umbrellas speckle the sand, while in the distance motorboats buzz lazily across the water, some towing water skiers or young children clinging to inner tubes. A fat yellow road sign in the shape of a sun welcomes me to Summerland. As I approach the town centre, small fruit-and-vegetable stands shaded by cheerful awnings spring up along the highway with increasing frequency. Feeling hungry, I pull into a stand featuring a hand-painted sign with a rosy-cheeked boy biting into a large red apple, and the words "Alistair's Apples"[1] written above. I open the car door and feel a rush of heat. The earth beneath my feet is parched and dry and the sun overhead is still fiercely hot, although it is late afternoon. I take a cold bottle of water from the cooler and then fill up a few paper bags with peaches and nectarines.

The young woman who rings in my purchase is friendly and asks me where I'm from. I tell her that I'm a graduate student from McGill University in Montreal and that I'm interviewing farmers to find out what they think about agricultural biotechnology. "My uncle's a farmer," she tells me. "This is his fruit stand. I'm sure he wouldn't mind speaking with you – just wait here, he's in the back." A few minutes later she reappears followed by a man who looks to be in his early 40's, dressed in jeans and a long-sleeved shirt. He shakes my hand and tells me his name is Gary.[2] I explain my project to him

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[1] A pseudonym.
[2] A pseudonym.

and he invites me to come back with him to his farm. It will be dusk soon, and he says he's just about to close the stand up for the day anyway.

Once we have reached the farm, Gary gives me a tour of the orchards. We walk through even rows of dwarf-sized trees impressively laden with apples, most of which are still small and green. The trees are planted close together and are at most a foot taller than I am myself. Gary's orchard is a modern one. A century ago, when the first orchards were started in this area, tall fruit trees were planted at a generous distance from one another. Today rising land prices in combination with more competitive market conditions encourage farmers to use the available land space as efficiently as possible. Densely planted, high-yielding dwarf varieties allow fruit farmers to produce large quantities of fruit relatively quickly even on small plots of land. This type of orchard is fairly labour-intensive and requires building stands to help support the trees as well as extra pruning and weeding.

"So, my niece tells me you're interested in biotechnology?" Gary asks.

I nod yes.

"Well, I like biotechnology. Actually, I practice it myself."

This takes me by surprise. I find it hard to picture this laconic, sun-weathered man in a laboratory. He notices my puzzled expression and takes me over to a small cluster of trees growing in one corner of the orchard, slightly set apart from the rest. Most of the fruit on these trees is not quite ripe yet, but he hunts around until he finds one that is. He hands me a large red-and-yellow apple and invites me to taste it. The apple is one of the best I've ever eaten. It's crisp and juicy, and contains just the right blend of sweetness and tang. There's a subtle aftertaste I like too, which reminds me of almonds.

I tell Gary how much I like the apple and ask him how he developed it. As he explains his method, which involves a combination of artificial pollination, grafting cultivars onto rootstock and trial and error, I soon realize that he is describing a form of conventional breeding. Broadly defined, the term biotechnology encompasses conventional methods of genetic manipulation along with modern scientific ones.[3] However, in contemporary discourse biotechnology usually refers more narrowly to recombinant DNA technology, which can be performed only in a laboratory and involves the use of a gene gun to insert microscopic pieces of DNA into the embryos of organisms.

Gary concludes his explanation by telling me that he initially undertook the experiment to celebrate the birth of his firstborn son. He calls the new variety "Alistair" and is in the process of developing a new variety for his younger son (the trees for this experiment have not yet begun to produce fruit). I ask Gary if he has applied for Plant Breeder's Rights over the Alistair apple, but he says he can't be bothered with the paperwork and application fees. Besides, he tells me, the apple probably has little commercial value. While the taste and texture are excellent, the size of the apple is considered too large to sell fresh by supermarkets because smaller apples of a uniform size sell best. Gary sells the Alistair apples at his fruit stand and uses what's left over for home consumption and to give away to family and friends.[4]

I drive away from the orchard with a small cardboard box of Alistair's apples on the passenger seat beside me. Out the window, a succession of small farms flash by.

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[3] Definitions of biotechnology are controversial and unstable. Klaus Lesinger of the CibaGeiby Foundation defines biotechnology as "the integrated application of biochemistry, microbiology and process technology with the objective of turning to technical use the potential of microorganisms and cell and tissue cultures as well as parts thereof" (Kneen 1998: 41). Alternatively, the Canadian government ministry Agriculture and Agri-Food Canada defines biotechnology more simply as "The applied use of living organisms, or their parts, to produce new products" (Ibid.).

[4] Interview with Summerland orchardist, August 4, 2004.

This town is part of the fertile Okanagan Valley, an area often referred to as the "fruit capital of Canada" because it produces thousands of tons of cherries, grapes, nectarines, apricots, apples peaches, prunes and pears annually. The farms in this area are small, family-run farms, and like small farms across the rest of Canada, they are in hard financial straits. Summerland's surface image as a happy-go-lucky vacation destination belies the underlying tensions and anxieties currently affecting local farmers. The most recent crisis to affect the valley is the brewing controversy over the proposed introduction of genetically-modified (GM) seed technologies into local agricultural practices. While GM seeds for annual field crops such as corn, canola, and soybeans have been available to farmers in Canada for over a decade now, the technology for GM fruit trees is at a less advanced stage and is only now approaching readiness for commercial sale. Summerland is at the heart of the controversy since the town is host to two research and field test sites: the government-run Pacific Agri-Food Research Center and a private company called Okanagan Biotechnology Inc (OBI).

While human beings have for millennia bred plants and animals for particular characteristics, modern biotechnology represents a departure in that it allows scientists to isolate particular genes in laboratories and to then transfer these genes between unrelated living organisms. The view of living organisms on which genetic engineering is based is sometimes referred to as "genetic reductionism" because an organism is understood as being defined by its genetic makeup. According to this viewpoint, DNA acts as a "blueprint" for determining the characteristics and behaviours of a given organism. For the purposes of genetic engineering, genes are studied in isolation from one another and the outside environment in order to determine what they "code" for. Once this is believed to have been established, the gene may be inserted into another organism for the purposes of altering it so as to encode the characteristic of the inserted gene. This reductionist paradigm occludes consideration of the relationship of individual genes to their surroundings. Ironically, the field of molecular biology has in recent years begun to shift as a result of the work of scientists such as Nobel Prize winner Barbara McClintock, who maintained throughout her career that the behaviour of genes cannot be explained in isolationist terms but must instead be studied in terms of relationships to other entities and processes both inside and outside of the organism. Ecologists and other critics of biotechnology are concerned that genes inserted into foreign organisms through DNA technology may react in unforeseen ways to other genes in the host organisms or to various elements of the environment to which the genetically-modified living organism is exposed (Buell 2003: 158-160). The latter concern is of particular concern as most testing involving GM organisms occurs either in sterile laboratory conditions or a single field test location, despite the fact that most GM seeds companies are hoping to sell their products to a global market.

The reductionist understanding of living organisms that guides the practice of biotechnology posits that organisms may be viewed as "machines" whose "parts" (*i.e.,* genes) can be taken apart and reassembled into new forms. This mechanistic view of life lends itself well to patent protection. Historically, living organisms were excluded from patentability because it was assumed that human beings could not author life. Biotech industry advocates challenged this assumption, however, by arguing that the living "products" of biotechnology emerge out of laboratories rather than nature and thus qualify as human inventions. In 1980, a landmark United States Supreme Court decision accepted this logic for the first time and ruled that a GM bacterium qualified as "manufacture" or "composition of matter" and thus constituted patentable subject matter. This decision initiated a spate of new patents in the US and other industrialized nations on incrementally higher life forms. More recently, the Trade-Related Intellectual Property Rights (TRIP's) Agreement of the World Trade Organization (WTO) commits all 144 member countries to creating domestic legislation for patents on GM life forms at the microbiological level.

For the past several years, the Canadian government and OBI have been jointly involved in developing a fruit tree genetically-modified to prevent the flesh of apples (and, more recently, peaches) from browning when exposed to air. However, both the research on the trees and the anticipated commercial release date have been delayed due to local farmer opposition. In 1999, a group of protestors dubbed "the nighttime lumberjacks" by the local newspaper broke into the research station overnight and dug up all of the GM trees then being field-tested. Following this incident, the trees were replanted and security at the research station was intensified. In 2001, a coalition of farmers led by Linda Edwards, an organic fruit farmer in Cawston, BC, persuaded the then provincial minister of Agriculture, Corky Evans, along with scientists from OBI and the research station to meet with local organic and commercial farmers to discuss their concerns about the field-testing and eventual commercial release of GM fruit trees. As a result of this meeting, it was agreed that field testing on the GM trees would be carried on outside the valley, at least until such time as it could be guaranteed that non-GM orchards could be protected against contamination. While the farmers were satisfied with this agreement, the issue is likely to resurface in the near future as OBI intends to make the technology available for commercial sale in 2010.[5]

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[5] There is no secure method of ensuring that cross-contamination between GM and non-GM fruit trees does not occur. Arguably, the economic consequences of contamination for Okanagan farmers may be somewhat less severe by 2010 than they were in 2001. A World Trade Organization challenge that

In this Master's thesis I explore the controversy in the Okanagan Valley over the introduction of GM seed technologies into local agricultural processes. In particular, I focus on how local farmers view the technology and their perception of how the technology will affect them and their farming practices. GM seeds are the outgrowth of a broader paradigm of modern farming that encourages farmers to rely heavily on commercially-produced off-farm inputs and to compete to sell their products on the global marketplace. This paradigm favours uniformity both in terms of methods of production and the end product because uniformity is more efficient from a business standpoint. This emphasis on standardization, which has been intensifying rapidly over the past few decades, is gradually eroding the autonomy and creativity of the farmer. In particular, the growth of GM seed sales internationally in combination with the strong intellectual property rights that protect them threaten to undermine farmers' informal plant breeding practices. This erosion is unfortunate, both for farmers who are experiencing a de-skilling of their trade and for the rest of society, as we no longer benefit to the same extent from farmers' local ecological knowledge.

In this MA thesis, based on an ethnography of Okanagan fruit farmers, I advance two primary arguments. First, that the use of GM seeds as they are currently regulated in Canada threatens to erode farmers' knowledge of plant breeding, and second, that this erosion is of concern not just to farmers but also to the rest of society because the environmental knowledge and skills that farmers possess with regard to

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Canada (along with the United States and Argentina) brought against the European Union (EU) for its moratorium on the importation of GM foods has recently been decided, largely in Canada's favour. While the EU must now allow the importation of most GM food crops, they are likely to be labeled as genetically-modified and there is no guarantee that consumers will purchase them.

cultivating agricultural biodiversity is sorely needed in order to ensure food security in this era of climate change and rapid biodiversity loss.

I forward these arguments over four chapters. In the first chapter, I describe the growth of the orchard industry in the Okanagan Valley from its inception over a hundred years ago up until the present day. I discuss current fruit farming practices for both conventional and organic growers with an emphasis on the pressures that market forces bring to bear on growers. In the second chapter, I consider the legislation in place in Canada covering seed saving and Intellectual Property Rights (IPR's) for plant varieties with a discussion of the differing interests of key stakeholders. In the third chapter, I discuss Okanagan farmers' positions on the use and ethics of GM seed technologies. In the fourth and final chapter of the thesis, I discuss GM seed technologies in relation to sustainable agriculture and argue for an agricultural policy that helps local knowledge systems, such as those possessed by Okanagan fruit farmers, to flourish. Before I begin this analysis, however, I briefly outline below the methodology and the theoretical framework that guided my research.

Methodology

The methodological framework I have adopted for this thesis is a combination of Glazer and Strauss's "grounded theory," Ortner's "practice theory," and Marcus's "multi-sited" ethnography. Below I briefly introduce each of these approaches and then relate their application to my thesis in a description of my fieldwork.

a. Grounded Theory

Glaser and Strauss define grounded theory thus:

> Generating a theory from data means that most hypotheses and concepts not only come from the data, but are systematically worked out in relation to the data during the course of research (1967: 7).

Grounded theory is inductive. It allows substantive concepts and arguments to arise first, on their own. In this way, grounded theory is more faithful to the data collected as it does not attempt to force data to fit any particular theory. The theoretical understanding that emerges from grounded theory is gradual, contingent, and embedded. Grounded theory has been likened to ethnography itself, where "[t]he ethnographic case study has become the post-modern 'tale of culture,' in which description is taken as problematic, and in which theory, rather than an edifice from which hypotheses may be mechanically derived, assumes a more tentative, inductive character" (Harper 1992: 141).

Grounded theory involves the use of what Glaser and Strauss term "theoretical sampling" (1967: 45). Random sampling is typically employed with a view to constructing and legitimizing generalizations (Platt 1992: 42). *Theoretical sampling*, by contrast, is used to develop theory as it emerges, where the process of data collection is in a sense *controlled* by the emerging theory. The starting point is not chosen in accordance with a preconceived theoretical perspective in mind. Rather, the initial starting point of research is found outside the case study but is subsequently brought to bear on the process of theory development (Glaser and Strauss 1967: 254), a process that is equally consistent with the tenets of reflexive ethnography (Rainbow 1977; Clifford and Marcus 1986; Bourdieu and Wacquant 1992; Geertz 1995; Burawoy et al. 2000; Anderson and Berglund 2003).

b. Practice Theory

In the late 1970's and early 1980's the social sciences generally and anthropology in particular underwent an at once epistemological and methodological shift away from structures toward the study of practices (Ortner 1984). In reality, however, the shift was away from a wholly deterministic view of the operation of social and political structures toward a view of the interaction between structures and local practices. As Giddens (1979) argued, the study of practice is not an alternative to the study of structures, but a necessary complement to structural analysis – practice as a theoretically strategic window unto the operation and reproduction of structure.

What, then, qualifies as practice? Ortner's original description remains instructive: "[T]he study of practice is after all the study of all forms of human action, but from a particular—political—angle…. The analyst takes these people and their doings as a reference point for understanding a particular unfolding of events, and/or for understanding the processes involved in the reproduction or change of some set of structural features" (1984: 149).

Ortner concludes her account of practice as the key symbol of 1980's anthropology by suggesting that others might have chosen an alternative key symbol, namely history, a term embodying, among other things, time, process, development, and transformation. Ortner goes on to speculate that the move in the field from systems to persons and practices may have been but a corollary of the move from the static to dynamic, diachronic analyses of microdevelopmental processes of transactions, projects, and careers. This move echoes a strand of the political economy approach, which attempts to understand changes in small-scale societies in relation to (and as a consequence of) large-scale developments – mainly, colonialism and ongoing capitalist expansion (Ortner 1984: 158). In concluding this way, Ortner anticipates Marcus's (1995) call for an anthropology in and of the world system, to which I turn below.

c. Multi-Sited Ethnography

Picking up where Ortner left off in the mid-1980's, Marcus (1986, 1989) identified two distinctive ways in which ethnographic analysis began to apprehend the context of the historic and contemporary world system of capitalist political economy. The most common way preserved the intensely observed single site of observation and participation supplemented by archival research and the work of macrotheorists (subsequent exemplars include Comaroff and Comaroff 1991, 1992). The second, still emergent mode of ethnography is self-consciously embedded in the world system (Marcus 1995). According to Marcus:

> This mode defines for itself an object of study that cannot be accounted for ethnographically by remaining focused on a single site of intensive investigation. It develops instead a strategy or design of research that acknowledges macrotheoretical concepts and narratives of the world system but does not rely on them for the contextual architecture framing a set of subjects. This mobile ethnography takes unexpected trajectories in tracing a cultural formation across and within multiple sites of activity that destabilize the distinction, for example, between lifeworld and system, by which much ethnography has been conceived. Just as this mode investigates and ethnographically constructs the lifeworlds of variously situated subjects, it also ethnographically constructs aspects of the system itself through the associations and connections it suggests among sites (1995: 95).

More concretely, Marcus describes multi-sited ethnographies as those that define their objects of study through the "preplanned or opportunistic" tracing within different settings of complex cultural phenomena given "an initial, baseline conceptual identity that turns out to be contingent and malleable as one traces it" (Marcus 1995: 102). As an example of the multi-sited approach Marcus draws on Wallerstein's research into global commodity chains:

> The concept of commodity chain is central to our understanding of the processes of the capitalist world economy…. Take any consumable product, say clothing. It is manufactured. The manufacturing process minimally involves material inputs, machinery, and labor. Material inputs are either manufactured or produced in some way. Machinery is manufactured. And labor must be

> recruited either locally or by immigration, and must be fed.... We may continue to trace each "box" further back in terms of its material inputs, machinery, land, labor. The totality constitutes a commodity chain (Wallerstein 1991: 4).

As Marcus notes, Wallerstein's commodity chain lacks a specific ethnographic example, but it is nonetheless suggestive of how multi-sited research may be conducted.

Marcus goes on in his review to note that the multi-sited approach is especially usefully applied to the social and cultural study of science and technology. Marcus here cites the work of Rainbow on the discovery and commodification of polymerase chain reaction and, as an especially telling example of the multi-sited approach, the title of a then recent survey of biotechnology: "Gene Dreams, Wall Street, Academia, and the Rise of Biotechnology" (cited in Marcus 1995). Consider also the multi-sited character of recent development studies, in particular Escobar's (1994) study of a region in Colombia that traces the intersections among social movements, traditional development approaches, and the environmentalist advocacy of biodiversity.

Multi-sited ethnography is both a literal and a conceptual method, as Marcus observes in his discussion of the "strategically situated single-site ethnography." This form of ethnography attempts to come to terms with a systemic phenomenon in a local context. As I will outline below, my ethnography is multi-sited both literally and conceptually.

d. Fieldwork in the Okanagan Valley

This thesis is based on three months of fieldwork in the Okanagan Valley during the summer of 2004. During this time I conducted interviews with farmers in three separate sites within the valley: the towns of Salmon Arm, Sorrento, and Summerland.

My relationship with this region of British Columbia is an intimate and longstanding one as several members of my extended family have lived in the area for generations. Although I was raised in major Canadian cities, my summers were always spent visiting with relatives in the Okanagan. I began my fieldwork in the north Okanagan town of Salmon Arm. My aunt runs a grocery store in this town and purchases much of the produce she sells from local farmers. My first contacts with farmers occurred through my aunt's business contacts. These initial contacts gave further recommendations in both Salmon Arm and the neighboring town of Sorrento. The interviews I conducted with farmers in Summerland I obtained by simply stopping at the farmer-run fruit-and-vegetable stands that line the highway on either side of the town and asking to conduct interviews. Again, the initial interviews I secured led to others through farmer referrals (*i.e.,* "snowball sampling").

The farmers with whom I obtained interviews through these initial methods happened all to be conventional farmers. Because I wanted also to interview organic growers, I consulted an Internet directorate of BC organic growers and contacted some of those located in the Okanagan valley. Included in this group was Linda Edwards, an organic fruit grower from Cawston BC who is the president of the Organic Producers Association for Cawston/Keremoos and who played a leadership role in organizing farmers to oppose the field-testing of GM fruit trees in Summerland. Unlike the other interviews, which were conducted in person, this interview occurred over the telephone. In total I interviewed seventeen farmers, four of whom were organic growers, and thirteen of whom were conventional growers. Of the thirteen conventional growers, three had experimented with the use of GM seed technologies in their plant crops.

As outlined above, I employed theoretical sampling consistent with grounded theory to strategically select interviewees for the purpose of theory generation. Both the number of organic farmers I interviewed as well as the number of farmers who had tried using GM seeds were disproportionately large in comparison with their statistical representation in the Okanagan. While organic farmers in the Okanagan currently make-up only about 10% of the farming community, organic production is the fastest growing sector (www.certifiedorganic.bc.ca). There is a great interest in the valley in general in reducing dependence on chemical inputs both for health and environmental reasons and for financial reasons. Many of the conventional farmers I interviewed were attracted to organic farming but were unsure if they could afford the five-year certification process during which time farmers cannot use chemical inputs but are not yet eligible to qualify for an organic label and so do not receive the premium prices that organic produce commands. Although no formal statistical information is available on the number of Okanagan farmers who use GM seeds, my sense is that the number is very low. First and foremost, fruit is the main crop the region produces and GM fruit tree technologies are not yet for sale. Most of the plant crops for which GM seeds are available (namely corn, soy, and canola) are not grown in large quantities in the Okanagan. Most of the farmers in this area are small farmers who are struggling financially and are therefore looking to avoid paying extra costs on inputs. The three farmers I did locate who are using the seeds were identified to me by other farmers. A high level of awareness of who was using GM seeds existed in the farming community because the choice of one farmer to use the seeds had implications for neighboring farms planting the same crops due to the possibility of contamination. I wanted to interview as many farmers as I could who were using GM seed technologies to get a sense of why they had chosen them. These three were the only three that I was able to locate during my fieldwork.

Most of the names of those farmers I interviewed have been changed in this thesis. Those farmers that requested that their real names be changed typically did so because they were worried about offending or alienating colleagues with different feelings than themselves on the issue of GM seed technologies. The issue is a volatile one, especially given the high levels of contamination associated with certain GM crops. In the case of organic farmers, the decision of a neighbor to grow a GM crop could result in the loss of organic certification should cross-contamination occur. Conventional growers exposed to possible contamination worried about the loss of markets in the EU and other countries where there is a high level of opposition to GM foods. In spite of these worries, the non-GM using farmers I interviewed were usually careful to express their respect for colleagues who had chosen to use the technology, and were anxious not to appear judgmental of them either in this thesis or elsewhere. Of the three farmers I interviewed that had used GM seed technologies, two were still growing GM crops and did not wish their names to be revealed for fear of alienating consumers and incurring the resentment of neighbors. The third farmer was no longer using the technology and permitted his real name to be used.

In addition to the interviews I conducted with farmers, I also conducted two interviews at the Summerland Research Station (a Federal government station). The first was with a lab technician who gave me a tour of part of the facility, and the second was with Dr. David Lane, the head scientist involved in developing the GM apple tree, and an employee of both the Canadian government and the OBI. Finally, I conducted one interview with an independent seller of heritage seeds. Thus I describe my ethnography as multi-sited in both the literal and conceptual senses of the term – literally multi-sited in that I conducted interviews in three towns, with three kinds of farmers (organic, conventional, and GM) and with researchers from both the public and private spheres, and conceptually multi-sited in that I pursue in this ethnography multiple conceptual intersections, including local versus global, science versus ordinary knowledge, and public versus private.

The issues raised by the interviews I conducted directed the library research I subsequently undertook. At the time that I began my fieldwork I was under the impression that GM seed technologies represented a radical break from previous farming practices. However, all of the farmers that I interviewed, whether opposed to or in favour of the technology, argued that GM seeds merely represented another step on a continuum and were consistent with the dominant philosophy guiding modern agriculture.

Similarly, upon initially entering the field, the farmers I contacted assumed both because of my university affiliation and because these farmers are accustomed to being visited by biotechnology advocates from academia, government, and industry intent upon selling them new products that I was in favour of biotechnology. This assumption made the farmers uneasy and, not uncommonly, they suggested that I speak with someone else (usually a child studying agricultural science at university) who spoke the language of science. The farmers I interviewed conceded little if anything to the scientific approach of biotechnology beyond their own perceived inability to deploy its "fancy vocabulary." Without being able to explain in scientific parlance their reservations regarding biotechnology, these farmers are nonetheless firm in their substantive, considered opinion that GM seed technologies have little to offer them in terms of benefits at the present time. As one farmer put it, "I know what I know." The discursive dimension of science generally and biotechnology in particular is suggestive of farmers' marginalized position vis-à-vis what Latour terms capital S science:

> This Science, capital S, is not a description of what scientists do . . . It is an ideology that never had any other use . . . than to offer a substitute for public discussion . . . It has always been a political weapon to do away with the strenuous constraints of politics. . . Because it was intended as a weapon, this conception of Science . . . has only one use: as the command, "Keep your mouth shut!" (Latour 1997: 189-90).

Much of my library research therefore involved tracing, consistent with grounded theory and the multi-sited approach, the development of modern farming and examining the broader context of scientific agriculture in which GM seed technologies have emerged. In order to explore this context I examined both the history of fruit farming in the Okanagan specifically and as the development of agricultural policy in Canada more generally. The area of agricultural policy that I explored most deeply was the history of seed breeding strategies in Canada and the respective roles that indigenous peoples, farmers, scientists, government, and industry have played. I also explored the various types of intellectual property rights that seed breeders in Canada can access in order to protect the new plant varieties they develop.

The interdisciplinary nature of this topic led me to diverse sources. In addition to academic books and journal articles from a range of disciplines including anthropology, law, agricultural science, and history, I also consulted provincial and federal government websites, promotional material produced by the ag-biotech industry, promotional material from the pro-organics industry, transcripts from relevant court cases, archival material from the Summerland Research Station and the Summerland Museum, mainstream farm periodicals such as the Western Producer and the BC Agriculturalist, alternative farming publications such as the Ram's Horn, and a variety of useful NGO websites including those of the National Farmer's Union, the ETC group, and the Indigenous Peoples Council on Biocolonialism.

Theoretical Framework: Envisaging Agriculture, Situating Knowledge

My purpose in this thesis is to explore the broader theoretical debate over the relationship between expert, scientific knowledge and local ecological knowledge concerning food production. The tension between these two forms of knowledge is today intensely felt at both the global and the local level. Anthropologists have long argued in favour of greater appreciation being given to the ecological insights of indigenous and other non-Western communities, pointing out that the ecological knowledge that accrues in communities with a longstanding intimate acquaintance with the land and a strong intergenerational transfer of knowledge can in some cases complement, enhance, or even trump Western scientific knowledge on a given problem. While these arguments have most often been made by anthropologists working with non-Western or indigenous communities, I contend that this argument may be legitimately and instructively extended to small farmers in the West, who also form deep, long-lasting relationships with the land and pass down knowledge intergenerationally.

While all agricultural production necessarily involves a degree of simplification and a corresponding degree of dependence on human cultivation (Scott 1998), the advent of twentieth-century agriculture, attended by monocropping, hybridization, and the intensive use of chemical herbicides and pesticides has precipitated an unprecedented level of standardization. While a diversity of knowledge systems and a diversity of plant life indubitably benefit both society and the environment, intense commercial pressures to maximize profits in an increasingly competitive global market for food act as a catalyst of standardization and genetic uniformity. The result is the radical simplification of both field and crop. As James Scott (1998: 268) notes, agronomic science has devoted itself to realizing the commercial and scientific ideal of food bearing uniform size, shape, colour, and "eye appeal" so as to conform to global standards of packaging, storage, shipping, and display.[6] The logic of *actual* farming – the inventive, practiced response to a highly variable local environment – has been supplanted by the ideal of so-called scientific agriculture, the inverse process of adapting the environment to its own standardizing paradigm. The corollary of standardized, uniform agricultural produce, then, is a form of standardized, uniform agricultural *knowledge*.

This process of simplification doubtless enabled an exponential increase in crop yields. Simplification, however, also carries with it several significant unintended environmental consequences. In a review of the history of major crop epidemics (prompted by a corn leaf blight that wiped out much of the 1970 U.S. corn crop), a committee of the United States National Research Council concluded that crop monoculture and genetic uniformity invite epidemics. Donald Jones, one of the pioneer breeders of hybrid corn in the United States, expressed both the potential and the unforeseen problems of genetic uniformity this way:

> Genetically uniform pure line varieties are very productive and highly desirable when environmental conditions are favorable and the varieties are well-protected from pests of all kinds. When these external factors are not favorable, the result can be disastrous … due to some new virulent parasite (cited in Scott: 268).

[6] For an historical recounting of the standardization of meat production in the United States, see Roger Horowitz, *Putting Meat on the American Table: Taste, Technology, Transformation* (Baltimore, MD: The Johns Hopkins University Press, 2006).

The corn leaf blight of 1970 brings into bold relief the limits and the dangers of the scientific and commercial ideal of genetic uniformity. As Scott notes, immediately before the blight in 1970, 71 percent of all corn acreage was made up of only six hybrid strains. The specialists charged with investigating the blight emphasized the pressures of mechanization and product uniformity that produced a significantly narrower genetic crop base. Most of the hybrids had been developed by the male-sterile method using "Texas cytoplasm," and it was this uniformity that the fungus *Helminthosporium maydis* attacked; those few hybrids not created with the use of the Texas cytoplasm, by contrast, experienced only trivial harm. Ironically, it was a an exotic germ plasm from a rare Mexican landrace that offered a new way to breed hybrids so as to be less susceptible to blight, an exotic germ plasm created and preserved by a long history of informal, nonspecialist landrace development. As Scott (1998: 270) observes, "[M]odern, simplified, and standardized agriculture depends for its existence on a 'dark twin' of informal practices and experience on which it is, ultimately, parasitic."

The conflict between scientific knowledge and local, ordinary (or practical) knowledge is at once struggle for power and a genuine, irreducible debate about epistemology. As Scott notes, scientists' scorn for local agricultural knowledge is in part a *professional* (*i.e., institutional*) reaction – the more the local cultivator knows, the less the importance of the scientist as an intervening agent (see Marglin 1974). If the history of farming in the twentieth-century may be summed up as a process whereby those who knew nothing about farming learned how to profit from it, then scientists have, due to their institutional connections to state governments and large agribusiness corporations, no lesser a vested economic interest in the transformation of agriculture. Whereas farmers are typically open to new technologies derived from scientific experimentation so long as they are practicable, state- and corporate-sponsored scientists are not often receptive to farmers' knowledge, favouring instead the standardized conditions and methods that tend to reproduce and reinforce both state and corporate power.

Underlying and exacerbating this divide, however, are paradigmatic differences between scientists and farmers. The conceit of modern science is that knowledge derived outside of the formal protocols and instruments of science is neither to be trusted nor valued (Fischer 2000). And yet local agricultural knowledge is not easily dismissed. As Scott emphasizes, local farmers have across the world developed a range of efficacious practices regarding crop production, pest control, soil preservation, and environmental conservation. While local farmers may not always fully understand the biological and chemical explanations of why their practices work, they nonetheless know what works and what does not. According to Scott, some of these practically successful local techniques implicate a large, scientifically unwieldy number of interacting variables that lie beyond the reach of scientific explanation. It is in the interest, then, of agricultural scientists, policy makers, and growers to pay more attention to the insights of local knowledge. In agriculture, practice not only precedes theory, it sometimes outstrips it altogether.

Nevertheless, scientific knowledge is canonical in western society. Local knowledge, by contrast, remains a kind of nebulous concept (Fischer 2000). This, however, is true only so long as the distinction between science, on the one hand, and local knowledge on the other is maintained. Alternatively, it is possible to understand both "science" and "local knowledge" as knowledge systems. According to Watson-Verran and Turnbull (1994: 116), while knowledge systems differ as to epistemology, methodology, logic, cognitive structure, and socioeconomic context, the characteristic that all knowledge systems share is "localness." For Watson-Verran and Turnbull, science is less a linear product of rationality than it is an assemblage of local innovations, technical devices, theoretical languages, practical skills, and social strategies. As Fischer argues, what makes science "science" is the process of translating such local practices into categories of a global, universal language (also see Latour 1987).

Science, it turns out, is much like any other creative, constitutive endeavor – it is embedded in a social community and structured by social, political, and economic norms and pressures. Moreover, it is fundamentally a *collective* enterprise, both contemporaneously and historically.

It is crucial, however, to neither confuse nor conflate the two very different meanings of "localness" circulating in the accounts of social constructionists. This distinction may be avoided by considering localness (or "situatedness" generally) to have both an internal and an external dimension. Scientific practice and knowledge is ordinary and *internally* local insofar as it is produced by groups of people deploying social norms and practices. *Internally*, then, science is as local as so-called local knowledge is local. Scientific practice and knowledge, however, may be simultaneously internally local but *externally foreign*, not only in its *claims* for universality, but in the very way (simplified and controlled experimentation) and in the very places (standardized, artificial laboratories) it is conducted. For example, the brand of high modernist scientific agriculture dissected by Scott is at once internally local (local to and embedded in the institutional settings of state- and corporate-sponsored scientists and policy makers) and externally foreign to and disembedded from the local environmental conditions to which actual farmers are highly attuned. It is this latter form of locality that perhaps best differentiates scientific agricultural knowledge and local ordinary knowledge.

The research of van der Ploeg and Douwe (1994) into the local knowledge of Andean potato farmers brings this distinction between external scientific knowledge and local farmers' knowledge into sharper relief. Consider seed combinations. Agricultural scientists of the high modernist paradigm work in the artificial, standardized laboratory conditions of field research stations. Scientists begin with the presumption of an ideal, optimal seed type to be deployed in equally ideal environmental conditions, and proceed to test and verify the proper combinations of seed types and plot characteristics within a given, pre-determined range of parameters. This practice is emblematic of Scott's notion of high modernist agriculture, whereby agricultural scientists are provided with inputs (inputs which are, among other things, highly dependent on fossil fuels) and specifications that derive from neither scientific principles nor local environmental conditions but from corporate fiat.

Andean potato farmers, by contrast, work with actual conditions. Not unlike the real farmers described by farmer and essayist Wendell Berry, farmers who face variable conditions year to year, Andean farmers have to be masters of many possible solutions, one of which must be chosen under pressure at the right place and the right time. They select seeds, then, according to the variable climatic and environmental conditions affecting their land, conditions that they must monitor assiduously and therefore know intimately. Rather than attempting to standardize and control the environmental conditions of the land (as do scientists), Andean farmers, like farmers everywhere else, endeavor to increase the variety of conditions. The open-ended, variable, and highly contingent form of knowledge generated by Andean potato farmers is all but impossible to encode and measure scientifically, but it is precisely this anti-nomological character of local farmers' knowledge that makes it so flexible and adaptable to constantly changing environmental conditions.

Now, because scientifically engineered seeds require standardized field conditions that can be repeated in each field, heterogeneous field conditions are averaged together and then applied to the plots, no matter how different the plots may actually be. Farmers, for their part, must adjust their farming practices to try to instantiate the corporate-scientific models imposed upon them. Lost in this process is the farmers' ability to account for and adjust to a range of differences across fields (differences in, say, soil characteristics, cultivation techniques, even the climatic effects of wind). The scientists working in the Andes do not according to van der Ploeg and Douwe ask the farmers for their input, and the differences across fields are simply averaged out. Uniformity is produced. Farmers are excluded and alienated in favour of outside scientists and the outside state and corporate interests they represent.

As this example evinces, the local, often tacit knowledge of farmers is typically demeaned and dismissed by agricultural scientists representing the interests of large agribusiness corporations. As a result, farmers and farmers' knowledge are marginalized by the corporate-scientific enterprise. The consequences of this marginalization, for farmers and for the rest of society, are profound. Regarding food safety, biodiversity, and environmental conservation, the disembedded foreignness of scientific agriculture as compared to the intimate localness of farmers' practical knowledge is the central analytic terrain of this thesis.

Chapter One: The Lay of the Land

Before commencing my fieldwork, I (along with many other urbanites) was of the understanding that the introduction of GM seed technologies constituted a radical break with past farming practices. Virtually every farmer with whom I spoke, however, whether opposed to or in favour of genetic engineering, maintained that agricultural biotechnology represented merely another step in a continuum of technological developments affecting farming practice. As a result of the insistence of my informants on this point, I began to research carefully the history of farming and plant breeding in the area. In uncovering this history, it rapidly became apparent that the simplistic dichotomy which assumes that GM farm produce is "unnatural" while non-GM produce is "natural" is far too reductionist.

This chapter explores the historical development of farming in the Okanagan Valley from its low-tech beginnings to contemporary modern scientific practices. The lush face of the valley that I grew up taking for granted is the result of irrigation that has been in place for little more than a century. The area is naturally semi-arid, and where there is no irrigation, it is for the most part dry and desert-like. A current exhibit at the Summerland Museum celebrating the efforts and achievements of the early orchardists declares that prior to the arrival of these farmers the land produced nothing but "sagebrush and rattlesnakes." This exaggerated description is more revealing of the tendency of Westerners to construe desert landscapes as "wastelands"[7] than it is of the actual diversity of life that existed in the valley prior to the introduction of irrigation. Oral and written histories, in combination with archaeological evidence, show that the nomadic Okanagan aboriginal bands that inhabited the area prior to European contact

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[7] For more discussion of this see Valerie Kuletz's *Tainted Desert: Environmental and Social Ruin in the American West* (New York: Routledge, 1998).

enjoyed a rich and varied diet consisting of fish, deer, elk, bear and other animals, as well as many wild fruits, vegetables and plants which were used both for eating and for medicinal purposes. The first Europeans and Euro-Canadians to come and settle in the valley did not place a high value either on the desert landscape or on the well-developed body of ecological knowledge about the area possessed by its indigenous inhabitants. Consequently, white settlers had not been in the area long before they began to make changes that radically transformed both the appearance and the dynamics of the local ecosystem.

Part I: Roots and Development

The history of farming in the Okanagan valley began around 1850 with the arrival of the first settlers of European descent (Webber 1999: 167). Archaeological evidence dates human habitation of the area to about twelve thousand years ago. The indigenous occupants of the region, however, were nomadic hunter-gatherers and did not farm (Ibid.: 23). The first non-indigenous person to arrive in the Okanagan Valley traveled down the Okanagan River in 1811 for the Pacific Fur Company. For the next few decades, the Okanagan Valley was used as a route for fur traders between the coast and northern BC. As there were relatively few fur-bearing animals in the region, only a limited amount of fur trading occurred with the Okanagan aboriginal bands. However, European traders did rely heavily on the aboriginal inhabitants of the valley for food, horses and as guides to water sources and safe, efficient travel routes. In exchange for these things, Europeans traded goods such as firearms, steel tools, iron utensils and tobacco (Cannings and Durance 1999: 2).

In 1858 Governor James Douglas proclaimed colonial government on the mainland and in 1860 proclaimed civil authority in the interior. At this time, the

Dewdney Trail was established from Fort Hope to Fort Steele, a development that quickly led to cattle ranching in the Okanagan. Ranching was promoted by the colonial government as a easy and profitable means to begin settling the area. Consequently, from 1861 to 1864, an estimated 14, 000 cattle, sheep, and horses were brought up to the valley from Oregon along the Dewdney trail to graze on the abundant upland grasses. As the animal population of the ranches grew, cereal, feed grains, and hay were grown on the bottomlands (Ibid.: 11). The crops represented the beginnings of the Okanagan farm industry.

Ranching continued to grow until the last decade of the nineteenth century at which time it began to decline. By 1910, almost of the ranches had been sold to developers who invested in irrigation and turned the ranchlands into orchards. These developers tended to be wealthy individuals who bought up enormous tracts of land (in some cases tens of thousands of acres) for low prices. From 1900 to 1920 these tracts were divided for orchards on ten-, twenty-, forty-, and occasionally one hundred-acre lots and open wooden flumes were constructed for irrigation. In order to attract buyers for the plots developers advertised mainly in Western Europe and on the prairies for buyers. Advertisements to prospective buyers described the valley as a "garden of Eden" with "ideal" conditions for fruit farming but warned would-be farmers that they would need to have savings to get them through the eight-to-ten year period before the new trees began to bear fruit (Webber: 167; Cannings and Durance: 1-3).

The pioneer orchardists – a mixture of middle-class English and Scottish immigrants and disgruntled prairie farmers – were able to purchase irrigated land relatively cheaply at a few hundred dollars per acre. As seedlings can take ten to fifteen years to reach full fruit-bearing maturity, the early orchardists often spaced the trees widely and planted ground crops in between the trees in order to ensure some income from the farm. Most early orchardists also kept farm animals and the manure from these farm animals was used as a fertilizer. As almost all of the early orchardists were brand new to the region they possessed very little knowledge about local soil, climactic, and other ecological conditions. The first few decades involved a great deal of experimentation as farmers tried planting a variety of ground crops and fruit trees in order to discover which plants would thrive in the area. During this time relations between settlers and Okanagan aboriginals were growing increasingly tense and there was little friendly social intercourse between the two groups. Thus there is no record of the extensive ecological knowledge possessed by local aboriginals being consulted by white farmers at this time.

Due to the aridity of most of the region, ensuring a secure source of water for irrigation was usually crucial to the success of the orchard. The initial rudimentary irrigation systems proved too insecure for farmers. In 1918, the BC government under the leadership of Premier John Oliver decided to purchase 22,000 acres of Okanagan land in order to give to returning soldiers. The land was purchased from a private owner and in 1920 the government installed a gasoline engine powered irrigation system to service the area (Gray 1989). During the Depression the federal government began to recognize land reclamation as a national matter and gradually assumed responsibility for the irrigation of farmland in the Prairies and in British Columbia. The growth of the irrigation system (entailing the diversion of streams and eventually the damming of lakes) in combination with the creation of a system of private property ownership radically transformed the ecology of the area. The irrigated sections of the valley became lush and green while the non-irrigated sections remained semi-arid. The diversion of the streams and damming of certain lakes disrupted the annual salmon run and also diminished the water supply available to local wildlife. Furthermore, the erection of fences around private property meant that the migrating and foraging habits of many large animals were impeded and the population size of these animals consequently began to decrease.

These ecological changes had a significant impact on the practices of local First Nations communities. Although in negotiations with Governor James Douglas in the early 1860's First Nations peoples were promised access to Crown lands for hunting and fishing as well as to reserve areas sufficient to meet their economic needs, the changing ecology of the region meant that there were far fewer animals and fish to harvest. Moreover, while the original allotment of reserve lands to First Nations was relatively generous and in accordance with their demands, as the colonial government gained strength it began to take away large tracts of these lands. Due to the decline in local wildlife, First Nations people began to farm in ever-growing numbers. An 1881 Canada Census found that only five First Nations families of the sixty-five interviewed still made a living solely by hunting and gathering. The remainder of those surveyed all engaged in agricultural production to some degree. Unfortunately, however, the efforts of these families to farm was made difficult by the insecurity of their land tenure. In addition, First Nations farmers had difficulty obtaining water rights or access to irrigation systems. Under colonial law, only *fee simple* property owners were entitled to water rights, and residence on a reserve did not qualify a person as such. Furthermore, First Nations people were barred from buying land off the reserve and so could not expand their land base or secure water rights through purchase. These discriminatory laws made it difficult for First Nations to meet their own subsistence needs and virtually impossible for them to compete as commercial farmers with white settlers. Angered by these injustices, young aboriginal men threatened on a few occasions to wage war on the settlers but were dissuaded each time by elder leaders who were involved in negotiations with colonial authorities (Webber: 10-14).

The vulnerable and economically dependant position in which First Nations people found themselves by the end of the nineteenth century made them a valuable and easily exploitable source of seasonable labour for white farmers. During the summer harvest months First Nations families camped on the property of white farmers and helped them to harvest their crops at piece-rates. First Nations people used the profits they acquired through this labour to purchase goods such as blankets, tools, and flour that they took back with them to their reserves (Ibid.). Okanagan First Nations members were considered to be desirable pickers because of their ability to remove fruit quickly but gently without doing harm to the tree or plant. While First Nations people were the first demographic group to be used by white farmers as a seasonable labour source, they subsequently employed Chinese-Canadians, Doukhabors, Japanese-Canadians and, most recently, Quebecois workers.

The pioneer orchards in the Okanagan Valley were labour-intensive endeavors that relied on simple technologies and minimal equipment. Horses provided much of the power for tasks such as irrigation ditch-digging and fruit hauling. Many suffered hardship and setbacks due to inadequate irrigation, the planting of fruit tree varieties unsuited to the soil and climate, and various pest invasions. The monocultural planting practices of the early farmers left both fruit and ground crops vulnerable to pest infestation. The worst of these was the codling moth which lays its eggs in fruit and multiplies so quickly that the infestation had reached epidemic proportions by 1920 (Webber: 169).

Many of the hardships that the early orchardists faced were the result of their inexperience in the local ecological conditions. Early on, the orchardists began to petition the government to start an experimental station to generate knowledge on topics such as what varieties were best suited to local soil conditions, fertilizing techniques, pest management strategies and fruit storage and transport. Eager to encourage the development of a commercial fruit industry in the area, the government responded quickly to these requests. The federal government purchased 320 acres of land in Summerland from the Department of Indian Affairs and in 1914 the "Dominion Experimental Station" was opened. The first orchards and an ornamental garden for the enjoyment of the public were planted two years later. Initially, the experimental station was very well received by local farmers, all of whom were relative newcomers to the area and many of whom were also new to fruit farming. In the November 5th edition of the Summerland Review, a report on the town's first agricultural fair reported that the experimental stations display was "one of the outstanding features of the show. It proved to be one of the most popular sections and its lessons in concentrated form on practical farming methods were absorbed by many" (http://res.agr.ca/summer/parc.htm).

The discoveries pertaining to agriculture made through scientific research at the Summerland research centre and elsewhere did not begin to have a major effect on Okanagan farming practices until the 1940's. At this time, the introduction of chemical fertilizers improved soil productivity and yields, while the development of various chemical sprays used for pest and disease control as well as for thinning fruit on trees greatly reduced the need for labour-intensive farming practices. The introduction of various machines for purposes such as ploughing, harvesting and transportation also reduced labour costs and helped to increase the efficiency of farming operations in a variety of ways. In particular, better transportation options expanded markets for farmers and led to less waste due to spoilage. Additionally, improved processing facilities resulted in the creation of a use for 'cull' apples, which could be processed into applesauce, apple juice and as an ingredient in other foods. Finally, in the 1950's and 60's increasingly sophisticated scientific breeding programs led to the development of new varieties, most notably highly productive dwarf varieties which greatly increased total yield per acre and also made picking operations safer and easier (Ibid.; Webber: 168-173).

The major contributions of academic science to Canadian farming have proved a mixed blessing. The efforts of industry and government scientists to create effective, mass-producible fertilizers, herbicides, pesticides, farm machinery, hybrid seeds, and most recently, GM seeds, have (in some cases) aided farmers enormously in boosting the production and salability of certain crops. Whatever their achievements, however, these developments have also resulted in the loss of local traditional farmer knowledge on topics such as soil fertility, weed management, pest control and polycultural growing techniques.

As the level of complexity involved in agricultural technologies increased, Okanagan farmers grew more removed from the day-to-day workings of the experimental station. While in the early days some locals with farming experience but little formal education were hired on at the station to fill positions such as "vegetable foreman," or "orchard foreman," in later days the criteria for hiring became much more stringent. By the early 1960's, applicants to the station were required to have a doctoral degree.[8] At this time, the atmosphere at the station also became more formal. A large modern indoor complex with laboratories and state-of-the-art research and testing equipment was constructed. While formerly all employees had lived on the station, by the 1960's employees were living in neighboring towns and commuting to the station by car. By this time, scientists working at the station had relatively little in common with local farmers in terms of training and daily work life. This was in sharp contrast to the first days at the station when much of the work was manual and most research occurred out-of-doors. In 1981, the employees at the research station chose to design and enter a float in the Summerland parade, choosing as their theme the stereotype of the absent-minded scientist. The float, which featured wild-haired scientists chasing madly after colourful, fizzing test-tubes was popular with locals who came to watch the parade (http://collections.ic.gc.ca/agrican/pubweb/hs340029.asp). This good-natured gesture on behalf of the scientists is revealing of the public perception that had developed of distance and mystery surrounding the work of the researchers at the station.

The early (largely publicly-funded) scientific contributions to agricultural production were welcomed and greatly valued by Okanagan farmers, for the first few decades of fruit farming in the area were fraught with difficulty and setbacks. The knowledge and tools developed by scientists helped farmers better understand local soil conditions and what varieties they best suited, to fight diseases and pest infestations, to reduce the impact of adverse climactic conditions, and to more efficiently grow, harvest, transport and process their crops. Over time, however, farmers began to experience these contributions as a double-edged sword. The powerful chemicals so effective in

[8] With the exception of the support staff who performed cleaning and secretarial work.

combating pests, blight and other problems proved detrimental to the health of other, valued species in the area and sometimes also adversely affected the health of the farmers themselves. In addition, farmers found that as their dependence on off-farm inputs and knowledge increased they began to lose the self-sufficiency and autonomy that they prided themselves on.

Part II: Contemporary Orchards and Farms

Conventional farmers in the Okanagan today are heavily reliant on a range of scientifically-developed off-farm agricultural inputs to help them produce commodities competitively and of a quality consistent with the demands of the market. Frustration over this entrenched dependence has been mounting in recent years, however, as a result of two factors: firstly, the prices for inputs have been rising steadily while prices for agricultural commodities have been falling or remaining stable, creating an income crisis for small farmers; secondly, farmers have experienced a de-valuing of their knowledge as local farm practices have become increasingly standardized in accordance with the directions and regulations that accompany mass-produced fertilizers, chemical sprays, commercial seeds, farm machinery, and other inputs. The resistance of a majority of Okanagan farmers to the introduction of agricultural biotechnology, which is explored further in Chapter Three, cannot be understood outside of this context. In effect, present resistance to genetic engineering can be understood at least in part as the proverbial straw that broke the camel's back. The practice of genetic modification is the culmination of an alchemical process of technological development and corporate ascendancy that has systematically diminished the autonomy of small farmers.

Most orchards growing in the Okanagan Valley today are very different from the region's original orchards both in terms of how they are run and in terms of their aesthetics. Irrigation is now accomplished through the use of pressurized, underground systems funded by the federal government. Pot-holes in which trees are planted are no longer dug laboriously by hand but rather by machine. Trees are not planted from seed. Instead, cultivars from preexisting trees are grafted onto rootstock, usually of a dwarf variety. Nitrogen-based fertilizers are applied to the soil in which the trees are planted at various stages in their development in order to enhance growth. Chemical sprays are applied to the leaves and branches of the trees using a machine attached to a hose in order to fight diseases and pests and to aid in thinning. Human labour is usually employed to harvest the fruit, but in some cases farmers use picking machines if pickers are in short supply or if labour costs are too high. The fruit from the trees is then transported to packinghouses by truck where they are sorted by computers according to colour and firmness and then stored in temperature-controlled warehouses before being resold. In addition to these changes in the day-to-day operations of orchards, the outward appearance of orchards has also changed greatly.

In the town of Salmon Arm at the north end of the valley, for instance, a few old-fashioned orchards with full-sized trees reaching about twenty feet high planted roughly one hundred per acre still exist. More common, however, are compact modern orchards planted with dwarf trees (no higher than seven or eight feet) at a density level that ranges from 1,200 to 2,000 tree plantings per acre. These dwarf varieties are bred for high yields and the weight of the fruit is usually too heavy for the tree to support; this situation means that farmers have to support each tree with an elaborate fence system. The Canadian government has encouraged fruit farmers to switch to high-density orchards in order to increase the productivity of available land. Some farmers have taken advantage of the government-funded Okanagan Valley Tree Fruit Replant

Program that subsidizes the costs involved in replacing full-size fruit trees with dwarf varieties.[9] Laura Keegan and her husband James Keegan, both in their early 30's, took advantage of this program in 2001, chopping down old trees and digging out the stumps and root systems in order to make room for the new, modern varieties. In 2004, they were still waiting for the replaced plantings to bear fruit – a process that normally takes four-to-five years for dwarf varieties. In the meantime, James was working full-time as a long-distance truck driver while Laura worked as a recess and lunch-time school yard monitor at one of the local elementary schools. They were both looking forward to spending more time working on the farm and less at their respective jobs. They expect, however, to retain part-time off-farm jobs even after the trees have reached fruit-bearing maturity in order to help make ends meet.[10]

The many inputs that fruit farmers use in order to make their farms run more productively and efficiently come at high cost. Over the years, the prices of these inputs have steadily risen despite the relatively low and sometimes volatile prices that farmers receive for their produce. The income crunch experienced by Okanagan farmers in recent years has been only minimally alleviated by government subsidies. In a stated effort to comply with international obligations under free trade agreements such as the North American Free Trade Agreement (NAFTA) and the Agreement on Agriculture under the World Trade Organization (WTO), the Canadian government has been scaling back the amount of aid it provides to farmers. In 1999, then-provincial agriculture minister Corky Evans declared that Okanagan farm income levels had reached a "crisis point" but said that the government was unable to assist farmers aside

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[9] For more information on this program, see http://72.14.207.104/search?q=cache:OWoPKGYcu-sJ:www.iafbc.ca/orchard/pdf/orp-replant-guidelines.pdf

[10] Interview with Laura and James Keegan, July 17, 2004.

from offering low-interest loans to farmers to purchase the inputs needed to produce the years next crop of fruit (Wilson 1999: 10). In order to meet rising costs, many farmers – like James and Laura – have taken off-farm jobs in an attempt to make ends meet. In the Okanagan today, 85-90% of farmers perform at least some off-farm work to help pay their bills (http://www.legis.gov.bc.ca/CMT/36thParl/CMT08/hansard/1999/af102799.htm). While many farmers continue to struggle to stay in business by taking loans and doing work off the farm, many have given up and abandoned farming. In the 1970's, there were over 24,710 acres of fruit trees planted in the Okanagan. Today there are only 17,665 (Ibid.).

The economic difficulties that Okanagan fruit farmers are currently facing are not the result of a lack of productivity, efficiency, or demand. Over the years, Okanagan fruit farms have grown increasingly productive. According to provincial government statistics, last year the region's 12,000 growers on 17,665 acres of land produced 275,000,000 pounds of apples, 6,100,000 pounds of cherries, 15,800,000 pounds of cherries, 12,000,000 pounds of peaches 2,000,000 pounds of apricots and 1,300,000 pounds of plums. These numbers represent one of the highest per-acre yields in the region's history. From the sale of these crops growers generated $58,757,000 in farm gate profits (www.agf.gov.bc.ca/treefrt/profile/ind_profile.htm). In spite of the high yield of fruits per acre and no shortage of buyers, many of the region's fruit farmers are struggling financially. The high costs of fertilizers, chemical sprays, machinery and upkeep, fuel, support stands for dwarf trees, and other expenses for off-farm inputs mean that the prices farmers receive for their fruits are often barely enough to cover expenses *before* factoring in labour costs. In addition to high input costs, farmers have relatively little power in setting prices for their fruit because buyers are increasingly large companies that dominate the market to such an extent that they are able to influence and in some cases virtually dictate the prices at which fruits are sold (Heffernan 2000).

After listening to several farmers' reports of the heavy financial stresses that their farm enterprises involved, I began to ask them why they chose to remain in the business. Most of those I posed this question to told me that it was a way of life they cherished and were loathe to give up. Many conceded though, that the almost constant financial worry was taking a serious toll. One farmer joked to me that he's told his teen-age sons that if they hope to stay in farming that they better plan to marry rich.[11] Another farmer told me that he'd done exactly that – his wife is a lawyer and her income keeps the ten-acre mixed crop farm the couple lives on viable.[12] Beneath the joking, however, there runs a sense of bitterness and betrayal. These farmers work long, hard hours and their farms are more productive than they have ever been before. Yet despite these achievements, they are barely breaking even and in some cases losing money on their farms.

In 2005 the Canadian National Farmers Union (NFU) released a report on the farm income crisis claiming that the problem had reached an "excruciating intensity." The report observed that 2004 was the second worst year in history for the net income of Canadian farms. That year, the Realized Net Income from the market (a number that excludes government payouts) was *negative* $10,000. The only year that was worse was 2003, when farmers' realized net income was negative $16,000. In stark contrast to the economic hardship experienced by family farms, for the agribusiness corporations

[11] Interview with Rod Styke, August 26, 2004.
[12] Interview with Anonymous farmer, August 5, 2006.

dominant in Canada who sell off-farm inputs and purchase farm products for processing and retail, 2004 was the *best* year in their history, with profits hitting record highs. The NFU report looked at agribusiness corporations all along the food chain. According to the report, of the seventy-five corporations profiled in the study, 57 (76%) had their best year or nearly their best year while none had record or near record lows. The report also looked at the profits of agribusiness corporations all along the food chain, beginning with oil companies, then proceeding to fertilizer companies, agro-chemical companies, seed companies, veterinary drug makers, farm machinery companies, banks, rail roads, food processors, meat packers and cereal companies. In analyzing the link between the record profits made by a majority of agribusiness companies and the record losses suffered by family farmers, the NFU report concluded that there was a strong relationship between the two. In particular, the report argued that agribusiness corporations were using a range of strategies including cost externalization onto farmers, pricing power, fostering farmer dependence on inputs, and destroying non-corporate competitors.[13]

The NFU report backs up the conviction of many of the farmers I interviewed that their hard-earned profits are being "stolen" by the agribusiness corporations. The animosity that farmers feel towards big agribusiness companies is coupled with a feeling of bitterness towards the government, which they feel has sold out their interests in order to serve those of corporations. Understanding small farmers' present dislike of the government and big business and the reasons behind this dissatisfaction is crucial to understanding farmers' perspectives on GMLO's. Because the high cost of inputs is

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[13] "The Farm Income Crisis" (2006), The National Farmer's Union, available at http://www.nfu.ca.

putting an unbearable strain on many farms, most farmers are looking to decrease their reliance on inputs and are therefore extremely wary of creating a new dependence

A number of scholars have commented on the loss of autonomy that small farmers have experienced as a result of the industrialization of agriculture. For example, in his well-known study on "The Maturing of Capitalist Agriculture," R. C. Lewontin argues:

> The farmer becomes a mere operative in a determined chain whose product is alienated from the producer. That is, the farmer becomes proletarianised. It is of little import that the farmer retains legal title to the land and building and so, in some literal sense, is the owner of some of the means of production. There is no alternative economic use for these means. The essence of proletarianisation is in the loss of control over one's labour process and the alienation of the product of that labour (Lewontin 2000: 96-97).

In the Okanagan Valley and the rest of Canada, small independent farms find themselves in an ever-weakening bargaining position. The growing strength and concentration of agri-business corporations located both "upstream" (inputs) and "downstream" (wholesalers and retailers) from farms mean that farmers have very little ability to negotiate terms. A recent report released by a non-governmental organization called the Action Group on Erosion, Technology and Concentration reports that levels of concentration among agribusiness corporations have reached unprecedented levels recently, due to a series of mergers and acquisitions. For example, in the input sector for 2004, the report shows that in seeds the top ten companies control nearly half of the global commercial seed market, in pesticides the top ten firms control 84% of the global pesticide market, and in biotechnology the top ten publicly-traded biotech companies account for nearly three-quarters of the global biotech market. In terms of purchasers of farmers' produce in 2004, the top ten global food retailers accounted for 24% of the of the global market, while the top ten food and beverage processing companies also account for 24% of the global market.[14] The sheer size and purchasing power of these companies means that farmers typically have little choice but to pay the prices for inputs that companies demand and accept the crop growing terms and low prices that purchasers offer for their produce. The vast disparity in bargaining power between farmers and agribusiness corporations provides much of the explanation for why farmers are experiencing an income crisis at the same time that a majority of the dominant agribusiness corporations are experiencing record or near record profits.

Rural sociologist Jack Kloppenburg argues that the "proletarianisation" of the farmer has been an intentional process gradually achieved through ensuring farmer dependence on off-farm inputs with the effect of sometimes enhancing production and nearly always enhancing control. He writes that:

> The productive activities that are taken off-farm are not just any activities; they are those that reproduce the farmer's means of production. To the extent that the provision of seed, motive power, etc. is undertaken by capital and not the farmer, the autonomy of the petty commodity producer is eroded. The means of production come to confront the farmer as commodities- they can be purchased but they cannot be autonomously produced" (Kloppenburg 1988: 34).

Public support for industrial agriculture with its attendant high use of off-farm inputs has been achieved largely through the strength of the argument that it greatly increases productivity and yields. Critics, however, argue that as a society we need to support the exploration of a range of strategies to increase productivity, not merely strategies that promise profits to agribusinesses. Linda Edwards, an organic farmer from Cawston BC, expressed frustration in an interview that the Canadian government directs almost all of its public funding into agricultural research that is tied to the use of industrial inputs,

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[14] "Oligopoly, Inc. 2005," available at www.etcgroup.org.

while leaving organic farmers virtually without assistance. Edwards believes that "[i]ncreased productivity is not only achieved through the use of industrial inputs. There are many alternative techniques and technologies that could be pursued in order to increase productivity."[15] Given the potential benefit to farmers, consumers, and the environment that alternate techniques might offer, she feels that the government has a responsibility to diversify the types of agricultural research it supports.

[15] Interview with Linda Edwards, August 8, 2004.

CHAPTER TWO: SEED SAVING AND INTELLECTUAL PROPERTY RIGHTS

Part I: Traditional Seed Saving Practices

Farmers in the Okanagan Valley and elsewhere around the globe play a vital role in protecting and cultivating agricultural genetic diversity. While GM seeds and certified seeds developed by professional plant breeders are readily available on the market, many farmers continue to plant and save their own seeds. Robert McCormett, a Salmon Arm farmer with a 20-acre farm that produces mainly sweet corn along with peas, carrots, potatoes, beets and a few other vegetables, has been saving his own corn seed for the past twenty years. According to McCormett, most farmers in the area who grow sweet corn rely on certified hybrid varieties which do not breed "true" and must therefore be re-purchased from a seed seller every growing season. Both because he prefers the taste and texture of his own varieties and because it lessens his operating costs, he saves his own seed and uses it to sow future crops. McCormett does not harvest corn for seed. Rather, every four or five years he sets aside a cob of corn from roughly a hundred plants of each of the three sweet corn varieties he grows. He pulls the husks partway down the cobs and then allows them to dry out for two-to-three months. At the end of this time he removes the husks completely and then removes the dried kernels from the cobs and stores them in mice-proof containers until he is ready to sow them.[16]

While the seed-saving efforts of McCormett and other farmers around the world play an important role in cultivating agricultural diversity and generating plants that are uniquely adapted to local conditions, they also pose an obstacle to seed companies that would like to see farmers purchasing new seed every year. Under

[16] Interview with Robert McCormett, Farmer, July 14, 2004.

Canada's Plant Breeder's Act, which was enacted in 1990,[17] farmers are allowed to save certified seed for use on their own farms and to share or barter with other farmers, but they may not resell the seed. Thus, unlike fertilizers, herbicides, and pesticides that must be purchased afresh each year, seed is an input which farmers in theory need to purchase only once. Seed companies have long been interested in devising strategies to discourage farmers' from saving seed. Until recently, however, the only strategy available to seed companies was to focus on the development of hybrid seeds, which possess attractive characteristics but which do not reproduce and must therefore be purchased on an annual basis.

By saving and replanting seed taken from the healthiest plants on their own farms, farmers create plants with characteristics that are uniquely adapted to the soil, climate and pest conditions on their own farms. In contrast, large, centralized plant breeding systems based in laboratories or experimental stations generate uniform varieties that are not adapted to specific local conditions. They are designed for general conditions that are not naturally present on most farms. These uniform varieties typically require the addition of irrigation, synthetic fertilizers, pesticides, and herbicides in order to create the necessary growing conditions. While certified seeds produced

[17] The first Plant Breeder's Rights (PBR) Act in Canada was not adopted until 1990. This act, which is still in force today, is based on the original version of the International Convention for the Protection of Plant Varieties (UPOV) which was signed in 1978 and covers only the unauthorized commercial propagation of protected plant varieties leaving farmer seed saving and further breeding with protected varieties outside of the scope of the act. Although many seed industry lobbyists felt that the Act did not go nearly far enough, many felt that it was nonetheless an important first step. As Devin Kuyek argues, the Act is important because it establishes a basic legal framework that can tightened incrementally. In 1998, the federal government introduced a bill to amend the Act in order to bring it into conformity with UPOV 91. The proposed bill, which would have substantially limited farmers' ability to save seeds was not passed, but the government has since been working with industry to re-introduce the proposed amendments. The original bill was based on UPOV 91: it placed restrictions on further breeding; gave breeders rights over harvests and the exclusive right to "condition propagating material of the plant variety for the purpose of propagating the plant variety"; and limited farmers' rights to "the use of harvested material of the plant variety grown by a farmer on the farmer's holdings for subsequent reproduction by the farmer of the plant variety on those holdings." Bill C-80- Plant Breeder's Rights, 1998. For more information on this topic, see Kuyek (2004).

through modern scientific plant breeding practices are often described as "high yield," they are sometimes also referred to as "highly-responsive" because they usually respond very well to off-farm inputs but are usually much less productive in their absence.

As with early seeds developed through Mendelian plant breeding techniques, GM seeds are closely tied to agrochemical inputs. The three dominant ag-biotech companies – Monsanto, Bayer and Syngenta – are all former agrochemical companies and most of the GM seeds currently on the market are linked to agrochemical inputs (http://www.ipcb.org). For example, Monsanto's Round-Up Ready (RR) Canola, which is genetically-engineered to be resistant to the company's glyphosate-based herbicide RR, was developed in large part to ensure a continuing market for the herbicide, which went off-patent in 2005. Although Round-Up Ready (RR) canola has been marketed as a technology which will enable farmers to use less spray overall, the truth of this claim has been disputed at least as concerns the long-term use amount, because invasive weeds in RR canola fields develop resistance to the herbicide typically within a few generations (Déchant 2001).

While high-yield/highly-responsive varieties are at present the most commonly available seeds on the market, there is a small movement growing that is attempting to encourage a renaissance of heritage seed varieties. One person active in this movement is Hugh Baylor, a young man of about thirty whom I chanced to meet one day while waiting to interview a husband-and-wife organic farming team in Sorrento, BC. Baylor, who is based on the gulf islands, was traveling through the Okanagan Valley selling heritage variety seeds door-to-door and running workshops for farmers and interested gardeners on how to save your own seed. He told me that he had been raised on a conventional potato farm on Prince Edward Island but had grown concerned about the dwindling of agricultural genetic diversity while doing a master's degree in plant sciences at the University of Saskatchewan. Three years ago he began his own fledgling heritage seed business. He says that while the enterprise is only marginally profitable, there is a growing interest amongst small farmers in seed saving and in reducing dependence on inputs. While most of his sales are to organic farmers and farmers interested in switching to organic production, Baylor says that some conventional farmers along with home gardeners also purchase his seed. He also said that the consumer backlash against genetically-modified foods has helped to generate interest in heritage varieties of fruits and vegetables which are GMO free.

Through leading workshops on effective seed saving methods, Baylor believes that he is helping to preserve and promote an important aspect of farmer's knowledge. He argues:

> An incredible amount of agricultural knowledge has been lost already. We need to be vigilant about protecting the remaining rural ecological knowledge that farmers possess. If we want to protect agricultural biodiversity now and in the future, its not enough to have seed banks. We must also preserve farmers' knowledge of how to cultivate agricultural genetic diversity. Some of the big seed companies, the ag-biotech companies in particular, don't want farmers to have this knowledge because they want farmers to depend entirely on their seeds in order to grow their crops.[18]

The usurpation of farmers' control over seeds and the corresponding loss of ecological knowledge has occurred incrementally over the past one hundred years but has accelerated in the last two decades. Prior to the 20th century, farmers carried out nearly all plant breeding. Through experimentation and selection, first indigenous farmers and later settlers identified and adapted a diversity of agricultural plant varieties that today serve as the basis for North American agriculture (Madely 2002: 6-11). The state only became actively involved in the process near the end of the twentieth century.

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[18] Interview with Hugh Baylor, August 14, 2004.

The first public plant breeding programmes in Canada focused on further increasing the agricultural biodiversity base through the distribution of foreign varieties to farmers for experimentation and adaptation. Varieties were collected from around the world and then grown on Canadian experimental stations. Seeds from these plants were then collected, put into packets and distributed freely to farmers across the country for testing, selection and multiplication (Kloppenburg 1988: 56-57). These seed distribution programs were highly popular with farmers. In 1895, the first year of the program, the government was swamped with 31,000 requests from farmers for seed. In 1896, the government distributed 35,000 packets of seeds to interested farmers to experiment with. Thus in the early stages of state involvement, farmers continued to play an integral and innovative role in the development of new plant varieties (Kuyek 2005: 43).

Over the course of the next few decades, Canadian plant breeding programmes[19] underwent a critical change in direction. Gradually, the free seed programmes that sent out a diversity of varieties for farmers to select from were replaced by a centralized and regulated seed research and production system that focused on releasing "elite" varieties developed by scientists. These elite varieties were considered "finished," and as a result of this change the site of plant variety development shifted from the farm to the research station. Along with the shift in the site of development came an ideological shift. In the early stages of state involvement in plant breeding, the practice was dominated by a Darwinian approach known as gradualism (or biometrics) and was in essence a continuation of the traditional selection practices of farmers. Following this

[19] My discussion of the history of plant breeding in Canada is deeply indebted to the excellent research done on the topic by Devin Kuyek both in his MA thesis "Reaping What's Sown: How the Privatization of the Seed System Will Shape the Future of Canadian Agriculture" (2005) and in his book *Stolen Seeds: The Privatisation of Canada's Agricultural Diversity* (British Columbia: The Ram's Horn, 2004).

approach, plant breeders selected plants from a large population and then randomly cross-pollinated them. The gradualist school was primarily concerned with quantitative traits that are controlled by a complex of many genes. For example, if a red and a white flower are crossed, the progeny will show all degrees of pinkness from red to white, but most will be of a colour mid-way between the two parents. The major problem for the gradualists, however, was that they were unable to explain the inheritance of qualitative traits – those traits which are controlled by single genes and which are either present or absent in a plant, with no degrees in between (Ibid.: 44-51).

A group of leading scientists seized on this knowledge gap in the biometric school and attempted to argue that this hole invalidated the school entirely. In its place, these scientists supported an approach to plant breeding based on a Mendelian understanding of genetics, whereby individual genes were assumed to be responsible for particular traits. Kloppenburg points to the personal stake that the scientific community had in supporting the Mendelian approach. Gradualist methods simply extended traditional on-farm selection methods, they could be refined and taken up by scientists, but they could also be carried out by, or in collaboration with, farmers on farms. In fact, the gradualist approach was most effective when undertaken by many people working in many locations.

The eventual rise of the Mendelian approach shut both farmers and their farms out of the plant breeding process to a large extent. Under the Mendelian school, the focus of plant breeding shifted from plant varieties to plant genes and from adapting new varieties to improving established ones (Kloppenburg 1988). Scientists collected plant varieties from farmers' fields that possessed genes for traits of interest, then transferred the desired genes to their established or "elite" cultivars, and finally sent these "finished" varieties out to farmers. Periodically a new variety would be released to replace the previous one. Farmers' fields thus came to serve a dual and arguably conflicting purpose: they served both as a source of genetic resources for scientists to use for plant breeding and as a site to adopt new elite cultivars bred by scientists. Ironically, however, the more successful and widely adopted the new cultivars became the less genetic diversity that remained available in farmers' fields. This paradox did not spark a fundamental change in approach. Instead, gene banks assembled and controlled by scientists were set up to preserve some of the diversity that was rapidly disappearing from farmers' fields. As a consequence of this system, public scientists secured a high level of control over plant breeding decisions (Kuyek 2005: 39-42). Although farmers were largely excluded from the official plant breeding system, they continued to play an important role in the larger seed system by multiplying, distributing and saving seeds and thereby continued to exercise a high level of independence within the seed system.

Part II: Agricultural Biotechnology and Intellectual Property Rights

As Kloppenburg notes, the most obvious impediment to capital's expansion into plant breeding is the biological ability of plants to reproduce (Kloppenburg 1988). Profit-oriented seed companies, since their emergence into the Canadian market in the 1980's, have aspired to limit farmers' ability to multiply, save and distribute seed to their colleagues. Prior to the emergence of patent-protected GM seed technologies, however, seed companies were only able to achieve this goal in a limited way through the sale of hybrid seeds that possess qualities not found in regular seed but that are unable to reproduce as a result of their hybrid nature. Farmers who choose to plant these seeds enjoy their special qualities but must repurchase them each season rather than saving and replanting seeds from the harvested crop. Because of the strong intellectual property rights protection that GM seeds enjoy, sellers of GM seeds are able for the first time in Canada to contractually forbid farmers from saving the seeds of GM crops. Farmers who purchase GM seeds must first sign a "Technology Use Agreement" that restricts their use of the seed for food crops only. Furthermore, companies selling GM seeds can sue any farmer with GM plants on his or her property who has not paid a technology use fee that year for patent violation.

The growth and development of the ag-biotech industry as a whole has been greatly assisted by the implementation of strong intellectual property legislation to protect biotechnological inventions. In Canada, patents are permitted at the microbiological level but cannot be taken out on higher organisms such as plants or animals. This rule was effected by a 2001 Supreme Court decision (Harvard Oncomouse v. Commissioner of Patents) which refused a patent on a GM mouse on the basis that it was not appropriate for the judiciary to determine whether higher life forms are patentable. Famously, Justice Bastarache stated:

> The choice we are urged to make is a matter of high policy for resolution within the legislative process after the kind of investigation, examination and study that legislative bodies can provide and courts cannot. That process involves the balancing of competing interests and values, which in our democratic system is the business of elected representatives. Whatever, their validity, the contentions now pressed on us should be addressed to the political branches of the Government, the Congress and the Executive, not the courts.[20]

The final vote on the case was contentious, however, with five judges against issuing the patent and four in favour. Justice Binnie, writing the minority's dissent, argues that in order to stimulate innovation in the fields of medical and agricultural biotechnology a financial incentive must be provided. He writes: "We must feed the goose that lays the golden eggs" (Ibid.: 14). In writing for the majority, however, Bastarache addresses this

[20] *Harvard College v. Canada (Commissioner of Patents)*, [2002] 4 S.C.R. 45 at paras. 169, 206.

argument by countering with a concern for farmers' rights to save seeds and the need to protect "innocent bystanders" from involuntarily committing patent infringement by unknowingly growing GMLO's on their property (Ibid). Bastarache's concern over the continued legal protection of Canadian farmers' privilege to save seed may be understood in part as a desire to ensure that farmer's ability to contribute to informal plant breeding be preserved.

The Harvard Mouse ruling sets Canada apart from other Western countries whose court systems approved patents on higher GM life forms in most cases without direction from elected governments. However, the Canadian parliament has yet to draft, let alone pass, legislation explicitly dealing with this question. In the meantime, the issue has become even murkier as a result of the Supreme Court's ruling in the summer of 2004 on the case of Schmeiser v. Monsanto. In this case, the court ruled that Monsanto's patent over a glyphosate-resistant gene in a canola plant confers ownership rights over the entire organism, a move which some argue renders meaningless (*i.e.,* reverses) the finding in Harvard Mouse that higher organisms are excluded from patentability.

The Schmesier case has been much publicized in Western Canada and was paid close attention by many farmers. Of the farmers that I interviewed, all except one had some degree of familiarity with the case. For this reason, it is useful to briefly outline the facts of the case. In March of 2001, a seventy-one year old Saskatchewan farmer, Percy Schmeiser was found guilty by the Federal Court of Canada of infringing upon Monsanto's patent on its RR canola seed; Schmeiser had been growing canola in Bruno, Saskatchewan since the 1950's and the last time that he claims to have purchased seed was in 1993. In 1996, Monsanto introduced its RR canola, genetically-modified to withstand the company's popular herbicide thus allowing growers to spray canola fields with the herbicide to kill the weeds but leave the canola unharmed. Two years after the introduction of RR canola, Monsanto's private inspectors found RR canola growing in Schmeiser's fields.

During the trial, Schmeiser testified that he had not intentionally obtained Monsanto's canola seed and that contamination of his fields must have occurred through an accidental road spill of RR seed or cross-pollination from neighboring crops. He further testified that he had not benefited from the presence of GM canola in his fields since he had neither sprayed them with Monsanto's herbicide nor sold the canola as seeds to other farmers. Monsanto's lawyers did not contest these claims. Federal Court judge A. MacKay, however, ruled that these claims were not relevant in determining whether or not patent infringement had occurred. Thus, although Schmeiser was not accused of fraudulently obtaining seed or illegally reaping the benefits of "stolen" technology, he was nonetheless found guilty of patent infringement on the basis that (1) he knew or ought to have known that his fields had been contaminated with Monsanto's RR gene; (2) that he had failed to alert Monsanto officials of that fact; and (3) that he had saved and replanted canola seeds containing the RR gene. Judge MacKay ordered Schmeiser to pay Monsanto royalty fees for use of the technology plus the value of his crop and an additional sum in punitive damages. Furthermore, Schmeiser's entire canola crop was confiscated, which meant that he also lost the improved genetics resulting from his lifelong practice of saving his own seed. Schmeiser appealed the ruling at the Supreme Court. In a narrow 5-4 judgment, however, the original ruling was confirmed, the only exception being that the punitive damages were revoked.

While Percy Schmeiser lost the genetics to the canola seed that he had been breeding for over fifty years, organic canola farmers in Saskatchewan whose crops were contaminated by Monsanto's RR gene fared even worse. Because organic certification requirements do not permit any level of GM content in the crops, organic farmers whose canola fields became contaminated were unable to sell their crops as organic. In 2002 the Saskatchewan Organic Directorate (SOD) filed a class-action lawsuit on behalf of all Saskatchewan organic grain growers against Monsanto and Aventis Crop Science alleging that the level of contamination of GM canola in organic farms was so high that it was virtually impossible to continue to grow canola as an organic crop any longer. As proof of the extent of the damages suffered by organic farmers, SOD alleges that organic farming is one of the few ways that the family farm in Canada can now survive due to the low input costs and premium prices for commodities. The SOD also successfully petitioned the government to block the release of GM wheat into the Prairies, arguing that to do so would be to destroy organic grain production in the region altogether.

The foregoing cases are but the most recent indications of how, over the past one hundred years, the role that farmers play in plant breeding has undergone a transformation. While one hundred years ago farmers were the primary developers of new plant breeds, today that role has been usurped by government and industry scientists. Due to the farmers' privilege to save seed under the current PBR Act, Canadian farmers continue to play an important role in contributing to agricultural genetic diversity. However, farmer's ability to continue to play this role is threatened by the lobbying efforts of the seed industry to restrict farmers' ability to save seed.

CHAPTER THREE: OKANAGAN FRUIT FARMERS AND THE FIGHT TO KEEP GM FRUIT TREES OUT OF THE VALLEY

All of the Okanagan farmers that I interviewed were familiar to some degree with the Percy Schmeiser case and the related issue of contamination of non-GM fields in Saskatchewan with volunteer GM canola; their knowledge of these issues played an important role in shaping their response to the proposed introduction of GM fruit trees into the area. Many of the farmers that I spoke with had a sibling or another relative farming in the prairies and so had an intimate personal connection to the changes that have unfolded there as a result of the introduction of GM crops into the area in the mid 1990's. The organic farmers in particular were deeply worried over the demise of organic canola production in Saskatchewan as a result of GM contamination and fearful that a similar scenario could arise for fruit farmers in BC.

Linda Edwards, the organic fruit farmer who played a leadership role in opposing the field-testing of GM fruit trees in the Okanagan, has both a brother and a cousin who farm in Saskatchewan. Her brother is a conventional farmer who adopted GM canola hoping to reduce his herbicide expenditures while her cousin is an organic farmer like herself. Edwards' brother found himself no further ahead financially as a result of his decision to adopt GM canola because although his herbicide costs were lower, the extra costs he had to pay as a "technology use fee" for the GM canola ate up the savings from the herbicide. In the meantime, her cousin, along with virtually every other organic grain producer in the province, was forced to discontinue his production of organic canola due to endemic GM contamination. In 1999, upon hearing that the

Summerland research station had begun field-testing GM apple trees, she grew concerned and began to speak about the matter with other farmers.[21]

The GM fruit trees developed at OBI and the Summerland research station are modified to prevent the flesh of fruit from browning when exposed to air. An Australian scientist initially identified and isolated the gene responsible for causing browning in fruit – the polyphenal oxidase (PPO) gene – and applied for a patent to protect the discovery. The Australian scientist later sold this patent to OBI and the Canadian government, who subsequently worked together using precision-breeding techniques to silence the expression of this gene in apples and other fruits.[22] On a Canadian government promotional website, the non-browning apple, which has been named "Eden," is described as "a pure white apple straight from paradise." The website boasts: "The flesh of a perfect apple would be aromatic, sweet, juicy, firm and crisp, *but most of all would not turn brown after being cut.* Such a fruit now exists, thanks to a team of Agriculture and Agri-Food Canada scientists . . ." (http://www.agr.gc.ca/cb/index_e.php?s1=tip-puce&s2=2006&page=05 [emphasis added]). The OBI website describes the non-browning technology in more moderate terms, noting that the browning of the flesh of apples and other fruits when exposed to oxygen is generally considered an "unattractive trait" and stating further that the companies' belief that the non-browning technology will act as a "consumption trigger" for consumers due to the enhanced appearance of the fruit. OBI envisions that fruit growers using the technology could market the fruit as a specialty product to fresh-cut fruit retailers, who could use the non-browning fruit to sell in pre-packaged fruit salads or as a desert in restaurant and hotel buffets

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[21] Interview with Linda Edwards, August 8, 2004.
[22] Interview with Dr. David Lane, August 23, 2004.

(http://www.Okanaganbiotechnology.com/market-impact.php).

The concern of Linda Edwards and some other farmers opposed to the field-testing of the non-browning technology in the Okanagan Valley was that if through the natural pollination process bees were to transfer DNA from the GM trees to conventional and organic orchards, farmers might lose both organic certification and therefore access to markets both in Canada and abroad as a result of the contamination. Organic consumers will tolerate no level of GM contamination and so the possibility that bees, which can fly distances of up to several kilometers, might cross-pollinate organic orchards with pollen from GM trees poses a serious threat. The potential for lost markets also exists for conventional fruit farmers because a significant portion of Okanagan fresh fruit, fruit juices, and other fruit products are exported to Europe and Japan each year. If conventional Okanagan orchards are thought by consumers in these countries to be possibly contaminated, then the markets for these products are likely to dwindle. In Saskatchewan, conventional canola growers lost EU export markets amounting to approximately $300 million annually as a result of contamination by GM crops (http://www.annieappleseedporject.org/seedofdoubs.html). Following the verdict in the Percy Schmeiser trial, farmers were also legitimately concerned that if a patented gene or property were to appear in fruit grown on their property – however unwanted and unwelcome – that they could be sued and found guilty of patent infringement.

In 2001, with the support of a number of other fruit growers, Edwards was successful in persuading then-provincial agricultural minister Corky Evans as well as some of the scientists from OBI and the Summerland research station to meet with her and other farmers to discuss the potential impact on organic and conventional growers of releasing GM trees into the local ecosystem. At the meeting, farmers expressed fears that the GM fruit trees growing at the research station for test purposes could contaminate their own orchards. Bees can pollinate trees for distances of up to four or five kilometers. According to Edwards, any blossom on a non-GM tree pollinated by a bee that has just visited a genetically engineered one will produce fruit that will test positive for genetic modification. The seed of fruit pollinated with pollen from a GM tree will contain the transformed DNA and the vectors used to put it there. Although the fruit itself might contain no foreign DNA, other changes could occur such as changes to nutrient content or toxin levels. One of the engineered pollen nuclei helps to form the endosperm that produces the hormones and growth regulators that catalyze and regulate development of the fruit tissue.[23]

All the farmers who attended the meeting were worried that the potential for contamination could lead to the loss of important markets in GM food-averse countries, particularly the European Union and Japan. The organic growers were also concerned that they might lose their certification, because in order to be certified organic, a producer must be certain that his crops are GM-free. As a result of this meeting, Corky Evans contacted the federal agency responsible for approving permits to field test genetically-modified crops and asked that the permit for GM fruit trees in the Okanagan be revoked until such time as it could be guaranteed that contamination would not occur or that there would be no adverse consequences to farmers if it did occur. The federal agency complied with this request and the farmers were satisfied with this outcome, at least in the short term. The trees, however, have been field-tested

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[23] Linda Edwards, e-mail communication, May 2004. Available at http://lists.ibiblio.org/pipermail/permaculture/200-May/011097.html

in other locations and, according to OBI's website, the technology will be available on the market as of 2010 (www.Okanaganbiotechnology.com). As of 2010, any local grower who wants to purchase the technology will be able to do so, irrespective of the wishes of other farmers in the area.

As Canadian government regulation currently stands, GM seeds cannot be denied regulatory approval on the basis that they may harm other growers' markets or create tension in rural communities (Mehta 2005).[24] They can only be denied on the approval of scientifically proven health and environmental considerations. However, newly introduced GM varieties are virtually certain to contaminate other varieties, even when precautions are taken (Danish Institute of Agricultural Sciences 2003). This poses a challenge to the current regulatory system. Presently, the Canadian government agency responsible for approving new varieties can only refuse to authorize a GM variety if it can demonstrate that the variety presents absolutely certain environmental and health risks. Under the existing regulatory framework for GM crops, which is based on the principle of "substantial equivalence," there is no scope for refusing to register varieties modified with today's commercially available GM traits. A GM crop can be prohibited neither on the ground that it can cause economic losses to farmers nor on the ground that it can cause other socio-economic problems through the contamination of crops (Kuyek 2004: 78).

Over the past decade, the governments of Japan and the EU have imposed a virtual moratorium on the importation of GM foods due to concerns over possible health and environmental consequences. In essence, these countries have justified the

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[24] For more information on the regulatory process for GM plant varieties in Canada see "Made to Order: Regulation," ch. 9 of Brewster *Kneen's Farmageddon: Food and the Culture of Biotechnology* (British Columbia: New Society Publishers, 1999).

moratorium on the basis that not enough testing has been done to ensure the health and environmental safety of the products of GM food technologies. In Canada and the US, government regulators use the doctrine of "substantial equivalence" to approve GM foods. This policy holds that GM varieties should not be treated differently from other non-GM varieties. In other words, if a product looks like a potato, tastes like a potato, smells like a potato, it is a potato and will be regulated according to the same criteria that govern the regulation of any other new potato variety (Brocking 2001: 5-6). Any additional testing on the safety of GM products is conducted by the companies that develop the product and is submitted to the government for consideration but is not made publicly available without the consent of the company. The EU and Japan argue that this minimalist approach to the regulation of GM foods is inadequate and on this basis have resisted exposing the citizens of their countries to any possible health or environmental risk that GM foods might pose. In 2001, Canada, the US, and Argentina launched a challenge against the EU and Japan through the World Trade Organization alleging an unfair trade barrier and arguing that there are no proven risks associated with GM foods. A WTO tribunal recently ruled on the issue ordering the EU and Japan to lift the moratorium. In response, the EU has been developing legislation dealing with traceability and labeling of foods containing GM content. Since public opposition against GM foods is very high in the EU, it is unclear if the lifting of the moratorium will result in much sale of foods with GM content since consumers will have the option of avoiding it due to mandatory labeling laws. Thus, in spite of the recent ruling ordering an end to the moratorium, Okanagan fruit farmers still have strong reason for concern that the introduction of GM fruit trees into the area would result in a loss of European markets.

Farmers in the Okanagan are already producing (albeit at low levels) two GM crops: corn and soybeans. Through my fieldwork, I was only able to identify three farmers who are currently growing GM crops in the Okanagan Valley. Due to the controversial nature of the issue in the valley, an aura of secrecy pervaded discussions of which farmers where producing GM crops. When, during the course of my interviews, I asked farmers not using GM seed technologies if they knew of any colleagues who were, they often looked uncomfortable and said that they did, but that they would prefer that I not identify them as having passed on the information. Similarly, those farmers who revealed to me that they were using GM crops asked me not to pass on the information to any other farmers or to consumers. While a farmer's decision to purchase and grow GM seeds is a matter of personal choice, it is a choice that has potentially serious implications for his or her neighbours. A farmer growing organic corn faces a serious risk of losing his or her organic certification if a neighbor decides to grow GM corn on a nearby field, yet the GM grower is under no obligation to consult with the organic grower before sowing his GM seeds. Currently, organic growers bear the responsibility of protecting their own crops from GM contamination. Neither the GM grower nor the company that holds the patent over the technology holds any liability for non-GM crop growers whose fields are contaminated, resulting in loss of markets or organic certification. It is possible, however, that this situation may change pending the outcome of the class-action lawsuit that has been launched by the Saskatchewan Organic Directorate against Monsanto.

Due to the high stakes involved for different growers, there is great interest and concern amongst Okanagan farmers on the subject of which farmers may be growing GM crops. In spite of the substantial personal investment that many farmers have in this issue, most are attempting to remain supportive and non-judgmental of their colleagues' choices regardless of their own feelings. The farmers that I interviewed who were strongly opposed to the use of GM seeds tried to be balanced and sympathetic in their representations of why others might want to use the seeds, and in some cases also asked me not to use their names in my thesis or in any other public forum. These efforts were presumably made in an effort to maintain relatively harmonious relations amongst members of the farming community. In the Prairies, for instance, many rural communities have suffered from social fractures and hostilities arising from the GM controversy, of which farmers in the Okanagan are keenly aware. Monsanto has been much criticized for setting up a 24-hour 1-800 "snitch line" which farmers were encouraged to call if they suspected their neighbors of illegally growing patented plants on their property. Monsanto used private investigators to follow up such tips and rewarded callers with the gift of a leather jacket. Eventually, however, the line was shut down due to criticism from rural communities (http://www.percyschmeiser.com/misinformation2.htm).

In his study of "The Impact of Agricultural Biotechnology on Social Cohesion," sociologist Michael Mehta argues that GM seed technologies erode social cohesion by creating a "culture of surveillance" in communities where relationships are fractured through suspicion and conflict. He also argues that GM seed technologies have a "deskilling" effect on farmers' labour, an effect that ultimately weakens the position of small farmers by making it easier for large farmers to hire unskilled agricultural labourers to grow crops. Mehta writes:

> Farmers who grow Monsanto's Roundup Ready products are required by the company to sign a technology use agreement that prohibits the practice of seed saving. This represents a direct example of farmer deskilling. Farmers who grow these crops no longer have the option of selecting seeds from plants

> that grow best on their land. Most of the control that farmers had over their farming practices has been given away to companies such as Monsanto. In exchange for better weed control, farmers have sacrificed much. Their long-term financial security is more vulnerable to changes in the prices of purchased seeds and the herbicide with which they are designed to work (2004: 20).

The deskilling of farm work can be an advantage to large farms because it renders agricultural labourers more replaceable and interchangeable. Large farms of several hundred or even several thousand acres rely heavily on temporary, low-wage agricultural labourers to perform much of the day-to-day work on the farm. Because they are a relatively transient workforce, these labourers are unable to form in-depth ecological knowledge about soil, pest, and weather conditions on a particular piece of land in the way that small farmers who own their own land are able to. Whereas small farmers have the expertise to make knowledgeable decisions about what to plant where and when, and how to deal with any adverse growing conditions that might arise, temporary labourers are more reliant on standardized instructions on how to plant and harvest the crops.

One of the major frustrations expressed by the farmers whom I interviewed was a perception that their knowledge is under-valued both by the government and by industry. The development of agricultural biotechnology in Canada, which was initiated by the federal government in the late 1980's and included strong industry involvement by the late 1990's, was pursued entirely in the absence of consultation with farmers.[25] According to former Prime Ministers Brian Mulroney and Jean Chrétien, investing heavily in biotechnology was part of a broader strategy to strengthen Canada's knowledge economy and its role as a global leader in innovation (Kuyek 2004). In the

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[25] For more information on the development of biotechnology policy in Canada see Devlin Kuyek, *The Real Board of Directors: The Construction of Biotechnology Policy in Canada, 1980-2002* (British Columbia: The Ram's Horn, 2004).

case of agricultural biotechnology, the innovators were envisioned as scientists and businessmen; farmers entered into the picture only as consumers of the ag-biotechnologies. Unfortunately, as the Monsanto v. Schmeiser case made plain, ag-biotechnologies do not exist in a neutral relationship with farmers' knowledge. Instead, the patents that are designed to stimulate innovation in the area of ag-biotechnology threaten farmers' ability to farm creatively and independently.

Ironically, modern developments in biotechnology build on crops and varieties bred by generations of farmers using traditional plant breeding techniques and depend for future innovations on the continued existence of a rich pool of agricultural genetic diversity to draw upon. However, as they are currently applied the patents that protect biotechnological "inventions" neither reward the creative input from farmers that helped to develop the plant variety over generations nor do they make any contribution towards preserving agricultural genetic diversity for future uses. This state of affairs is short-sighted as it risks encouraging an agricultural landscape that is very vulnerable due to a high level of genetic uniformity. Defenders of patents on agricultural biotechnological "inventions" counter this argument in part by arguing that people are free to continue growing traditional, unpatented varieties of patented plants. While this is true in theory, the threat of gene contamination and legal liability for patent infringement can be a strong deterrent to growing non-patented varieties of plants anywhere in the vicinity of patented ones.

Monsanto Corporation is an ambitious company that has been aggressively promoting GM seed technologies around the globe. In January of 1999, at a biotech industry conference, a representative from the now defunct Arthur Anderson Consulting Group described how his company had been assisting Monsanto in reaching their stated goal of creating a global market where 100% of commercial seeds would be genetically-modified and patented. In order to reach this goal, Monsanto and other ag-biotech corporations acquired as many smaller seed companies as they were able, acquiring 23% of the seed companies existing globally within a few short years. By 2001 Monsanto had established market dominance, owning 91% of the GM seeds on the market. The Arthur Anderson representative stated at the conference that "The goal of industry is that over time the market becomes so flooded that there's nothing you can do about it. You just sort of surrender" (Smith 2004: 5-7). Some conference participants objected to what they perceived as an environmentally reckless goal. In response to these objections, the representative shrugged and stated that the strategy was "just good business" (Ibid.: 8). In order to increase their sales, Monsanto and other biotech companies are trying to cajole, persuade and coerce as many farmers as possible around the world to plant genetically-modified seeds and repurchase them annually. The more farmers purchase and plant Monsanto's seeds, the greater the success of the latter's business strategy. But the adoption of Monsanto's GM seed varieties on a massive scale would have an extremely deleterious effects on the world's collective store of agricultural genetic diversity, diversity which, ironically enough, Monsanto and other biotech corporations depend on in order to generate new GM seeds.

In its zeal to create an intellectual property rights system and a business and regulatory climate supportive of innovation in the area of biotechnology, the Canadian government neglected to ensure that farmers' ability to participate in plant breeding and contribute to the cultivation of agricultural biodiversity was similarly protected. Consequently, farmers' autonomy and ability to exercise a wide range of choice in terms of farming techniques is threatened. Diminishing farmers' ability to engage in independent farming practices has both social and environmental implications.

Agricultural practices arguably have a greater impact on the environment than any other human activity. Modern, monocultural, chemical- and irrigation-intensive farming practices reduce biodiversity and threaten water, soil, and air quality (Madely 2002). In 1992, nearly 1700 senior scientists (including a majority of the then living Nobel Laureates in the sciences) signed and released a document titled "The World Scientists' Warning to Humanity." This strongly-worded appeal to humanity opens with the following statement:

> Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about (www.deoxy.org/sciwarn.htm).

Among the activities that are highlighted as requiring change in the world scientists' four-page warning is modern agricultural practice. In particular, the warning emphasizes the need to reverse trends in biodiversity loss and to lessen the amount of toxic agricultural waste that degrades soil and pollutes river and ocean ecosystems. This astonishing and uncompromising document warns that humanity has very little time in which to radically change many practices and so avert a compromised future. Tragically, this appeal issued by the world's preeminent scientists has been overwhelmingly ignored by the media, governments, and the business community. More recently, the Millennium Ecosystem Assessment Report (2005), which was compiled over a four year period by 1360 scientists from 95 countries along with other ecological experts, including indigenous informants, found that current human practices are rapidly degrading a number of key "ecosystem services (that) provide the conditions for a decent, healthy and secure life" and have "taken the planet to the edge of a massive wave of species extinctions, further threatening our own well-being" (www.milleniumassessment.org). Like the World Scientists' Warning to Humanity, this report emphasizes the need for reforms in agricultural practices in order to render food production more sustainable.

Most of the farmers that I interviewed during my fieldwork do not self-describe as environmentalists. Nevertheless, their efforts to reduce their dependence on off-farm inputs and to sell more products locally, thereby reducing the "food-miles" and related fossil-fuel emissions attendant to their produce, help to reduce the burden that human activity is currently placing on the earth. As discussed in Chapter One, these changes are primarily motivated by financial considerations. The ever-rising costs of inputs coupled with low commodity prices are placing great financial stress on farmers who are consequently looking for ways to reduce costs and achieve higher prices for their products. Despite their best efforts, however, many small farmers are simply unable to remain in business.

The failure of the Canadian government in recent years to ensure the continued viability of the family farm is justified by the notion that larger farms are simply more efficient and productive. However, the organic farmers that I interviewed argued that large-scale conventional farming externalizes significant costs onto the environment through soil degradation, reduced air quality, and water contamination as a result of toxic agricultural run-off. If these environmental costs were factored into the price of produce produced through conventional methods, my organic informants argued, then conventional produce might well become more expensive than organic produce. The positive environmental contribution that organic farmers make through low-impact farming methods is not rewarded at this time by government policy and conventional producers are in effect subsidized by government policies, policies which allow them to externalize many of the environmental costs of their production methods to the public.

Although as mentioned above the primary motivation for most of the farmers that I interviewed to reduce the use of chemical inputs was financial, most were also motivated by health and environmental considerations. The farmers that I spoke with were aware of the risks of skin disease, breathing complications, higher incidents of miscarriage, and increased rates of cancer that accompany long-term exposure to herbicides and pesticides and consequently preferred to minimize their exposure. My informants also viewed reduced levels of chemical use as a measure to protect the health of the soil and water on their farms over the long term. In the following chapter, I turn to an exploration of the role that Okanagan farmers sometimes play as ecological guardians and argue that government policies should provide more support and encouragement for this role. I also examine the perception of Okanagan farmers of the role that agricultural biotechnology has in contributing to more sustainable farming practices.

Chapter Four: Farmers' Relationships and Responses to Biotechnology

Part I: Farmers' Relationships with Animals and Nature

Gort's Gouda Cheese Farm is located on a lush hillside in Salmon Arm and is run by Gort and his wife Yolande. The couple emigrated from Holland over twenty years ago and bought the fifteen acres of land on which they now run their farm. Most of the farm is open pasture land upon which their herd of fifty-odd cows graze. There is also a large barn where the cows are milked and housed, a cheese factory where the milk is processed, and a retail store where the farm's award-winning cheeses are sold. Customers who visit the store are invited at certain times during the week to tour both the farm and the cheese factory. On the day that I visited the farm, Yolande showed me around and answered my many questions with a friendly, open manner. One aspect of the farm that particularly impressed me was the affectionate relationship that Yolande enjoys with the cows, all of whom are individually named. Having grown up on a farm with animals in Holland, she is extremely comfortable around animals and says she cannot imagine living a life where she is not surrounded by them. Although she describes herself as an "animal lover," she is not, and cannot afford to be, sentimental about the farm's cows, many of whom must be sold as beef cows once they are no longer able to produce milk. Nevertheless, Yolande says that she cares deeply about the welfare of her herd and that she and Gort do their best to give the cows a good quality of life while they are living on the farm.

In addition to providing their cows with plenty of pasture land, a well-kept barn, and healthy food, Yolande and Gort try to minimize the number of medications such as antibiotics and hormones that they administer to their animals. In the North American dairy industry today, cows are routinely given feed mixed with antibiotics to guard against infections and hormones to promote growth (Kneen 1999: 63-95). In the United States, a new recombinant bovine Growth Hormone (rbGH) called Somatotropin has recently been adopted by many dairy producers. Although scientists do not understand precisely how the drug affects the body chemistry of the cow into which it is injected, it is understood that the hormone encourages milk production in the cow above other functions such as fat storage. In consequence, cows who are injected with the hormone produce 25-40% more milk than cows not on the hormone. One downside of rbGH is that the extra milk production places stresses on the cow which can lead to conditions such as mastitis (udder soreness), foot problems and significant weight loss.

Somatotropin was denied regulatory approval in Canada in 2001 due to human health concerns. When I asked Yolande what her opinion was about the decision, she said that she had felt enormous relief because she felt that she would be very reluctant to use a drug that would jeopardize the well-being of the cows, yet before the drug approval had been denied she was worried that widespread use of the drug might result in a situation where dairy farmers who chose not to use the drug would find themselves unable to compete.[26] Yolande's concern is echoed by Cornell agricultural economists Dale Bauman and Robert Kalter who, in a preliminary study on the drug published in 1985, concluded that "Increases in production imply a reduction in consumer prices [and] declining national dairy farm numbers . . . Should bGH become widely used and prices allowed to adjust, it is unlikely that nonadopters could survive" (Cited in Kneen: 74). Yolande said that she and her husband feel both gratitude and affection to the cows for the milk and cream that they produce and were relieved not to find themselves

[26] Interview with Yolande, Gort's Gouda Cheese Farm, August 9, 2004.

in a position of having to choose between using the drug with the attendant increase of stress on their animals versus not using the drug and risking becoming uncompetitive.

Western secular society tends to accord some consideration to the feelings of animals but much less, if any, to those of plants. Like cows administered Somatotropin, some genetically engineered plants have had their chemical make-up changed in order to make them produce more, or to produce in ways that are more convenient for people.[27] In general, we in Western society are less inclined to feel concern over the possible stresses placed on the plant as a result of these interventions than we are likely to feel concern over the feelings or well-being of an animal. In an interview, Brewster Kneen (a Sorrento-based organic farmer and food policy analyst) told me that in recent years he has begun to feel that the interventions that modern biotechnology imposes on seeds are as violent as those imposed on animals through the application of biotech drugs such as Somatotropin. Both Brewster and his wife Cathleen believe that modern industrial farming practices contribute to a relationship between people and other living things that is premised upon violence and control. For them, modern biotechnology embodies both of these values and is thus a natural outgrowth of pre-existing industrial farming practices.

Brewster is an outspoken public critic of corporate-driven agriculture in general and biotechnology in particular. He says that when he delivers public lectures he is often asked by audience members if he is opposed to all modern biotechnology or if he concedes some useful applications. In response to this question he says that while he has no doubt that useful applications exist, he is nonetheless opposed to all biotechnology because it embodies a "bad attitude" towards life and towards creation.

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[27] For examples and discussion of this issue, see www.ipcb.org.

He believes that genetic engineering is an expression of ingratitude and disrespect towards other life forms, and that it is premised on a desire to control and dominate. He also objects to the patents that protect biotechnological "inventions" and the underlying assumption that it is reasonable and morally acceptable to claim patents over life.[28]

Both the Kneens are very concerned about the current state of the environment and believe that changes in agricultural practice are crucial to creating a more sustainable economy. The couple operated a conventional sheep farm in Nova Scotia for fifteen years before relocating to British Columbia and starting a small organic farm. They chose to switch to organic production in large part because they worried about the environmental impact of conventional farming. They believe that through their polycultural, pesticide- and nitrogen-fertilizer-free farming methods they are making a positive contribution to the health of the Okanagan ecosystem.

The Okanagan Valley is currently facing a number of serious environmental problems. In 2005 Environment Canada released a report on the impact of climate change in the Okanagan that concluded that the region was growing increasingly arid due to overall warmer temperatures and hotter summers, rampant forest fires, a reduction in precipitation levels, and overuse of existing water resources. The filling up of marshes and wetlands in order to create more farms or for building construction has also contributed to the increased aridity of the area. The "drying up" of the area is of great concern to Environment Canada, unsurprising given that the area is one of the country's most productive agricultural regions but is highly dependant on irrigation. The report concludes that in the near future some difficult choices will need to be made

[28] Interview with Brewster and Cathleen Kneen, August 19, 2004. Also, see *Farmageddon: Food and the Culture of Biotechnology*, pp. 29-37.

about priorities for water use as current levels are not sustainable and some uses will need to be discontinued (www.ec.gc.ca/EnviroZine/english/issues/51/feature3_e.cfm).

A related problem is that existing water supplies have been contaminated by the heavy use of agricultural chemicals over the past fifty-plus years. The 1995 State of the Environment Report observes that preliminary testing of groundwater found five samples out of twenty-two (23%) to contain detectable levels of pesticides. These findings are worrisome as they are likely to affect the health of drinking water (Cannings and Durance: 1). Pesticides related to agricultural use are also present in the soil. These pesticides have recently been found to cause neurological damage in birds (especially robins) that feed on earthworms in the contaminated soil (Iwaniuk et al., in press). Both water and soil in the Okanagan continue to contain residue from DDT, a pesticide whose use in Canada was restricted severely in the 1970's and fully banned in 1989 after the chemical was found to be carcinogenic. The residual presence of DDT in the valley ecosystem has led to the extinction of several species, most notably the peregrine falcon (Krupa 1998).

Farmers have an important role to play in determining the ecological health of the Okanagan region. The choices that farmers make in terms of growing practices in the coming years will likely have a profound effect on the future health and sustainability of the valley. The continued health of the valley is important for all of Canada, since it is one of the country's most productive regions. The biotechnology industry has been actively positioning itself as a solution to some of the environmental problems inherent in modern farming practices.[29] Many proponents of biotechnology advocate it as a solution to at least some of the environmental problems that are currently being caused by industrial farming practices. For example, Richard Rominger, a strong advocate of biotechnology and the US Department of Agriculture Deputy Secretary, argued in a speech that:

> Biotechnology is our greatest hope . . . It dramatically increases crop yields. It uses less water and pesticides, offers greater nutritional value. And in the process, there's less stress on fragile lands and forests . . . Food biotechnology is already making its presence felt. It's filling consumer demand with high-quality, good tasting food products produced in ways that are environmentally sustainable (Cited in Kneen: 17).[30]

Brewster, Cathleen and many other organic farmers, however, feel that agricultural biotechnology further entrenches many of the attitudes and practices inherent in industrial production that created the environmental problems to begin with. Similarly, some critics of biotechnology argue that biotechnologies serve mainly to prop up existing, environmentally destructive industrial farming practices. For example, in his book *From Apocalypse to Way of Life*, Frederick Buell argues that GM seeds technologies are "accomodationist" in that they permit otherwise unsustainable farming practices to continue functioning, at least for a little while longer. Plants genetically-engineered to be pest-resistant (such as B+ cotton) are a case in point. Pesticides were

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[29] See the website for the Biotechnology Industry Organization, an international US-based biotech lobby group with over 1000 member companies: http://www.bio.org/foodag/background/benefits.asp.

[30] Of the existing applications of biotechnology on the market, herbicide and pesticide-resistant crops are arguably of the most benefit to the environment as they will potentially reduce the amount of chemicals that farmers will need to apply to their crops. The truth of this claim is still uncertain as farmers have only been growing GM herbicide and pesticide resistant crops for a decade. Preliminary evidence suggests that while herbicide and pesticide use on these crops is indeed less in the first few years, that it soon returns to former levels as local weeds and pests begin to develop immunity. Furthermore, in the Prairies volunteer herbicide-resistant GM canola has been causing a serious weed problem for farmers when it appears unwanted in other crops. Because these plants are resistant to glyphosate-based herbicides, farmers most use more heavy-duty pesticides in order to eradicate them. Thus the long-term, overall impact of herbicide and pesticide resistant GM crops is difficult to calculate. For a more developed discussion of this controversy, see Miguel Altieri (1998) "Environmental Effects of Transgenic Crops: Agroecological Assessment." Available at http://www.biotech-info.net/altieri3.html.

developed after monocultural cropping was widely adopted because the genetic uniformity of monocropped fields left crops highly vulnerable to pest infestations. The pesticides developed to deal with the problem of vulnerability due to genetic uniformity in fields, however, soon proved to bring deleterious effects of their own, such as water and soil contamination and harm to other species. Seeds genetically-altered for pest-resistance are a response to the problems brought about by widespread pesticide use, but some scientists worry that these genetically-engineered plants will lead to new, unintended ecological problems. Many critics of dominant agricultural practices argue that monocropping itself is an unsustainable practice and that a truly sustainable agricultural system would require a return to polycultural copping techniques. According to this way of thinking, pesticides and genetic engineering for pest-resistance are the products of a reactionary approach, one that deals with the symptoms rather than the root causes of crop susceptibility to pest infestation. According to Buell, the danger of accomodationist technologies is that they can deflect attention away from the need to make more radical changes to existing systems in order to address the root causes of environmental problems (Buell 2003).

Part II: Farmers' Resistance to Corporate Biotechnology

Many farmers in the Okanagan Valley have lost faith in agribusiness companies to make a positive contribution towards either the health of rural communities or the health of the land and have been attempting to reduce their dependence on agribusiness inputs for a combination of financial, health and environmental reasons. The farmers that I interviewed all had developed strategies for trying to reduce their use of expensive inputs. The most obvious solution is to switch to organic production. Although only three of the farmers I interviewed grew certified organic crops, of the remaining fourteen, nine had become or were seriously considering becoming organic producers. According to these farmers, however, the organic certification process is a major obstacle for conventional farmers wishing to make the switch. In BC, a conventional farmer must cease using chemical fertilizers, sprays, and GMO's for a full five years before he or she can be certified as an organic producer. During this time, the farmer will not receive the higher prices that organic produce commands. Furthermore, for the first few years after the farmer abandons chemical fertilizers and sprays he or she can expect that yields will be significantly lower. The reasons for the lower yields are many, but one important factor is that soil fertility is depleted over time by the use of chemical fertilizers, thereby creating a dependence on the fertilizer. After a few years with no exposure to chemical fertilizers, the soil gradually replenishes itself. Nine of the conventional farmers I spoke with expressed an interest in organic production for financial and health/environmental reasons but felt that they were not financially equipped to weather the transition period involving lower yields commanding only conventional food prices prior to certification after the five year mark.

Although a full switch to organic production for most farmers in the area is not practical or necessarily desirable, many farmers are making a concerted effort to reduce their pesticide use. Pesticide reduction in the valley has occurred rapidly over the past decade-and-a-half, largely due to the implementation of an Integrated Pest Management strategy that involves using small amounts of pesticides in combination with other pest-fighting tactics. The BC provincial government promoted this strategy throughout the 1990's as both "economically and financially sustainable." Today, pesticide use in the valley has been reduced more than 50% from levels used in the 1990's (http://www.legis.gov.bc.ca/CMT/36thParl/CMT08/hansard/1999/af102799.htm).

The conventional farmers I interviewed all said that they were conscious of trying to reduce the amount of pesticides they used on their fields and orchards.

While most of the farmers emphasized the financial savings of reduced pesticide use, environmental and health benefits also played a role. Rod Stykes, an Okanagan farmer who at the time that I interviewed him was in the process of converting from a conventional to an organic farm, said that he made the decision to stop using chemical sprays and fertilizers on his farm because he kept finding dead birds on his property. He eventually concluded that the birds were being poisoned by the worms they ate out of the fertilized soil. In addition to feeling sorrow over the dead birds, he worried that the chemicals that were killing the birds might also harm his young children and himself and his wife.[31] Like many other farmers in the area, Stykes places little faith in the claims of agribusiness that the chemicals they sell are safe. Likewise, he is cynical about the regulatory procedures of the Canadian government for chemical sprays and fertilizers, being well aware of the statistics which show that workers on conventional farms experience significantly higher rates of miscarriages, skin conditions, and certain forms of cancer all linked to pesticide exposure.[32]

Peter Stevens,[33] a Salmon Arm orchardist in his sixties, is also deeply concerned about the health effects of chemical sprays. The orchard that Steven farms belonged to his mother and father before him, and he grew up on it along with his six brothers. For several years, the family relied heavily on DDT for insect control on their fruit trees. Stevens and his brothers sprayed the trees frequently, often coming into direct contact with the chemical. "We didn't realize how dangerous it was," he told me. "A lot of the

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[31] Interview with Rod Stykes, August 26, 2004.
[32] See, for example, Caroline Cox (1994), "Working with Pesticides on the Farm," *Journal of Pesticide Reform Vol. 14*, No. 3, pp 2-5.
[33] A pseudonym.

time we weren't wearing masks." Over the years, five of Stevens' six brothers developed throat cancer related to DDT exposure and all of the five eventually succumbed to the disease. As a result of this tragic experience, Steven is distrustful of all chemical sprays and uses them as sparingly as possible on his trees. With some frustration, however, he observes that customers expect fruit to look "perfect," blemish-free with even colouring and of a uniform size. "Customers say they want food produced with less chemicals," he said, "but they won't buy it. They always go for the perfect-looking fruit that takes a ton of chemicals to produce."[34]

Stevens' complaint about customers who are largely ignorant about how food is produced is a common complaint among farmers. Most of the fruit that Okanagan farmers produce is sold to large packing houses, which sort and grade the fruit and then resell it to various buyers. The poorer quality fruit is used for juicing and for use as an ingredient in a variety of processed foods, while the top grade fruit is sold as "fresh fruit" in supermarkets and grocery stores across Canada and abroad. The major supermarket buyers demand visually appealing fruit of uniform size and colour in a limited range of varieties.[35] Urban Canadians have come to take for granted and to regard as normal the appearance of supermarket fruit. And they tend to be ignorant or unreflective of the way in which this aesthetic is tied to a relatively high level of chemical use.

Many of the farmers I conducted interviews with prefer to sell their produce directly to consumers, not only because they can obtain higher prices through the

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[34] Interview, August 24, 2004.

[35] There are about seven thousand known varieties of apples, but only about one hundred of these are grown in North America. In Canada, 73% of last year's commercial apple crop was represented by just five varieties: MacIntosh, Red Delicious, Spartan, Empire and Idared (www.agr.gc.ca/malus/varieties_e.html).

elimination of wholesalers, but because it is an opportunity to open up the lines of communication between food producers and consumers. It also offers farmers the opportunity to exercise more autonomy in terms of production as they are not constrained to the same extent by the narrow and rigid criteria of supermarket requirements. In the Okanagan, there are three main strategies that farmers use to market their products directly to consumers. Firstly, and probably most successfully, many Okanagan farmers set up roadside fruit and vegetable stands along the highway; secondly, farmers bring their wares to weekly farmers' markets, usually located in the town centres; and thirdly, farmers participate in the Community Supported Agriculture (CSA) program where consumers are supplied with a weekly basket of seasonal produce for a fixed rate usually paid in advance.

Direct producer-to-consumer sales allow farmers to make a little extra much-needed revenue. Also important is the fact that farmers like Gary (introduced in the opening of this thesis) can sell their own apple varieties and that farmers like Hanna can talk to consumers about his decision to use a minimal amount of chemical sprays, even if this means that his apples sometimes have a lop-sided shape or the occasional scab. Many CSA farmers use the weekly food baskets to introduce consumers to vegetables they may never have seen in the supermarket before. One of the farmers I interviewed, a woman named Sally in her mid-sixties, said that whenever she introduces a new item into the food basket that she thinks her customers might not be familiar with, she includes a photo-copied note with instructions on how to prepare it and recipe suggestions. Sally enjoys surprising her customers and says that she has gotten a lot of positive feedback from people who enjoy being exposed to new types of produce.[36]

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[36] Interview with Sally Hayes, August 24, 2004.

In the short term, direct farmer-to-consumer transactions help farmers to boost their incomes and also provide farmers with a little more flexibility and autonomy over what they grow and how they grow it. But in the longer term, increased communication between farmers and consumers may help to create a public that is more knowledgeable about the challenges that farmers face and about the social and environmental impacts of different types of food production. Sociologists Jo Ann Jaffe and Michael Gertler recently published a study on the issue of what they term "consumer deskilling" in the food system. According to the authors, consumers have lost the knowledge necessary to make discerning decisions about the multiple dimensions of quality pertaining to food, such as the contributions a well-chosen diet can make to consumer health, the health of the planet, and community economic development. The authors argue that this consumer deskilling in its various dimensions carries significant consequences for the restructuring of our food systems and for consumer sovereignty, diets and health (Jaffe and Gertler 2006). The efforts of farmers in the Okanagan and elsewhere to sell and communicate directly with consumers about their products is helping to provide consumers with knowledge about the food they consume that is not being disseminated in supermarkets or through corporate advertisements.

Consumer demand for organic, non-GMO products in Canada has been increasing rapidly at a rate of 20% per year since 1990.[37] In spite of growing consumer demand, the Canadian government has done little to show support or encouragement for organic producers. Cawston organic orchardist Linda Edwards believes that from both an economic and environmental perspective organic farming holds out the most promise for a viable future for agriculture in the Okanagan Valley. However, she argues

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[37] "Organics Goes Mainstream" on the Canadian Broadcasting Corporation's *Ideas* radio programme, 2006 (www.cbc.ca/ideas/features/organics/index.html).

that organic farmers need government support and should be rewarded for the contribution they make to the environment both through helping biodiversity in the area to flourish and through keeping the soil and water free of chemicals.[38] Similarly, Brewster and Kathleen Kneen believe that the initiatives that Okanagan farmers have been taking to promote an increase in the consumption of local foods have an environmental benefit because they help to reduce the amount of fossil fuels used to transport food.[39]

The Canadian government's failure to support and protect struggling small farmers is justified by the argument that large farms are more efficient and productive. However, small farms employing polycultural techniques use the land more intensively, utilize resources more efficiently, and can produce more food overall per acre.[40] Small farms are more likely to stimulate what Aldo Leopold (1949) characterized as a "land ethic" where stewardship of natural resources and investments in conserving biodiversity are more likely. The interests of small farmers are closely aligned with those of consumers. Farmers who raise and feed their families off of the land they work are strongly motivated to ensure that both the land and the food they produce are healthy. Farmers who hope to pass on their land to their children also have a strong investment in maintaining the long-term sustainability of the land. In contrast, the objectives of agribusiness are often at odds with the best interests of society. For example, it is in the best interests of society to maintain a high level of agricultural biodiversity. In this era of rapid climate change in particular, it is imperative that we

[38] Interview with Linda Edwards, August 14, 2004.
[39] Interview with Kathleen and Brewster Kneen, August 19, 2004.
[40] M. Duafy (1999). "Crop Yields and Net Returns from Long-Term Cropping System Comparison, Iowa State University," in Rick Wekh, *Economics of Organic Grain and Soybean Production in the Midwestern United States, Policy Studies Report No. 13* (Greenbelt, MD.: Henry A Wallace Institute for Alternative Agriculture).

retain a diverse genetic base in our agricultural species in order to ensure that species upon which we depend for our food security are able to adapt to changing climatic conditions. Commercial seed companies, however, at least in the short term, are motivated to increase their profits by selling as widely as possible the limited pool of seeds that they themselves have developed. Likewise, producers of pesticides, herbicides, and chemical fertilizers are motivated to generate high sales of these products despite the negative impacts on the health of soil, air and water.

The most striking example of where the interests of agribusiness diverge from those of farmers is in the creation by transgenic seed companies of "Genetic Use Restriction Technologies" (GURTs). Two types of GURTs have been developed thus far: the first is the "Terminator" technology which causes seeds to produce sterile plants, and the second is the "Traitor" technology which prevents fruits from ripening until a chemical spray has been applied. Both of these technologies are currently banned under the UN's biosafety protocol because of the danger that the traits might spread to other varieties or into the wild thereby posing a serious threat to both food security and the health of ecosystems (http://www.parl.gc.ca/information/library/PRBpubs/prb0588-e.html). From a profit perspective, it is in the interests of agribusiness to exercise a high level of control over seeds and to be able to force farmers to repurchase seed every year. From the perspective of food security (especially for the poor) and ecological stability (which is in everyone's interest), however, it would be destructive in the extreme to jeopardize the capacity of plants to self-reproduce.

It is not my intention to argue that there is no place for agribusiness and the products they develop through scientific innovation. To the contrary, when carefully regulated and operating in the service of farmers they have the potential to contribute much. Currently, however, large agribusinesses are in a dominant position vis-à-vis farmers both financially and politically and are therefore able to exercise an inappropriate level of control over what and how farmers produce. The deterioration of the social fabric of rural communities as well as continuing environmental degradation from agricultural production are in large part the result of this power dynamic. We need to provide more government and societal support for small farmers, both because food producers deserve our respect and appreciation and because we are dependant upon them to provide us with nourishing, non-toxic food and to maintain the health and sustainability of the land over the long-term.

Currently, farmers in the Okanagan and elsewhere who are struggling to reduce their dependence on off-farm inputs and to farm in more environmentally-sustainable ways are receiving virtually no government support. The Canadian government has entered into close partnerships with various agribusiness corporations (notably Monsanto) and has proved very responsive to corporate lobby groups. Farmers do not have a comparable ability to make their interests and views known at the policy-making level and are not being consulted for their input in the creation of policies that affect them. The lack of government support for the initiatives of small farmers and their exclusion from policy-making debates is shortsighted because it overlooks the important potential that farmers possess to contribute to healthy rural ecosystems and the maintenance and cultivation of agricultural biodiversity.

Models of government support for the role of farmers as "environmental stewards" already exist in other countries.[41] The Canadian government needs to consider implementing similar strategies – our food security and the health of our land depend upon it.

CONCLUSION

Historically in Canada, small farmers have needed a great deal of local ecological knowledge in order to run their farms successfully. An in-depth familiarity with local soil, pest and weather conditions as well as a basic knowledge of seed saving and plant breeding techniques were prerequisites for growing healthy crops. The introduction of a range of off-farm inputs including irrigation, chemical fertilizers, herbicides, pesticides, machinery and commercial seeds contributed to a standardization of farm practices and have resulted in an erosion of farmers' local ecological knowledge.

Non-indigenous farmers in the Okanagan were initially complicit with the derogation of local knowledge through their unwillingness to recognize indigenous knowledge of the non-irrigated desert landscape as practicable and thus valuable. For many decades these farmers welcomed and frequently sought out both government and industry-sponsored scientifically developed off-farm inputs to help make their farming operations more efficient and productive.

In recent years, however, the acceleration of various health and environmental problems (such as climate change, soil degradation, water and air pollution, and loss of biodiversity) linked to industrial farming practices has revealed the need for changes in agricultural production practices. Small farmers with strong personal investments in the

[41] For example, in Europe farmers are paid a sum of money each year for fulfilling various acts of environmental stewardship (Skrypiczajko 2005).

health of the land and an intimate familiarity with the day-to-day workings of their farms are ideally positioned to act as environmental watchdogs and stewards.

The widespread introduction of patented, genetically-modified seeds threatens to further erode farmers' autonomy and local ecological knowledge – particularly conventional and organic farmers' traditional plant breeding methods. This trend is problematic, not only for those farmers who practice seed saving or other forms of plant breeding, but for all of society because the richness of the agricultural genetic diversity on which our long-term food security rests is threatened. The development of ag-biotech policy in Canada and internationally has occurred almost entirely without farmer input. The patent protection that GM seed developers have been granted was put in place in order to promote and encourage the innovation of scientists. Unfortunately, the importance of farmers' creativity was sidelined and the important plant breeding skills and capacity they possess are now jeopardized by the direction in which the seed system is currently developing. We need not only to protect farmers' rights to practice creative planting and breeding techniques, but to actively encourage it.

The contributions of conscientious and innovative farmers such as Gary, who developed the Alistair apple, and Robert McCormett, who has been saving and developing his own corn seed for nearly twenty years, are threatened by the introduction of patented, GM seeds into the Okanagan valley ecosystem. The Canadian government has justified its support of the biotech industry in the form of funding and strong patent protection on the ground that Canada needs to develop an "innovation-based" economy. Unfortunately, however, support of the ag-biotech industry has occurred at the expense of small farmers and no measures have yet been taken to ensure that small farmers' local ecological knowledge and related ability to farm independently and creatively are protected. The ecological knowledge possessed by small farmers is of great value to society. Existing agricultural genetic diversity is due largely to the efforts of small farmers and our continued food security depends on its maintenance. If as a society we are to continue our support of agricultural biotechnology, we must ensure that it does not compromise the seed saving and traditional plant breeding practices of small farmers. The local ecological knowledge of small farmers has a vital role to play in maintaining rich agricultural genetic diversity and healthy land over the long term and it is therefore in all of our best interests to make sure that this knowledge is protected.

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