Assessment of the Policies and Regulations that Control Bovine Spongiform Encephalopathy in Switzerland

An Interactive Qualifying Project by:

Patrick Pastecki

David Laperriere

Jason Field

Advised by:

Professor Kent Rissmiller

Submitted on May 4, 2001

Zürich Project Site

Worcester Polytechnic Institute

Worcester, Massachusetts 01609 USA

Abstract

This research assesses the confidence of the organizations involved in beef production in Switzerland in the methods used to prevent Bovine Spongiform Encephalopathy (BSE) from entering the food supply. Interviews were conducted with individuals representing each facet of beef production and these interviews were analyzed to identify issues of controversy and widespread agreement. This analysis was used to assess the status of BSE control in Switzerland and to make recommendations for its improvement.

Executive Summary

Today, as panic over the spread of mad cow disease grips Western Europe, scientists, policy makers, and meat industry officials are taking stringent steps to curtail any further expansion of this fatal brain affliction. The disease, formally known as bovine spongiform encephalopathy (BSE) because of the sponge-like plaques that develop in the nervous tissue of affected animals, is linked with the deaths of dozens of people who contracted a similar disease called new-variant Creuzfeld-Jakob disease (vCJD), evidently from eating beef contaminated with BSE. Today, Switzerland, along with most industrialized nations, has a series of policies and regulations in place to prevent BSE from contaminating the food supply. Although many of these policies and regulations were formed on the basis of solid scientific evidence, due to the inadequate understanding of all aspects of this disease, some policies have been formed on the basis of incomplete evidence as precautionary measures against poorly understood characteristics of BSE. This is significant because the perceived quality of these policies and regulations will affect the confidence of the public and the beef industry with respect to the safety of beef in Switzerland. As a result the primary objective of this research was to assess the confidence of the different organizations involved in beef production in Switzerland in the methods used to prevent BSE from entering the food supply.

The project team began by conducting a literature review in order to gain an extensive understanding of the problem, including the biological and epidemiological aspects of BSE, the various governmental policies controlling BSE, and certain economic

ramifications caused by BSE. The information presented in the literature review was used as a guide in developing an effective and efficient methodology.

Archival data research and interviews were the major methods used to collect data concerning the confidence of the various groups involved in beef production. A total of seven interviews were completed with individuals representing the following organizations in Switzerland: Interferm AG, a company that produces additives for animal feed; The Swiss Federal Veterinary Office; The cantonal veterinary office of Zürich; Bell AG, a company that processes and distributes beef in Switzerland; Micarna SA, a company that slaughters, processes, and distributes beef in Switzerland; The Schweizerischer Bauernverband, a farmers' union located in Brugg, Switzerland; and Centravo AG, the company that is responsible for processing specific risk material from cattle in Switzerland.

A combination of narrative policy analysis and conventional policy analytical techniques were used to interpret the interview data. The analysis consisted of examining the viewpoints of the interviewees and identifying both controversial issues and areas of general agreement. Some of the topics that were addressed include the need for more research, the necessity for high quality meat products in Switzerland, the controversy over the January 2001 feed ban amendment, implementation of BSE policies and regulations in Switzerland, the degree to which current BSE regulations build consumer confidence, and the fact that it may be impossible to achieve total safety from BSE.

Upon scrutiny of the discussions presented in the analysis section, the project team developed some final conclusions and recommendations. Some of the ideas discussed in this section include a call for more research on BSE, recommendations for

improving consumer confidence, the belief that Swiss policies can be used as a model for other countries, and the fact that better implementation of Swiss policies is necessary. The final report was submitted to Swiss governmental regulatory agencies and to the organizations involved in beef production so that these groups could work together to optimize the system that controls BSE in Switzerland.

Table of Contents

Authorship

J = Jason Field

D = David Laperriere

P = Patrick Pastecki

Introduction	J
Literature Review	
History and Epidemiology Before 1990	J
History and Epidemiology Since 1990	J, P & D
Nature of Transmissible Agents	J
Prions	J
Prion Diseases	J
General BSE Policies	D
Switzerland's BSE Regulations	D
BSE Policy Problems in the United Kingdom	D
General Information on Agriculture in Switzerland	J
Beef and Related Industries Decline	P
Costs	P
Imports	P
New Waste Material Gathering	P
Livestock and TSE	P
Conclusions	J
Methodology	J & P
Results	J, P & D

Introduction

Today, as panic over the spread of mad cow disease grips Western Europe, scientists, policy makers, and meat industry officials are taking stringent steps to curtail any further expansion of this fatal brain affliction. The disease, formally known as bovine spongiform encephalopathy (BSE) because of the sponge-like plaques that develop in the nervous tissue of affected animals, is linked with the deaths of dozens of people who contracted a disease called new-variant Creuzfeld-Jakob disease (vCJD), evidently from eating beef contaminated with BSE. Most scientists agree that the spread of BSE in the bovine population is caused by the unnatural and relatively recent practice of feeding ground up animal parts to animals that are normally strict herbivores. It is believed that the infectious agent, an abnormally folded protein called a prion, contaminates the food supply when a cow infected with BSE is rendered for animal feed. Cattle that eat this contaminated feed are then subject to infection with BSE. In response to this problem, many countries have adopted policies that ban the use of ruminant and other animal byproducts in animal feed. In addition, mandates for the destruction of animals that are infected, or possibly infected, with BSE have become widespread.

Today, Switzerland, along with most industrialized nations, has a series of policies and regulations in place to prevent BSE from contaminating the food supply. Although many of these policies and regulations were formed on the basis of solid scientific evidence, due to the inadequate understanding of all aspects of this disease, some policies have been formed on the basis of incomplete evidence as precautionary measures against poorly understood characteristics of BSE. In addition, because BSE threatens the food supply, there is immense pressure on politicians and policy makers to make decisions that will protect the public. Because it has been

necessary to make decisions without a comprehensive understanding of BSE, it is possible that some of the regulations in place to prevent BSE contamination of the food supply may be less than optimal.

This is significant because the perceived quality of these policies and regulations will affect the confidence of the public and the beef industry with respect to the safety of beef. The impact of BSE in Western Europe has already shaken consumer confidence and any further BSE related problems could further devastate the beef industry. For these reasons, the government and the beef industry have a high stake in the success of the policies and regulations in place to prevent BSE from contaminating the food supply.

There are many groups involved in taking beef from the pasture to the dinner plate. The chain of beef supply starts with farmers and includes the animal feed industry, cattle processors and distributors, beef retailers and various government agencies. Although all of these groups have a vested interest in the policies and regulations regarding BSE, most groups do not have direct control over them. Instead, these groups rely on policy makers to weigh their interests against those of the health community and the public to make BSE related regulations. As a result, it is possible that some, if not all, of the organizations involved in the beef supply chain have some concerns about the various regulations in place to keep BSE out of the food supply. It is the objective of this team to address these concerns.

Specifically, this project team assessed the confidence of the different beef supply groups and institutions in the methods used to prevent BSE from entering the food supply. By assessing the confidence in the various BSE related policies and regulations, the strengths, weaknesses and problems with the current policy infrastructure became apparent. These problems are then

detailed for presentation to policy makers, government officials, and beef industry officials so that appropriate solutions can be determined.

Literature Review

Bovine Spongiform Encephalopathy (BSE) and the related human affliction known as variant Creuzfeld-Jakob disease are currently the cause of immense concern throughout Europe and other parts of the world. The purpose of conducting this literature review was to gain an extensive understanding of the problem, including the biological and epidemiological aspects of BSE, the various governmental policies controlling BSE, and certain economic ramifications caused by BSE. The information presented in this literature review was then used as a guide in developing an effective and efficient methodology.

History and Epidemiology Before 1990

Although the complete history and epidemiology of BSE and other related prion diseases is too extensive to be included in this report, a shortened chronology is included to give the reader a sense of how the BSE crisis unfolded. The first known instance of a prion disease, or transmissible spongiform encephalopathy (TSE), occurred in 1732 when scrapie, a prion disease related to BSE, was first recorded in sheep (Guardian Newspaper Limited, 2001). The next significant event in the history of BSE came in 1900 when meat and bone meal (MBM) first became used as a feed for ruminant animals (The BSE Inquiry, 2000). By the 1920s, rendering slaughterhouse remains into animal feed began on a widespread scale as a way of feeding the protein needed for fast growth and high milk production (Guardian Newspaper Limited, 2001; The BSE Inquiry, 2000). In the 1960s and 1970s, large-scale continuous rendering plants were developed in the United States and were adopted by an increasing number of large rendering

companies. Compared with the previous batch techniques, continuous plants offered savings in labor and energy costs at levels of high capacity utilization (The BSE Inquiry, 2000). Today, many scientists believe that this change allowed the agent responsible for BSE to survive the rendering process and become incorporated into the animal feed Guardian Newspaper Limited, 2001).

On December 22, 1984, Dr. David Bee, a veterinary surgeon, was called to examine Cow 133, which was suffering from an arched back and weight loss on the Pitsham Farm in Great Britain (The BSE Inquiry, 2000). Later, on February 11, 1985, Cow 133 died, having earlier developed head tremors and loss of coordination. A clinical report published on the case later that year described the cow as suffering from "a novel progressive spongiform encephalopathy" (The BSE Inquiry, 2000). This was the first known case of BSE.

In November of 1986, BSE became officially recognized as a disease in the United Kingdom (Cnn.com, 2001). In August of 1987, development of a BSE database began at Britain's Central Veterinary Laboratory (CVL) to keep track of all confirmed BSE cases. By December 15, 1987, initial epidemiological studies were completed, showing some evidence to suggest that ruminant-derived MBM is a factor in the cause of BSE (The BSE Inquiry, 2000). Before the year's end, UK government ministers were first told about the disease.

On July 7, 1988, the UK government announced the slaughter policy which mandates the destruction of all animals showing clinical symptoms of BSE. Later that month, the UK banned all ruminant meat and bone meal from inclusion into cattle feed until December 31, 1988 while a review of the rendering process was conducted (The BSE Inquiry, 2000). The result of this review led to the Bovine Spongiform Encephalopathy Order of 1988 which prolonged the

ruminant feed ban and prohibited the use of mik from suspected cattle for any purpose other than feeding to a cow's own calf (The BSE Inquiry, 2000).

In July 1989, Europe banned export of British cattle born before July 1988 as well as any animals showing BSE symptoms (Cnn.com, 2001). Later that year, the UK government instated a total ban from human consumption of high-risk offal, such as the brain, spinal cord, and spleen of ruminant animals (The BSE Inquiry, 2000). Finally, the Bovine Spongiform Encephalopathy Amendment Order came into force on December 31, 1989, making the ruminant feed ban permanent by deleting the provision that stated that the ban would expire on January 1, 1990 (The BSE Inquiry, 2000).

History and Epidemiology since 1990

In the beginning of the decade there was a large number of BSE cases reported. An average of 300 cases per week were discovered in Great Britain throughout the year. New surveillance units in Edinburgh, England were designed to determine if CJD infections were correlated to BSE (Cnn.com, 2001). In response to these outbreaks the beef consumption in the UK dropped to the lowest level since 1962 and 65% of UK doctors had stopped eating beef because of the BSE threat (Dealler, 1998). Due to lack of evidence to prove that CJD was caused by BSE the Minster of Agriculture in the UK, John Gummer, insisted that there was no risk and that beef was safe (Dealler, 1998).

A year later BSE appeared in a cow that had been born after the feed ban and it was believed that this cow had not consumed any contaminated feed (Dealler, 1998). This event supported the theory of vertical transfer along with a later case in which a calf born from a BSE

infected cow eventually developed the disease. Evidence was discovered in 1992 that suggested that BSE was carried in the brain, bones, liver and potentially the blood (Dealler, 1998). By 1993 the UK had peaked with 100,000 confirmed cases of BSE (Cnn.com, 2001). Another interesting event that occurred in 1993 was that two dairy farmers with infected herds of cattle died from CJD.

Later in 1994 more evidence supporting vertical transfer theory and/or endemic infection was observed. Large numbers of BSE infected cattle still existed (700 cases per week) six years after the feed ban (Lacey, 1994). Other events of 1994 include identification of specific risk material from cattle as well as incidences of non-compliant businesses attempting to export potentially contaminated beef. This was also the same year that the Spongiform Encephalopathy Research Campaign was started. In 1995 it was estimated that 1.8 million infected cattle from the UK farms would be eaten by the year 2001 as a result of unreported BSE cases in 1992 to 1993 (Dealler, 1998).

Policy making in the year 1996 was very active in response to the BSE discoveries. The UK Health Secretary, Stephen Dorrell, officially announced that there was a suspected link between BSE and vCJD (Cnn.com, 2001). The European Union quickly banned the export of cattle and all bovine products from the UK. The UK challenged this export ban and offered a policy to slaughter and destroy all the cattle over the age of 30 months (Cnn.com, 2001). This was not adequate for the situation since renderers were still using infected material in cattle food (Dealler, 1998). Other events that occurred this year included more research concluding that sheep were susceptible to infection of BSE as well as a political scandal between the European Commission, Agriculture Commission and European Parliament (Dealler, 1998).

Later the next year the UK government imposed the "beef-on-the-bone" ban (Cnn.com, 2001). Also, more research was conducted that supported the contention that variant Creuzfeld-Jakob (vCJD) was a direct result of BSE. Also in 1997, Belgium and the Netherlands recorded their first case of BSE in their cattle populations.

In 1998 Switzerland recorded only 14 BSE cases. This was the lowest number since 1991. The meat and bone meal ban for ruminants was looked at as being fairly effective. However, up to this year there were 45 cattle that were born after the 1990 ban were found to be infected with BSE. Thus it was debated whether a full ban of all animal based meal would be necessary.

Toward the beginning of 1999 Switzerland instates a BSE surveillance program. The goal of this program is to achieve a higher detection rate of BSE infected cattle and to identify the BSE risk population. As a result of this strengthened monitoring system, the number of BSE cases jumped up to 50.

The next year was marked by the first cases of BSE in 3 different European countries. Spain, Germany and Denmark, recorded their first cases of BSE in cattle that were not imported. This year also found France's number of BSE cases jump to 162. In December 2000, several cattle born after 1996 are found to be infected with BSE. This caused Switzerland great distress as policies, which were instated in 1996, were thought to have been stringent enough to remove the Swiss BSE problem

Thus at the very beginning of 2001, Switzerland increased its animal meal regulations to include a full ban on feeding animal remains to all farm animals. This is the most stringent animal meal regulation that a country can have.

Nature of Transmissible Agent

Prions are unique pathogens that induce a variety of fatal neurodegenerative diseases by way of an unprecedented mechanism. Examples of prion diseases include bovine spongiform encephalopathy (BSE) in cattle, scrapie in sheep, Creutzfeldt-Jakob disease (CJD) in humans, and a variety of other transmissible spongiform encephalopathies (TSE). Prions are completely devoid of nucleic acid and seem to be composed entirely of a modified cellular protein (PrP^{Sc}). The disease progresses and spreads when a normal cellular protein (PrP^{C}) is converted into a modified version (PrP^{Sc}) through a process in which the prion acts as a template upon which PrP^{C} is refolded into PrP^{Sc}. The structural transition from PrP^{C} to PrP^{Sc} results in significant changes in the physiochemical properties of the PrP protein, in turn leading to the fatal consequences associated with TSE.

In the early days of studying TSE, suggestions as to the nature of the disease-causing agent ranged from small DNA viruses to membrane fragments to polysaccharides to proteins (Prusiner, 1998). Subsequent research on the agents causing scrapie and CJD showed these pathogenic particles to be extremely resistant to procedures that alter nucleic acids, such as ultra-violet light and ionizing radiation. These results suggested to researchers that perhaps nucleic acids are not a required component of the disease-causing agent (Prusiner, 1998). In addition, the factor responsible for scrapie was found to be resistant to inactivation by formalin and heat treatments, two popular techniques used to inactivate viruses. This suggested that the scrapie agent might be different from viruses. Over time, data began to accumulate indicating that scrapie infectivity could be reduced by procedures that modify proteins but not by procedures that alter nucleic acids or viruses, establishing for the first time ever that a protein was required

for infectivity (Prusiner, 1998). The resulting 'protein-only' hypothesis maintains that the disease-causing agent, or prion, lacks genomic nucleic acid and that the essential pathogenic component is a protein (Aguzzi and Weissmann, 1997). Because the concept of a protein as an infectious entity is unique in biology and some features of the diseases caused by prions and viruses are similar, some scientists refuse to accept the 'protein-only' hypothesis. Instead, this group of researchers maintains that the agent responsible for TSE is some sort of virus with unusual properties. According to Stanley Prusiner, winner of the 1997 Nobel Prize for his work with prions, "numerous attempts to disprove the prion (protein-only) hypothesis over the past 15 years have failed" (1998, 13366). In fact, no evidence exists for a virus-like particle or a nucleic acid genome being responsible for TSE infectivity (Prusiner, 1998). In addition, the discovery of unrelated prion-like events in yeast and fungi serves both to broaden and strengthen the prion 'protein-only' hypothesis (Prusiner, 1998). Because of these, and other more detailed reasons, most TSE researchers today adhere to the 'protein-only' hypothesis (Aguzzi and Weissmann, 1997).

Prions

According to Prusiner, "the best current working definition of a prion is a proteinaceous infectious particle that lacks nucleic acid" (1998, 13365). Prions appear to be composed exclusively of a modified form of a normal protein found in the brain and other organs of all vertebrates examined so far. This normal protein, designated PrP^{C}, can be converted into a misfolded, pathological form, designated PrP^{Sc}, by an autocatalytic process in which PrP^{Sc} acts as a template upon which PrP^{C} is refolded into a nascent PrP^{Sc} molecule (Masters and Beyreuther, 1997). Examination of the secondary structure of the two PrP isoforms revealed

markedly different conformations despite the fact that both isoforms retained identical primary structure (Prusiner, 1998). In other words, the examination revealed that the two PrP isoforms are the same protein folded in two distinct ways. In tissues of individuals dying of prion diseases, only PrP^{Sc} has been detected to be specific for the encephalopathies (Prusiner, 1998). The exceeding specificity of PrP^{Sc} for prion disease is an important feature of the protein and is consistent with the postulated role of PrP^{Sc} as both the transmissible and pathogenic agent of TSE (Prusiner, 1998). Interestingly, the physiological role of the normal prion protein, PrP^{C}, has yet to be determined. Mice engineered not to produce PrP^{C} develop normally and suffer from surprisingly few defects (Aguzzi and Weissmann, 1997). Nevertheless, the results of many studies have shown that the two PrP isoforms play a central role in the transmission and pathogenesis of prion disease. In addition, the abnormal isoform, PrP^{Sc}, is an essential component of the infectious prion particle (Prusiner, 1998).

On the basis of genetic studies, Prusiner and colleagues have postulated that an unidentified 'protein X' may interact with PrP^{C} and help in its conversion to PrP^{Sc} (Aguzzi and Weissmann, 1997). Considering the substantial structural transition that takes place during prion formation, it seems entirely likely that a 'chaperone' protein may participate in the refolding process. Whether or not 'protein X' actually exists still remains to be determined (Prusiner, 1998).

Currently, little is understood about the mechanisms through which prions elicit brain damage. The manifestations of prion pathogenesis, however, have been well documented in the literature. Prions cause the formation of cavities within the brain, death of nerve cells, activation of astrocytes and microglial cells (two components of the central nervous system), and eventually lead to the lethal breakdown of electrical functions of the brain (Aguzzi and

Weissmann, 1997). The precise contribution of the various types of cells in the central nervous system (CNS) to prion pathogenesis remains to be determined, however by the time the first symptoms of a spongiform encephalopathy are recognized, there is already substantial damage to the CNS (Aguzzi and Weissmann, 1997).

BSE infection in cattle results in the loss of ability to coordinate muscular movement due to loss of motor control (Prusiner, 1998). At the beginning of the onset of BSE the cow appears alert but restless and anxious. As the disease advances, the cow starts to take a wide base posture, the abdomen becomes drawn up, and the manner of walking becomes abnormal, resulting in tumbling and skin wounds (Dealler, 1998). Small muscle spasms are seen over the surface of the neck and body with an occasional larger jerk. The cow loses eventually loses weight and makes frantic movements, including aimless head-butting (Dealler, 1998).

Outwardly, the human prion disease CJD manifests itself as progressive dementia. After the incubation period, the first signs of the disease are changes in sleeping and eating habits, and over the course of a few months the condition progresses to a completely neurological syndrome. Symptoms include muscle spasms, dementia, a loss of higher brain function, sensory and visual function decay, and behavioral irregularities (Dealler, 1998). The disease continues even further due to deterioration in cerebral and cerebellar function and decreased neurological activity. Inevitably the patient dies, usually after a decrease in lower motor neurological function which results in seizures. Most die in about a year, but some can suffer for as long as 10 years (Dealler, 1998).

Research has found prions to be most damaging when delivered directly to the brain, however this is not a normal route of infection. Most cases of CJD transmission in humans have been traced to intramuscular injection of prion-contaminated pituitary hormones (Aguzzi and

Weissmann, 1997). Oral uptake of prions has also resulted in infection, for example, cannibalistic rituals have been linked with incidences of Kuru (another spongiform encephalopathy) in Papua New Guinea in the 1950s (Aguzzi and Weissmann, 1997). Among animals, BSE is a more recent and significant example of a disease that is caused by oral uptake of prions. Once in the body, prions seem to be able to travel through the body to the brain of the host, yet they only cause noticeable damage in the CNS (Aguzzi and Weissmann, 1997). It is suspected that during the incubation phase of TSE that prions may multiply in 'reservoirs' without causing harm to the body. One such reservoir may be the lymphoid organs of the immune system (Aguzzi and Weissmann, 1997). Although the lymphoid organs are a suspected reservoir of TSE it is unlikely that immune cells transport prions all the way from lymphoid tissue to the CNS during the infectious stage. Instead it is suspected that the infectious agents probably spread through the peripheral nervous system (PNS) to the CNS, much like rabies and herpesviruses (Aguzzi and Weissman, 1997).

One particularly disturbing aspect of prions is their strong resistance to inactivation when using methods that are conventionally effective against bacteria, viruses, and other hazardous biological material. Prions are resistant to inactivation by ultraviolet light, ionizing radiation, phenolic disinfectants, cooking, and even autoclaving at 132-138°C (Taylor, 1999). According to Taylor, the only methods that appear to be completely effective under worst-case conditions are immersion of contaminated material in strong sodium hypochlorite solutions (bleach) or hot solutions of sodium hydroxide. While this may be effective, these are both harsh chemicals and have no place in food production and limited applications for sterilizing high-tech hospital instruments (Taylor, 1999).

Prion Diseases

The prion diseases affecting humans can be broken down into three separate categories: genetic, infectious, and sporadic disorders. In genetic disorders, the prion disease is caused by a mutation in the PrP gene. This inheritable mutation results in the production of an abnormal version of the normal cellular protein PrP^{C}. Much like PrP^{Sc}, the abnormal protein resulting from the mutation can go on to cause spongiform encephalopathies (Prusiner, 1998). To date, more than 20 mutations of the PrP gene are known to be responsible for the inherited human prion diseases, some of which include familial CJD (fCJD), Gerstmann-Straussler-Sheinker disease (GSS), and fatal familial insomnia (FFI) (Prusiner, 1998).

The infectious prion diseases are caused by pathogenic prions that are incorporated from an outside source. One example of an infectious prion disease is Kuru of the Fore people in New Guinea, where prions were transmitted to tribe members by ritualistic cannibalism (Prusiner, 1998). Infectious CJD has occurred on several continents because of prions present in improperly sterilized depth electrodes, transplanted corneas, human growth hormone derived from cadaveric pituitaries, and dura mater grafts (Prusiner, 1998). Perhaps the most widely publicized example of an infectious prion disease in humans today is variant CJD, which is shown to be caused by the same strain of agent that has caused the BSE epidemic (Almond and Pattison, 1997).

In addition to the prion diseases that are known to be caused by genetic mutations or infectious episodes, there are also prion diseases that occur despite a lack of mutation in the PrP gene and lack of connection to an infectious agent (Prusiner, 1998). These prion diseases are

classified as sporadic disorders until some causal understanding can be obtained (Prusiner, 1998).

Understanding the BSE epidemic in Europe today is the predominant challenge for biologists studying infectious prions. It is now estimated that at one point, almost one million cattle were infected with prions in Great Britain (Prusiner, 1998). Because the average incubation time for BSE is 5 years, most cattle never manifested the disease because typical slaughter occurs between two and three years of age. In spite of that, more than 160,000 cattle, primarily dairy cows, died of BSE between 1988 and 1998 in Great Britain (Prusiner, 1998). Today, most scientists agree that the cause of the BSE epidemic can be traced back to meat and bone meal that was fed to cattle as a high-protein nutritional supplement (Prusiner, 1998). This meat and bone meal was prepared from the waste products (offal) of sheep, cattle, pigs, and chickens. In the late 1970s, the hydrocarbon-solvent extraction method for rendering of offal was widely abandoned, resulting in meat and bone meal with a much higher fat content (Prusiner, 1998). It is believed that this change in the rendering process allowed infectious scrapie prions from the sheep to survive and be passed into the bovine population, thus leading to later outbreak of BSE (Prusiner, 1998).

In 1994, the first cases of CJD in teenagers and young adults that would eventually become known as variant CJD (vCJD) began to occur in Britain (Prusiner, 1998). Recognition of the emergence of vCJD as a predominantly British disease about ten years after the start of the BSE epidemic did not go unnoticed. Given the rarity of the appearance of new TSE, the emergence of a new form in Great Britain at that time was considered unlikely to be a mere coincidence (Almond and Pattison, 1997). The unusual neuropathologic changes in victims of vCJD had not been seen in traditional CJD cases in the US, Australia, or Japan, giving rise to the

suspicion that this was indeed a new infectious prion disease in humans (Prusiner, 1998). Although controversy still remains, epidemiological and clinicopathological studies, along with pathological prion protein analysis, strongly support the hypothesis that the human prion disease vCJD is causally related to BSE. (Hill et al., 1997). Because of the long incubation times and other unknown factors, such as genetic predisposition and exposure criteria, scientists still cannot assess whether the incidence of vCJD will increase or decrease in the future (Aguzzi and Weissmann, 1997).

As researchers learn more about prion biology it should become possible to design effective therapeutics. Because people at risk for inherited prion diseases can now be identified decades before symptoms are evident, the development of an effective therapy is imperative (Prusiner, 1998). Currently, the most attractive target for therapy would be interfering with the conversion of PrP^{C} into PrP^{Sc}. Alternatively, drugs that destabilize the pathogenic structure of PrP^{Sc} might prove useful (Prusiner, 1998).

In addition to developing therapies for prion diseases, researchers are also looking into novel ways to prevent occurrence of the disease in the first place. One way to prevent BSE from entering the food chain is to monitor for prion disease in cattle as they are slaughtered for human consumption (Prusiner, 1998). Although there is no reliable test for prion disease in live animals, assays do exist that will detect pathogenic prions in the brainstems of cattle. This may provide a reasonable approach to establishing the incidence of BSE entering the human food chain (Prusiner, 1998). Another possibility lies in using genetic modifications to produce prion-resistant animals (Aguzzi and Weissmann, 1997). While promising in theory, this solution would be very expensive and the practical difficulties of replacing many different breeds while maintaining genetic diversity may be limiting (Aguzzi and Weissmann, 1997).

General BSE Policies

Variant Creuzfeld-Jakob disease is as of yet an incurable, deadly disease that one could contract simply by eating a hamburger at the neighborhood restaurant. Because of this, many government agencies worldwide have instated strict policies and regulations on the cattle industry. The purposes of these regulations are two-fold. First and foremost, they are meant to protect humans from the immediate danger of contracting vCJD. The second purpose is to eradicate BSE from the bovine population. The later is the long-term solution to both vCJD and BSE.

To protect humans, BSE infected animals must be kept out the human food chain. Testing and finding all diseased animals and disposing of them are one of the ways to accomplish this.

There are two major ways to detect a BSE infected bovine. The first is by clinical monitoring. That is, a bovine is watched for signs of BSE behavior. However, BSE has on average a 4 to 6 year incubation period. Clinical signs of BSE will not show up until after this incubation period. The second detection method is BSE tests. These tests look for the prions that accompany the BSE disease. However, they cannot be administered to live cattle. A suspect bovine must first be slaughtered. In addition to this, even the best tests will only give a positive BSE reading 6 months before the first clinical signs of BSE become apparent (Swiss Federal Veterinarians Office, 2001).

It is this difficulty of detection that makes BSE such a difficult problem. For example, even if contracted at birth, it impossible to tell whether a cow under 3 years of age has contracted

BSE. It is all too easy for an infected cow to slip through detection and enter the human food chain.

Thus, other regulations are required to prevent human consumption of BSE infected bovine. The basic idea behind these regulations is the destruction of bovine and bovine material that has the greatest chance of being infected with BSE. The infective BSE prions in (pre-) clinical bovines are found mainly in tissue known as specific risk material (SRM). SRM consists mainly of nervous system tissue and lymphatic system tissue. In many countries SRM for all bovines is banned from entering the human food chain. Another example of these regulations is the slaughter and disposal of all bovines that were born before a certain time on cattle farms that have experienced one or more BSE cases. The logic here is that the rest of the members of the herd must also be looked at as having come in contact with BSE infected feed.

Ultimately the main goal is to eradicate BSE from the bovine population. Since, there is mainly one method of transfer of BSE; that being feed, one might believe this is relatively easy. A simple ban on feeding ruminants animal remains should take care of the issue. However due to factors such as cross-contamination and difficulty of detection, this is not so.

To get a better understanding of this, the dynamics of a BSE/Bovine system must be understood. A BSE/Bovine system like Switzerland's can be viewed as a compounding circulation loop. The loop begins with an initial importation of infected cattle and (or) infected bovine feed into it. The infected cattle are slaughtered and their remains are rendered into more BSE infected animal feed. All this feed then infects more cattle. These newly infected cattle are eventually slaughtered and rendered. This loop goes on all the while more infected feed and cattle are imported into it. Without any policies to hold the loop in check, the system would produce an enormous population of BSE infected bovines over time. Such a system would be

considered extremely unstable[1]. This typified the situation in Switzerland prior to November 1990. To prevent a BSE/Bovine system from being unstable, several policy measures must be taken. These are Surveillance and culling policies, Specific Risk Material policies, rendering regulations and feed policies.

Surveillance and culling is a factor in prevention by identifying BSE cases and related cattle at risk. The BSE infected cattle are culled from being processed and then destroyed. Since the culled cattle are destroyed, the amount of infective material entering the bovine food chain is reduced. This factor is not as essential in controlling BSE as the other factors. However, it can improve the stability of a BSE/Bovine.

Specific Risk Material policies are an important factor in decreasing the amount of infectivity in a BSE/Bovine system. By excluding this material from rendering, the majority of the prions in an infected bovine are kept out of the bovine food chain. For example, if a BSE infected bovine slips through the surveillance program and is sent to rendering, the portions that harbor the most infectivity cannot enter the bovine food chain.

Rendering another very key step in the BSE model. As was stated earlier in this review, the spread of BSE has been linked to a change in the rendering process at large continuous rendering plants. The different process allowed the infectivity to survive to be eaten by other animals. Thus a rendering process can reduce the amount of BSE infectivity, which can enter the bovine food chain.

Feeding regulations are the last lines of defense to prevent a bovine from consuming BSE infected material. These regulations are particularly important when an animal feed ban is in

[1] According the Scientific Steering Committee SSC in their *Report on the Assessment of the Geographical BSE-Risk (GBR) of Switzerland,* stability is defined as "... the ability of a BSE/cattle system to prevent the introduction and to reduce the spread of the BSE agent within its boarders." The report goes on to explain "... a 'stable' system would eliminate BSE over time; an 'unstable' system would amplify it." (SSC, 11 and 12)

place for bovines only. Cross-contamination of different feeds and the feeding of pig or chicken meal to bovines become the main ways of transfer of BSE to bovine. This was the case for Switzerland between the years of 1990 and 2001.

Switzerland's BSE Regulations

Since the first outbreaks of BSE in Great Britain, Switzerland has been very active in adopting specific risk material policies, rendering regulations and feed policies. The country has also instated an extensive BSE surveillance program.

The first of these regulations, instated on June 13, 1990, banned the import of live cattle, meat and bone meal, cattle byproducts, and cattle meat that originated in Britain. Though the ban did not officially begin till 1990, no import permissions were given for these products starting in 1988. As the first diagnosed case of BSE appeared in Britain in 1984 and the disease has a 4-6 year incubation period it would be safe to say that Switzerland was importing British BSE effected cattle and material for at least 8 years.

The next sets of policies attempting to stabilize the Swiss BSE/Bovine system were initiated in December 1990. They were in response to the occurrence of the first case of BSE in Switzerland. The two major factors addressed by these policies were feed and specific risk material. The feed measure was a ban on feeding meat and bone meal to ruminants. It should be noted that this policy affected only ruminant feed not any other farm animals (such as pigs or chickens). The SRM policy initiated at this time required that the carcasses of affected animals be incinerated. This reduced the amount of risk material that could enter the BSE/Bovine system.

The first policy regarding surveillance and culling was also established in these polices. A duty of notification was established for farmers. It also established that an epidemiological investigation would be conducted after a confirmed BSE case. In addition to this, all animals suspected of BSE were slaughtered and examined for the disease.

The next policy measure occurred February 1993. This measure addressed SRM. Previous to 1993 the legal definition of the safest methods for handling potentially infected material was treatment at 120°C for 20 minutes at 3 bars of pressure (Perler, 2001). In 1993 this definition was changed to treatment at 130°C for 20 minutes at 3 bars of pressure. The Swiss adopted this definition in regards to the processing of high-risk animal offal.

The next BSE regulation again addressed the problem of specific risk material entering the bovine food chain. This May 1, 1996 policy was in response to an increasing number of infected cattle that were born after the 1990 feed ban (Perler, 2001). Since animal meal was considered the main source of transmission, it was thought that meal meant for pigs and chickens was being feed to bovines or was contaminating bovine feed. Thus to address this problem it was made mandatory to incinerate the brain, spinal cord, and eyes of slaughtered or perished cows. It also required incineration or sterilization of the remaining inedible offal (eyes, tonsils, spleen, etc.) in cattle above the age of 6 months for 20 min at 133°C at 3 bars of pressure. In addition all fallen cattle were required to be incinerated.

Later in 1996, it was made mandatory to dispose of direct offspring of cattle affected by BSE. This regulation is a precautionary one, as it has not been scientifically determined whether BSE can vertically transfer. However, studies from England did refer to a possibility of vertical transfer occurring in their cattle population (Perler, 2001).

Toward the end of 1996 increasing economic sanctions were placed on Switzerland by several countries due to its BSE problem. In response to this a trade policy an SRM policy was initiated. The SRM policy made it mandatory to incinerate all bovines born before the December 1990 feed ban on farms that had experienced a BSE case. This policy was modified a little less than three years later due to the findings of study, which defined the risk animals within an affected herd (Perler, 2001).

The trade policy of December 1996 attempted to remove the threat of importing more BSE into the Swiss cattle system. It allowed imports of live cattle and small ruminants originating from countries having prohibited the animal meal in ruminant feed.

Starting January 1999 Switzerland began its BSE Surveillance Program. Switzerland's Federal Veterinary Office (BVET) initiated this program with the development of better BSE test methods. According to the BVET models, out of the 1.7 million cattle population there are some 150 undetectable BSE infected bovines living in Switzerland (Swiss Federal Veterinary Office, 2001). The model calculations also predict that 100 – 110 will be detected in the future. This meant that 40 to 50 would enter the market. One of the main objectives of the Surveillance Program is to increase the BSE bovine detection rate and thereby decrease the number of infected bovines entering the market.

The program accomplishes this by testing fallen cows (those killed because of disease or an accident), emergency slaughtering of cows (those cows which are killed in the slaughterhouse due to suspicion of disease or an accident), and a random sample of cows.

Toward the end of 2000 it was found that cattle, which were born after the May 1996 SRM incineration regulations, had contracted BSE. This was particularly disturbing to the Swiss beef industry and policy makers as these regulations were viewed by many as being stringent

enough to end the circulation of BSE throughout the Swiss cattle system. The possible reasons for these born after 1996 cases are cross-contamination of feeds intended for different animals, non-compliance with the current BSE regulations, insufficient policies regarding BSE, vertical transfer of the infectious agent, and spontaneous mutation leading to BSE. To deal with cross-contamination, non-compliance and insufficient policies, a full ban on animal feedstuffs being feed to farm animals was initiated in January 2001.

BSE Policy Problems in the United Kingdom

One of the main world news stories of the late eighties and early nineties was the British government's handling of the BSE crisis. BSE originated in Britain and reached epidemic proportions there. Because it was a new and quite mysterious disease, England was initially forced to design policy without data. This is a particularly difficult situation for a government to be in. This difficulty showed itself in the form of two contradictory statements made by the British BSE research committee, the Spongiform Encephalopathy Advisory Committee (SEAC). Prof. John Pattison, the SEAC chair, declared that SEAC "had a high degree of confidence that the beef reaching the shops is safe to eat" (Oakley, 2000). However, not more than one month before, acting on the advice of this same committee (SEAC), the British government announced a ban on use of bovine vertebral column in the manufacture of mechanically recovered meat (Jacob and Hellstrom, 2000). These two statements coupled with a March 1996 SEAC report of a probable link between BSE and vCJD, caused what is referred to as "one of the most costly public policy crisis of the decade" (Jacob and Hellstrom, 2000). The British agricultural industry's reputation was severely damaged. The country's relationship with it's partners in the

European Union was greatly harmed. The monetary costs alone have been estimated to be around $10 billion. This figure does not even touch the damage to the British government's reputation.

The Phillips Report details the shortcomings of the British government and SEAC that resulted in this public crisis. The report indicates one of the major problems was that the SEAC was given too much authority to make policy (Oakley, 2000). The Phillips Report on BSE by the Lancet and vCJD states "A clear conclusion from the inquiry is that expert scientific committees should be restricted to giving advice and should not be setting policy" (1535, 2000).

Jacob and Hellstrom have a different take on the causes of the crisis. They stipulate that the unusually strong public response to the unsafe beef announcement had much deeper roots. During the decade before this announcement, there were a number of publicized food supply contamination problems in Britain (salmonella, listeria, E-coli, pesticide). These problems lowered public trust of the British government's commitment and ability to keep a safe food supply (Jacob and Hellstrom, 2000). Jacob and Hellstrom also suggest five broader factors that led to the disastrous outcome. These factors are "political culture, level of public trust in the government, European Union politics and regulations, policy understanding of science and national interests, and Britain's longstanding position as a reputable supplier in the international cattle industry" (Jacob and Hellstrom, 2000).

General Information on Agriculture in Switzerland

In 1998, 1.7078 million hectares were used for agricultural purposes in Switzerland, an area slightly less than 40% of the country's total area (Niggli, 2000). Approximately ¾ of that

land was used to produce livestock and feed for livestock, the other ¼ was dedicated to the cultivation of various crops including cereals (17%), potatoes and sugar beets (3%), fruit and berries (1.9%), wine (1.2%), and vegetables (0.7%) (Niggli, 2000). In 1998 there were 76,000 farms in Switzerland, averaging 14.2 hectares in size. Today, Swiss agriculture meets 65% of the total domestic food demand. In addition, domestic supplies are meeting 90% to 100% of the demand for potatoes, pork, veal, cattle, and most milk products. The current average productivity of Swiss agriculture is comparable to or higher than that of the EU (Niggli, 2000).

Beef and Related Industries Decline

There are approximately 3000 infected cattle with Bovine Spongiform Encephalopathy (BSE) in Europe presently. The demand for cattle plummeted in response to this news (Rohwedder, 2001). Within the beef and related industries workers have experienced layoffs. It has been predicted by International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers' Associations' (IUF) General Secretary, Ron Oswald, that the result of the recent outbreaks of BSE cases, beef demands have decreased (IUF, 2000). The decrease in demand for beef will lead to a decline in prices. In response to the decline in prices the beef industry will be forced to make job cuts and/ or reduce the income of the employees to maintain a stable economic balance. Between 1990 and 1999 there has been a 13.5 percent decline in the number of Swiss farms used to raise cattle (welcome.html, 2001). It can be concluded from the decline in farms that there has been a decrease in the number of herds of cattle in Switzerland between 1990 and 1999. It is suggested that from this data (Appendix B.3), the number of farms

have decreased in response to the discovery and spread of BSE in European countries including Switzerland.

The price of feed has increased as well. Prior to 1994 cattle feed contained recycled cattle remains including the head and intestines. This was a cheap source of protein to include in the feed. Since then the discovery of prions has indicated that recycling ruminant animal parts in feed leads to an increase in the number of cases of BSE in cattle. The farmers now must purchase more expensive feed that has been modified to have a suitable level of protein. This leads to an increase in the cost of the feed, which is another strain on the income of farmers in Europe. When facing increasing feed costs and declining beef prices, farmers can expect financial trouble.

Costs

There is a certain "willingness to pay" (WTP) that the public accepts in order to provide funding to research and eventually alleviate this problem (FSA, 2000). Values such as the level of exposure to the public rather than workers, children affected versus the general population affected, events that affect a large number of people at the same time and agents that cause disease in the future determine the public's willingness to pay (FSA, 2000). These factors usually play a role in whether people feel confident in investing their money into a program like research and detection facilities for BSE. Primarily occurring in young people vCJD has been a stressful disease that requires extensive attention and extensive funding. A substantial amount of funding would be required to research BSE to eventually derive a cure for the disease. Hospitals also require a significant amount of funding for the patients affected by transmissible spongiform

encepalopathies. Presently there are approximately 10-20 cases of vCJD diagnosed per year in the United Kingdom. The costs for treatment and care are approximately 45,000 thousand pounds per patient (FSA, 2000).

The estimated total that BSE has cost the United Kingdom (UK) is approximately 550 million pounds per year. The costs include compensation for destroyed cattle, removal of specified risk material (incineration) and surveillance of cattle. The table in Appendix B.1 shows the cost distribution between the British industry and government in millions of pounds per year.

The European government has recently allocated 150 million Lire to destroy ruminant animal remains and feed at risk of contamination from BSE (Rohwedder, 2001). French farmers in a recent protest in Vitre blocked the entrance to an integral cattle-processing plant with their tractors to bring the government's attention to the BSE problem. The French farmers are losing 2000 Francs per head of cattle because of complications from mad cow disease (Rohwedder, 2001).

Imports

The federal government of Switzerland is very supportive of the agricultural industry. Ten percent of the population in Switzerland is employed through the agricultural industry. Switzerland is approximately 65 percent self sufficient in the agricultural industry the remaining percentage comes from imports and exports (USDC, 1999). There were considerable quantities of beef exported from the European Union and Non-European Union countries to the United Kingdom (UK) in response to the controversy over BSE contaminated food. The Irish Republic was the number one exporter of beef within the European Union and Brazil topped the Non-

European countries. Switzerland has exported almost 600 tonnes of beef between September 1999 and August of 2000 to the UK (Appendix B.2). The Swiss agricultural portion of the economy over the last decade is slowly on the decline. There has been a decline in the importance of the agricultural industry, which is only being maintained by the federal government intervention and a larger reliance on foreign goods (welcome.html, 2001). Purity of a product and a good public reputation are key factors that appeal to consumers. This may lead to consumers to choose foreign beef products rather than deal with the threat of BSE contaminated native beef.

New Waste Material Gathering

Occupational risks are a concern when dealing with BSE. Agricultural and cattle-processing employees can be considered to be at the front line of the risk of exposure to transmissible spongiform encephalopathies (TSE) (IUF, 2000). Scientific reports suggest that there have been no cases of occupational transmission of TSE to humans. However, there have been past cases when healthcare workers have been exposed to Creutzfeldt-Jakob Disease (CJD), which suggests that transmission is linked to occupational exposure (WHO, 1999). An occupational transmission of a disease like CJD could occur in two ways: direct inoculation and exposure through mucous membranes. Infection through direct inoculation would occur if a person were to accidentally puncture his or her skin with a needle or introduce the contaminant to his or her body through an open sore. This method of exposure has the highest potential risk for infectivity. Accidental ingestion or incidental contact with the mucous membrane is classified as a potential risk for contraction of a TSE (WHO, 1999).

No cases of TSE have been recorded or known to exist as a result of occupational accident or injury while interacting with contaminated materials. A series of strategies have been designed to limit the potential risks in the event of an accident resulting in contact with infectious material (WHO, 1999). Procedures for limiting exposure levels through contact with unbroken skin, puncture wounds and mucous membranes were all given by the World Health Organization. Health and safety guidelines require that all documentation related to incidents like those described remain accessible for no less than 20 years.

TSE is known to be very resilient to disinfection and sterilization through most common procedures use today in the beef processing industry (BSE) and in health facilities (CJD) (WHO, 1999). A recommended list of unsuitable chemicals and physical processes to avoid for the decontamination of the infectious pathogen was defined ranging from ineffective to partially effective by a World Health Organization (WHO) literary source. It was explained by the WHO that use of disposable instruments is preferable to having to cleanse potentially hazardous instruments for reuse. In the event of reusing instruments the preferred method of cleansing is repetitive autoclaving of the instruments around 120-130 degrees Celsius and bathing the instruments through a series of sodium hydroxide solutions (NaOH) (WHO, 1999).

Similarly, work surfaces can be decontaminated by mechanically removing any build up of material then flooding the surface with NaOH for an hour and finally washing the surface with water. The remaining mixture of contaminates and cleaning solutions is considered to be hazardous material (WHO, 1999). All solid and liquid materials that are considered to be hazardous material must be disposed of properly. An absorbent material such as sawdust can be used to absorb liquid waste material. Then the sawdust and solids are properly disposed of

through incineration (WHO, 1999). Employees involved in decontaminating procedures should utilize disposable single use clothing, gloves, mask, and goggles for their safety and protection.

Waste materials can be described as the discarded material that has come into contact with blood and its derivatives (WHO, 1999). Material from hospital facilities such as cultures, syringes, scalpels, blood bags, swabs, dressing, tissues and materials from the beef processing industry such as cattle remains (head and intestines), decontamination liquids and solids can be considered waste materials. All of these waste materials that are disposable should be incinerated at the nearest incineration facility or if none are available the disposable material should be burnt on a pit (WHO, 1999). Metal materials such as syringes and other instruments can be autoclaved to remove any pathogens and then discarded.

Livestock and TSE

Some of the specific sources of contamination that have been identified by several health organizations are previously recycled ruminant cattle parts. Some of these ruminant cattle parts are recognized as specified risk material (SRM). In sheep and goats this includes the entire head, spleen, tonsils, spinal cord in both sheep and goats. In cattle the entire head (except for the tongue), spinal cord, tonsils, and spleen of all cattle over six months of age are considered specified risk material. In bovine the thymus and intestines are considered SRM after 2 months of age (BSE Control Review, 2001). This becomes an issue since these were formerly recyclable and now grow in a pile in the slaughterhouse until incinerated.

Conclusions:

Bovine Spongiform Encephalopathy continues to be a persistent problem in Switzerland and other countries throughout the world. Although it can be argued that Switzerland has some of the best policies in place to control BSE and prevent vCJD, it is unlikely that every policy is perfect. Indeed, despite the fact that extensive policies have been enacted to contain BSE, it is far from being eradicated. The three major preventative factors that have been combined to reduce the spread of BSE include avoiding recycled animal meal in animal feeds, inactivating BSE prions in animal feed, and excluding specific risk material (SRM) from the animal feed supply. Today, Switzerland has policies that reflect each of these key preventative measures and they have proven to be effective by reducing the cases of BSE in Switzerland over time. In addition, Switzerland has an extensive surveillance program in place for detecting cattle that may be infected with BSE.

Despite all of these preventative measures, there are still occurrences of BSE in Switzerland. Potential reasons for the endurance of BSE include the cross-contamination of feeds intended for different animals, non-compliance with the current BSE regulations, insufficient policies regarding BSE, vertical transfer of the infectious agent, and spontaneous mutation leading to BSE. Of these possible causes of BSE, cross-contamination, non-compliance, and inadequate policies can be controlled by enacting better BSE related regulations and through enhanced enforcement of the policies currently in place.

Methodology

As stated in the introduction, the primary objective of the research team was to assess the confidence of the various beef supply organizations in the methods used to prevent BSE from entering the food supply. The organizations of interest were farmers' unions, animal feed producers, cattle processors and distributors, beef retailers, the Swiss Federal Veterinary Office, processors of specific risk material and cantonal veterinarians. Archival data research and interviews were the major methods used to collect data concerning the confidence of these various organizations. Analysis of this data led to the identification of both controversial issues and areas of widespread agreement. This analysis was then developed into appropriate conclusions and recommendations.

At the beginning of the first week the project team contacted Dr. Caspar Wenk, a professor at the Institute for Animal Nutrition at the Swiss Federal Institute of Technology in Zürich. It was anticipated that Dr. Wenk would be able to serve a role similar to that of a liaison by helping the team identify initial contacts within the various organizations involved in beef production in Switzerland. Dr. Wenk proved very useful by providing a wide range of contacts within the beef industry.

During the first and second weeks, question and interview development took place. Preliminary data was collected from archival information contained in various Internet sources. Specifically, two types of information were sought. The first type included information and data on any current and pending policies regarding the control of BSE in Switzerland. This provided the essential policy understanding necessary for successful interview development and execution. The second type of information that was gathered was anything that helped to gauge

the confidence of the beef supply groups in the methods used to prevent BSE from being incorporated into the food supply. This material was also useful in developing and conducting interviews because it gave the research team an early insight into the confidence of the various groups in the current policy base.

For the interviews the research team designed a series of questions that were applicable to all groups involved in beef production. In addition to these core questions, the project team developed questions that were applicable to only certain organizations. These tailored questions were designed to gain addition insight into each area of beef production (Appendix C).

Before conducting any interviews, the project team pre-tested the interview schedule with Caspar Wenk. This was done for several reasons. The first reason was that the team wanted an unbiased opinion on the quality of the questions from a professional with a good understanding of BSE. Second, the team needed assurance that the questions were clear to individuals who do not speak English as a first language. Finally, the team wanted to ensure that Swiss natives would not interpret the questions as offensive. After making the corrections suggested by Dr. Wenk the project team was ready to begin interviewing individuals involved with beef production and supply.

The actual process of interviewing took place between the third and sixth week of the project. A total of seven interviews were completed with individuals representing the following organizations: Interferm AG, a company that produces additives for animal feed (Fritz Näf); The Swiss Federal Veterinary Office (Dagmar Heim); The cantonal veterinary office of Zürich (Heinrich Binder); Bell AG, a company that processes and distributes beef in Switzerland (Davide Elia); Micarna SA, a company that slaughters, processes, and distributes beef in Switzerland (Peter Hinder); The Schweizerischer Bauernverband, a farmers' union located in

Brugg, Switzerland (Heiri Bucher); and Centravo AG, the company that is responsible for processing specific risk material from cattle in Switzerland (Hans Hofer). Each interview started with an introduction of the team members and a brief explanation of the research being conducted. Then, after some preliminary information about the interviewee was obtained, the interview questions were asked. Each team member participated in asking the questions and each team member recorded the responses to the questions. Once the interview was completed the team members individually wrote out a more detailed transcript of the interview. These transcripts were then compiled and each team member examined the compilation for statements that could be classified into five different categories of results. The five categories and the scheme for classifying the data are defined in the beginning of the results section.

The analysis of the interview data was conducted between the 4th and 7th weeks of the project. A combination of narrative policy analysis and conventional policy analytical techniques were used to interpret the interview data. Emery Roe describes narrative policy analysis as the use of stories to describe policy issues (Roe, 1994). Essentially the technique inspects the uncertainties, complexities and polarization of groups related to, and included in the policy network. The project team designed a method for analyzing the data using ideas taken from Roe's narrative policy analysis.

The analysis consisted of examining the viewpoints of the interviewees and identifying both controversial issues and areas of general agreement. Some of the topics that were discussed include the necessity for high quality meat products, the degree to which current BSE regulations build consumer confidence, and the fact that it may be impossible to achieve total safety from BSE.

Once the analysis was completed the research team developed conclusions and recommendations. Some of the ideas discussed in this section include a call for more research on BSE, the belief that Swiss policies can be used as a model for other countries, and the fact that better implementation of Swiss policies is necessary.

The remaining time was devoted to preparation of the presentation and final report. Conclusions about the outcome of the research were drawn and the value of the research was established. The final report was submitted to Swiss governmental regulatory agencies and to the organizations involved in beef production and supply so that the conclusions and recommendations could be acknowledged and perhaps acted upon.

Results

In this section, the data collected from the interviews is presented. After each interview, the project team compiled interview notes and identified excerpts that could be classified into five general categories. These categories include problems, suggestions for improvement, causal relationships between BSE and the beef industry, relationships between policies and policy outcomes, and individual viewpoints. While the meaning of "problems" and "suggestions for improvement" should be intuitive, the latter three categories warrant some clarification. Excerpts classified as "causal relationships between BSE and the beef industry" are statements that illustrate the connection between a BSE related event and its impact on those involved in beef production. "Policies and policy outcomes" are excerpts that identify a perceived causal link between a policy and a particular state of affairs. Finally, "individual viewpoints" are those excerpts that could not be classified in the previous four categories but are still important for understanding the interviewee's insight into the issue. Grouping the results in these categories made it possible for the project team to conduct the analysis.

Dr. Fritz Näf

On Wednesday March 28, 2001 the project team interviewed Dr. Fritz Näf. Fritz Näf is the General Manager of Interferm AG (Wallisellen, Switzerland), a company that produces feed additives and natural products for animals. Dr. Näf was referred to the project team by Professor Kent Rissmiller of Worcester Polytechnic Institute (Worcester, MA U.S.A.). The project team chose to interview Fritz Näf because of his expertise with respect to the animal feed industry.

The following excerpts represent data collected from the interview with Dr. Näf. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- BSE is a global problem and mobility of livestock is a threat that affects all countries.
- The current BSE regulations are designed to enhance safety but it may be impossible to achieve absolute safety from BSE.
- There will always be some contamination with SRM in the slaughter process; no process can be perfect.
- If genetics plays a role in the ability for an animal to become infected with BSE, Dr. Näf believes that current artificial insemination and breeding practices can amplify the number of BSE cases.
- The total feed ban, which prohibits all farm animals from eating feeds containing animal proteins, is not favorable for Switzerland. After the removal of specific risk material from slaughtered animals there is a significant amount of protein remaining. It is ecologically wasteful to incinerate this source of protein.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland:

- Because Dr. Näf believes that the policy banning all recycled animal proteins in farm animal feed is excessive and ecologically wasteful, he suggests that recycling of animal proteins must be allowed in the future (except in the case of ruminants).

- Dr. Näf believes that more research needs to be conducted in order to better understand the problem of BSE. Specifically, he mentions that a BSE test for live animals should be developed.
- Dr. Näf strongly believes that the accountability required for an ISO certification minimizes the risk of feed being contaminated with BSE, hormones, or other chemicals. Because the origin and history of every feed component must be known, there is less risk of accidental inclusion of unsafe material.

These excerpts from the collected interview data were identified as causal relationships between BSE and the beef industry in Switzerland:

- The current BSE regulations build consumer confidence in the beef supply and therefore make the product more marketable. There is a large commercial benefit in following these regulations.
- The producers of beef have the incentive to go above and beyond the regulations to ensure that the consumer is receiving a high quality and safe product. This leads to more consumer confidence and trust from the public.

These excerpts from the interview with Dr. Näf were identified by the project team to be relationships between policies and policy outcomes:

- The current BSE regulations are designed to improve or help everyone in the beef industry. In effect, there is a large commercial benefit.

- Each canton is responsible for the implementation of the federal BSE regulations. This is conducive to a good surveillance system and better overall control of BSE in Switzerland.
- Within the slaughterhouses there is a veterinarian that inspects the slaughtering process. They then report to a higher-ranking veterinarian, who in turn reports to the cantonal veterinarian. Finally this cantonal veterinarian reports to the federal veterinarian. This leads to close supervision and a more responsive system. The farmers are also inspected by the cantonal veterinarians.
- Dr. Näf indicates that before the January 2001 total ban on animal based feed, farmers would sometimes feed to sick or under-producing cattle, feed intended for pigs or chickens. This was done because this feed had higher nutrient content. In addition he said mixing of different feeds, whether it occurs on the farms or at the feed companies, will continue to occur at small levels. However this mixing is no longer a problem. That is, feed will not be a direct cause for more cattle to become infected with BSE. This is due to the total ban on animal offal in animal feed.

Additional excerpts from the interview that were considered by the project team to be viewpoints belonging to Dr. Näf can be found in Appendix D.

During the interview, Dr. Näf emphasized the importance of two particular points. The first issue that he felt strongly about was the January 2001 feed ban amendment. He made it clear that this measure is ecologically wasteful and the recycling of animal proteins into feeds intended for non-ruminants must be allowed in the future. The second point that Dr. Näf underscored is the hypothesis that the ability to contract BSE requires genetic susceptibility. He believes that if this is the case, current breeding and artificial insemination practices could

amplify the problem if thousands of offspring are produced from an animal with genetic susceptibility to BSE. Because of these uncertainties, Dr. Näf also stressed the importance of more research on BSE.

Dr. Hans Hofer

On Thursday March 29, 2001 the project team interviewed Dr. Hans Hofer. Dr. Hofer is the CEO of Centravo AG (Lyss, Switzerland), a company that among other things is responsible for the rendering of specific risk material from slaughterhouses throughout Switzerland. The final product from this rendering process can be used as a fuel for the cement industry or it can be otherwise incinerated as required by law. Dr. Hofer was referred to the project team by Dr. Caspar Wenk of the Eidgenössische Technische Hochschule (ETH) in Zuerich, Switzerland.

The following excerpts represent data collected from the interview with Dr. Hofer. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- In Switzerland there is a law that states that the owner of waste is responsible for its disposal. Dr. Hofer poses the question: Who owns the waste from cattle slaughter? Farmers? Slaughterhouses? Consumers? Who should bear these costs?
- One weakness in the current policies is that the government still allows pigs to be fed liquid feed produced from slaughterhouse wastes.
- The government does not adequately compensate the costs incurred by stiffer regulations.

- There was a delayed reaction in Swiss policy making with respect to BSE. The problem was known to exist in the UK in the 1980s and he questions why Switzerland waited until 1990 to make its first policy.
- Dr. Hofer believes that there is probably some small amount of specific risk material left behind in the slaughter process. This he feels depends on the skills of the slaughterer. He says that even with good careful regulations there will always be some risk involved because no process can be perfect all of the time.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland.

- Dr. Hofer says he would ban all animal offal from feed intended for animals because of economic and consumer confidence reasons. This would include liquid animal feed produced from slaughterhouse wastes. He says the best way to handle the problem of BSE would be to ban all animal materials from feed intended for animals. In addition to this, Dr. Hofer feels that the government should better finance the costs incurred by the more stringent regulations.
- Meat must be high standard product because consumers must have confidence in the safety of what they are buying. Therefore the meat industry must remain clean and open to scrutiny.
- Dr. Hofer indicates that research is key for the BSE problem. He says we need better understanding as to the cause and modes of transmission of BSE. Additionally, he suggests

that research needs to be conducted to find a test for live animals and possibly to identify a BSE treatment.

The project team identified the following excerpts from the interview with Dr. Hofer as relationships between policies and policy outcomes:

- Years ago farmers were upset about the regulations and there was a lot of protest. As a result, it is possible that there was some non-compliance going on. Today, however, Dr. Hofer believes that most people are in support of the regulations because they build consumer confidence in the industry and therefore increase the marketability of the product.
- Dr. Hofer suggests that it will be interesting to see the outcome of the January 2001 animal feed ban on the number of cases of BSE. In addition, he is confident that the measures that have been taken so far have reduced the cases of infection in Switzerland.

The excerpts from the interview that were considered by the project team to be viewpoints belonging to Dr. Hofer can be found in Appendix D.

Dr. Hofer displayed more of a businessman's perspective on BSE policy throughout his interview. Many of his responses discussed economic factors relating to BSE. The economic factors he mentioned include marketability of the product, consumer demands for the industry, future trends in the industry, and more government financing of BSE problems in the industry.

In regards to the industry he seemed to be very consumer oriented. That is, he feels that the best thing the beef industry can do is provide the consumer with the highest quality product.

Therefore with respect to BSE, he feels that all the regulations, which the consumer deems necessary or will increase consumer confidence, should be taken.

Dr. Dagmar Heim

On Monday April 2, 2001 the project team interviewed Dr. Dagmar Heim. Dr. Heim is one of the leading authorities on BSE for the Swiss Federal Veterinary Office. She was referred to the project team by Dr. Caspar Wenk. The following excerpts represent data collected from the interview with Dr. Heim. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- Dr. Heim considers the total feed ban that was enacted in January 2001 to be "ecologically criminal," but justified at this point. She hopes that if it is possible the feed restrictions to non-ruminants will be relaxed in the future.
- It may be that the regulation for cohort culling is excessive. There is only some statistical evidence to support vertical transfer, no actual scientific experimentation. Of course, because of the lack of information surrounding this hypothesis it is probably better to err on the side of caution.
- The regulation banning the use of animal remains as fertilizer is excessive considering that there is no scientific reason to suggest that using animal remains as fertilizer might be a problem.
- The foreign media plays a role in the lives of Swiss citizens. A Swiss citizen will read a newspaper or watch a news program from France or Germany and fear that the problems

these countries are experiencing are also a threat to Switzerland, even though this is not the case. These misconceptions can prove to be problematic for the beef industry in Switzerland.

- The current legislation in Switzerland is adequate but there needs to be more effort devoted to implementation of this legislation.
- Each canton is responsible for the implementation of the BSE regulations enacted by the federal government. Because of this, there are differences in the way that the regulations are carried out from canton to canton. This can sometimes be problematic.
- While for the most part Dr. Heim believes that the current BSE regulations are being closely followed by other institutions involved in beef and feed production, she feels that there are probably some groups or individuals that are not complying to the regulations as well as they could.
- Dr. Heim believes that failure to comply with all the regulations is the cause of the majority of the continuing cases of BSE. Furthermore, she feels that cross-contamination of feed (before the January 2001 total feed ban) was underestimated in its potential to cause BSE. For example, there was one farm in February 1997 that kept pigs and cattle in the same area. As a result, pigs could eat cattle feed and cattle could eat pig feed. When confronted the farmer stated that he never thought about this as being a problem despite the fact that cross feeding was taking place.
- Unfortunately the Federal Veterinary Office cannot afford to wait a full incubation period between policy actions, sometimes it is deemed necessary to move faster.
- Sometimes companies will make false claims to the media, such as "we have developed a BSE test for live animals," and then report that the test is still being processed when questioned by the Federal Veterinary Office. This leaves the public confused and

apprehensive and it sometimes leads people to accuse the Federal Veterinary Office of withholding information.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland.

- Because the total feed ban is ecologically wasteful, Dr. Heim suggests that it should be relaxed (for non-ruminants only) in the future if it is safe to do so.
- Dr. Heim calls for more research on BSE because there are many questions that remain to be answered.
- Today only post-mortem BSE tests are available. Dr. Heim suggests that it would be worth looking into a BSE test for live animals.
- Because BSE is not completely understood it is probably better to err on the side of caution when making policies and regulations to control the disease.

These excerpts from the collected interview data were identified as causal relationships between BSE and the beef industry in Switzerland:

- The current BSE regulations have been modified over time to adapt to the increasing knowledge surrounding the disease.
- In Switzerland, the cantonal veterinarian is responsible for the actual implementation of the regulations enacted by the Federal Veterinary Office and the federal government. Because of this, there are differences in how well the measures are implemented from canton to canton.

Recent inspections by the federal government revealed some problems with the implementation in some cantons and as a result, the Federal Veterinarian Office is now putting together its own control unit that will oversee the whole country.

- Dr. Heim believes that a recent public information campaign was important for building consumer confidence. Most Swiss didn't know that the regulations in Switzerland were already in place when outbreaks occurred in Germany and France. The drop in beef sales was mainly a reaction to what was going on in these countries, not to what was going on in Switzerland. Many people were surprised but relieved to find out that Switzerland had already enacted most of the important regulations well before most countries in Europe.
- Before this year there was little concern in the Swiss Federal Veterinary Office that farmers did not understand BSE and its related regulations. For reasons that she did not get into, doubts arose in the Federal Veterinary Office earlier this year over how well the farmers actually understood the regulations. As a result, a letter was sent to every farmer in February and March (2001) detailing the information and instructions surrounding BSE. Although there were many articles in the farmers' press regarding BSE the Federal Veterinary Office still felt that it was better to personally inform the farmers via a personal letter. She believes that these educational measures are adequate.

The project team identified the following excerpts from the interview with Dr. Heim as relationships between policies and policy outcomes:

- Dr. Heim felt that the policy requiring an entire herd to be culled in the event of BSE was too burdensome. She remembers phone calls during which people were crying about having

their herd destroyed, and she remembers questions about why people needed to kill the calves born this spring or the cattle bought last year. The worst part about this policy was the fact that she could not give a good scientific reason as to why the whole herd needed to be culled. The change in policy from herd culling to cohort culling made things much less burdensome.

- In the past it was possible that because of differences in processes that some SRM may have made it into animal feed. Of course, with the new ban on all animal protein in animal feed this should no longer be a problem.
- Dr. Heim believes that the policies in Switzerland are quite good and that they are far ahead of those in the EU countries. In terms of both surveillance and measures taken, Switzerland is one of the best.

The excerpts from the interview that were considered by the project team to be viewpoints belonging to Dr. Heim can be found in Appendix D.

As one of the leading authorities on BSE in the Swiss Federal Veterinary office, Dr. Heim was naturally very knowledgeable about the science regarding BSE. One of the main ideas that she stressed is that it is important to have scientific justification for any policies that are enacted. In addition, she emphasized that it important to keep an open mind about all the ideas and hypotheses surrounding BSE. Because there are many questions that still need to be answered, Dr. Heim maintains that it is important to be objective and let the weight of the scientific evidence support or refute the many ideas and hypotheses regarding BSE.

Dr. Heinrich Binder

On Thursday April 12, 2001 the project team interviewed Dr. Heinrich Binder. Dr. Binder is a veterinarian for the veterinary office of the canton Zürich. Dr. Binder was referred to the project team by Dr. Dagmar Heim and the project team chose to interview him in order to gain the perspective of an individual who represents the government and works closely with farmers.

The following excerpts represent data collected from the interview with Herr Heinrich Binder. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- An important problem with the current regulations is ensuring adequate implementation.
- There have been some problems with smaller companies following the current BSE regulations. Unlike the larger companies involved in beef production, these smaller companies do not have strict regulations for product control and documentation.
- International trade poses problems because of varying BSE regulations from country to country.
- There is a deficiency in the regulations controlling the production of artificial milk used for feeding calves. This artificial milk is widely used in Switzerland because it is cheaper than using cow's milk. Dr. Binder believes that this deficiency in the regulations may provide a gap for BSE to enter the system.

- Dr. Binder believes that it is ecologically wasteful to ban all animal proteins from animal feed. He believes that there should be some recycling of animal proteins (for non-ruminants) in the future if possible.
- The current regulations are justified if their costs are not taken into consideration. Some of the current regulations force the industry to reorganize their production and this can be costly.
- Dr. Binder does not believe that there is adequate communication to the public regarding BSE. There must be a good communication of why the regulations are in place to increase the confidence of the public. The main goal is to justify the current regulations to the public.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland.

- It is important to periodically re-educate the public and beef producers on the policies regarding BSE.
- At the present time the BSE regulations are acceptable but there should be reevaluations in the future.

These excerpts from the collected interview data were identified as causal relationships between BSE and the beef industry in Switzerland:

- Due to earlier problems with cross contamination of feed many feed producers have redesigned their production methods so that feeds intended for different animals are not produced on the same production lines.

The project team identified the following excerpts from the interview with Dr. Binder as relationships between policies and policy outcomes:

- Between 1996 and 1999 the government required that an entire herd be culled if one animal in the herd tested positive for BSE. Because this was such a tough measure and because there was no scientific justification for the measure many farmers felt that it was unfair. Eventually this policy was reevaluated and Switzerland switched to a policy requiring only cohort culling. Cohort culling is much more accepted by farmers.

The excerpts from the interview that were considered by the project team to be viewpoints belonging to Dr. Binder can be found in Appendix D.

Heinrich Binder gave the impression that he has confidence in the current regulations to remove BSE from the human food chain in Switzerland. He mentioned that this BSE problem is very difficult to manage and, unlike most problems, difficult to avoid. Food is necessary to sustain life and cannot be avoided. Because BSE is a threat to this important resource it is a unique problem that cannot be avoided like other problems, such as traffic or pollution.

Herr Heiri Bucher

On Monday April 9, 2001 the project team interviewed Herr Heiri Bucher. Heiri Bucher is a representative of the Schweizerischer Bauernverband, a cantonal farmer union located in Brugg, Switzerland. The project team chose to interview Herr Bucher in order to gain the farmer's perspective on Switzerland's BSE regulations.

The following excerpts represent data collected from the interview with Herr Bucher. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- Herr Bucher believes that the current BSE regulations are good on paper but they may not be adequately enforced. Until the central control unit starts in the fall of 2001 the government's ability to enforce BSE regulations will be limited. In addition, it will take time for the central control unit to get into full swing.
- Because of the long incubation of BSE (4-6 years) it is difficult to gauge how effective each policy is.
- Herr Bucher believes that meat imported into Switzerland could be a problem. The Bauernverband maintains that any meat imported into Switzerland should be produced under at least the same regulations and restrictions that are imposed on Swiss farmers. The Bauernverband is currently lobbying the government for this. At the very least, Herr Bucher believes that people should be informed of the differences in regulations when they buy meat produced outside of Switzerland.

- The Bauernverband is currently lobbying the government to pay the extra cost of testing all cattle for BSE before they are butchered because farmers believe that this would increase both consumer confidence and safety in beef. The government is not willing to pay the extra cost of testing all animals because it does not believe that the slight increase in safety is worth the extra cost.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland.

- Herr Bucher believes that while the BSE regulations are good Switzerland needs better enforcement of these regulations.
- More research is needed for a better understanding of BSE.
- Herr Bucher maintains that any beef imported into Switzerland should be produced under the same regulations and restrictions that are imposed on Swiss farmers. At the very least, any imported product should have a label that describes the country of origin and that country's BSE regulations.
- Herr Bucher suggests that occasional reminders regarding the regulations and clinical symptoms related to BSE are important for beef producers and consumers.
- Herr Bucher believes that farmers should receive subsidies to make up for decreased beef prices.

These excerpts from the collected interview data were identified as causal relationships between BSE and the beef industry in Switzerland:

- Herr Bucher believes that the cross-contamination and mixing of feed that occurred after the initial MBM ban was the cause of later cases of BSE.
- In some ways, Herr Bucher feels that the media is responsible for the decline of beef consumption in Switzerland. Consumers see reports of events in France and Germany and the result is a decline in demand of beef by Swiss consumers even though Switzerland has had measures in place since 1990 and there have not been any major incidences since then. Every media story on BSE hurts the industry. To counteract this, many groups involved in beef production have taken additional measures to gain consumer confidence. An example of this would be increased labeling of meat products. Nevertheless, events in other countries continue to impact the confidence of Swiss consumers. Images of burning cattle from the foot and mouth epidemic in Great Britain have turned a lot of people in Europe off from beef. Because of this Herr Bucher feels that years of struggling to regain confidence can quite literally go up in smoke.

The project team identified the following excerpts from the interview with Herr Bucher as relationships between policies and policy outcomes:

- Some of the continuing cases of BSE can be attributed to non-compliance and inadequate enforcement of policies.
- In the past the regulation requiring entire herd culling was largely undesirable and was opposed by farmers. The current regulation requiring cohort culling is much more accepted by farmers.

The excerpts from the interview that were considered by the project team to be viewpoints belonging to Herr Bucher can be found in Appendix D.

Herr Bucher gave the impression that the best possible measures have been drawn up to eliminate BSE from Swiss beef and he believes that now more effort should be dedicated to the implementation of these policies. He felt that the farmers are being treated adequately in terms of BSE. Now that herd culling has been changed to cohort culling, he feels that the regulations are more considerate of farmers. Though Herr Bucher deems all these regulations necessary he still is negotiating compensational money for the farmers from the government.

Herr Davide Elia

On Tuesday April 10, 2001 the project team interviewed Herr Davide Elia. Davide Elia is the director of public and investor relations for Bell AG (Basel, Switzerland). Bell AG processes and packages beef for Coop, one of the two major supermarket chains in Switzerland. Herr Elia was referred to the project team by Dr. Caspar Wenk. The project team chose to interview Davide Elia because of his expertise with respect to the beef processing industry.

The following excerpts represent data collected from the interview with Herr Davide Elia. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- Herr Elia is not completely sure that the government adequately enforces the BSE regulations it enacts. The regulations are difficult to enforce because there are many producers involved. The regulations are especially difficult to enforce with smaller companies.
- Some BSE problems can be traced back to feed producers and as a result perhaps better enforcement is needed for feed producers.
- Some of the continuing cases of BSE can be attributed to non-compliance. There will always be individuals in the system that do not take the regulations as seriously as they should.
- It is important to remember that there will always be some "black sheep" in the system. In some cases farmers and producers are non-compliant because of the financial burden imposed by the regulations. In addition, the regulations can be somewhat burdensome to farmers. Because feed is the largest budget item in their work, some farmers may try to evade the regulations to save money. This has to be expected.
- Herr Elia indicates that BSE has been around for a long time and from a scientific point of view there is a lot of uncertainty surrounding the disease. This makes it difficult to suggest causes for all of the continuing cases of BSE.
- Herr Elia tends to believe that overreaction is prevalent (in terms of policy making) and in many ways this results from some political desire to make up for mistakes of the past.
- Testing cattle for BSE is a problem because the Prionics test will only verify a BSE case in the late stages of incubation.
- Herr Elia finds it troubling that only 40% of a cow is used after it is slaughtered.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland.

- Herr Elia indicates that good enforcement is just as important as the regulations themselves.

These excerpts from the collected interview data were identified as causal relationships between BSE and the beef industry in Switzerland:

- Bell tests all cattle over 20 months of age for BSE when they are slaughtered (until now just 1 case has been detected, all other tests were negative). This is done because of the demand for high consumer safety.
- Today the amount of beef imported into Switzerland is very low, only about 5-8% of total beef sales are from imported products. Most of this imported beef is from South America. In general, demand for Swiss beef products increases when problems start to occur while demand for foreign beef products goes down. This is because (right or wrong) Swiss consumers consider Swiss products to be the best.

The project team identified the following excerpts from the interview with Herr Elia as relationships between policies and policy outcomes:

- Herr Elia believes that the current regulations already have and will continue to enhance the public's confidence in the beef supply.
- No live cattle are permitted to enter Switzerland under the current regulations. Only specific cuts of beef are admitted into the country. The sources of imported beef include the US and Argentina and these countries are believed to be BSE free.

The excerpts from the interview that were considered by the project team to be viewpoints belonging to Herr Elia can be found in Appendix D.

Herr Davide Elia appeared confident in the current regulations to eliminate BSE from Switzerland although he did mention that there were some minor problems. Herr Elia believes that beef has a both a strong cultural identity and worth. He was particularly disturbed by the amount of a cow that is wasted at the present time. He mentioned that years ago, approximately 80-90% of the cow was used but now only approximately 40% is being used and the rest is incinerated.

Herr Peter Hinder

On Thursday April 12, 2001 the project team interviewed Herr Peter Hinder. Herr Hinder is a manager with Micarna SA (Bazenheid, Switzerland). Micarna SA slaughters, processes, and packages beef for Migros, Switzerland's largest supermarket chain. The project team chose to interview Herr Hinder in order to gain the perspective of an individual involved in beef slaughtering and processing.

The following excerpts represent data collected from the interview with Herr Peter Hinder. They were identified from the transcripts by the project team as statements that illustrate problems for the beef industry.

- Herr Hinder believes that it is impossible for the government to completely enforce the BSE regulations it enacts because there are simply not enough government employees to watch

everyone all the time. In large slaughterhouses, such as Micarna, it is easier for the government to enforce its regulations because a veterinarian is present at all times to look over the animals and monitor the slaughtering process. In small slaughterhouses or butchers a veterinarian is not always present. A vet may see the animals beforehand or see the final product but there is not always someone there to monitor the complete process. Because of this, you can never be entirely sure that all the government's regulations were being followed.

- Herr Hinder feels that not everyone takes the threat of BSE as seriously as they should. For example, there was one case a few years back in which a cow had a fever and a veterinarian was called to inspect the animal. The vet did not believe that the cow had any signs of BSE so he permitted the animal to be sold. The animal went to the public market, was sold, and at the slaughterhouse it was found that the animal had BSE. Herr Hinder believes that as soon as something does not appear right you need to be safer than safe in dealing with the problem.
- The interpretation of some of the regulations is left up to the industry. By this, he means that a regulation will say "do this" but it does not detail how to "do this." This vagueness in how to carry out a given policy could possibly be a problem.
- It is difficult to know what may account for the continuing cases of BSE because we do not know everything about the disease and there is not enough information about what the various individuals involved in beef production are actually doing.
- Herr Hinder believes that the regulation banning blood and bone meal for fertilizer is excessive.
- Herr Hinder believes that it is somewhat difficult to separate SRM from meat intended for human consumption. For example, the spinal cord is difficult to completely remove.

Furthermore, it is impossible to be sure that every piece of SRM has been removed from each carcass because no process can be perfect 100% of the time.

- Herr Hinder does perceive a weakness in Switzerland's way in dealing with the BSE problem. He feels that the government only spends a lot of money on a problem after it occurs. In general it is easier to get money to fix a problem than it is to get money to prevent a problem.

The project team identified these next excerpts from the interview transcripts as suggestions for improving the quality of beef production in Switzerland.

- One thing he would like to see is a BSE test for live animals so that cattle can be tested before they come in to be slaughtered. To do this, more money needs to be spent on research. The cost of administering these tests, if they are developed, should be paid for by the industry, not the government. The industry could easily reflect the costs of the testing in the price of the final product.
- Herr Hinder believes that more money is needed for research on BSE so that more can be known about the disease and if possible precautionary measures can be taken before an actual problem occurs.
- Herr Hinder believes that additional regulations are desirable. He maintains that no meat proteins should be fed to any animal (although kitchen scraps are okay). Micarna is currently fighting against the use of liquid feed (which contains chicken and pig proteins) from being fed to pigs. The primary reason for this is that many consumers are no longer willing to buy

meat that was raised on animal proteins. Micarna believes that a ban on liquid feed is important for consumer confidence.

These excerpts from the collected interview data were identified as causal relationships between BSE and the beef industry in Switzerland:

- Today, 90-95% of the meat sold by Micarna comes from Switzerland. The rest comes from countries such as Brazil, Argentina (no longer because of foot and mouth disease), and the United States. Micarna used to import meat from Scotland but does not anymore because of Great Britain's problem with BSE. In general, Micarna imports less than it used to because consumption of beef had gone down and therefore there is less need to import.

The project team identified the following excerpts from the interview with Herr Hinder as relationships between policies and policy outcomes:

- Herr Hinder believes that, for the most part, the current regulations are sufficient for the long-term control of BSE.
- It is important to remember that there is always a delay between the time that a regulation is enacted and that time at which everyone (or almost everyone) is in full compliance. This is to say that enacting a regulation is not like flipping a switch. It takes time for all concerned parties to change their practices to adhere to a new regulation.
- Herr Hinder does not believe that the current regulations will enhance the public's confidence in the beef supply. This is because nobody as a customer wants to hear anything about BSE.

Customers just want to know that their beef is safe. Herr Hinder stresses that we need to do everything possible to get rid of the disease so that we can get rid of all the discussion that goes along with it. He feels that customers are unsure to what to believe because they hear so many things, i.e. one person says that there is no problem while another says that there could be up to 1 million infected in Switzerland alone. The regulations will not enhance confidence in the beef supply, only successful eradication of the disease will enhance confidence.

The excerpts from the interview that were considered by the project team to be viewpoints belonging to Herr Hinder can be found in Appendix D.

Throughout the interview, Herr Hinder displayed a particular passion for BSE and beef safety. He showed this through the excitement and interest he presented while discussing BSE with the project group. It was obvious that he keeps himself well informed on the issue because throughout the interview he demonstrated a great deal of knowledge and understanding about BSE policy and incidences in Switzerland.

In terms of main ideas, he indicated that safety should be the most important factor in beef production. He believes that this is what the Swiss consumer demands. This quality first, cost second, idea seems to pervade the motivation behind the Swiss industry. He went on to say that he thinks, in the future, other countries' consumers will also have similar demands as the Swiss. Thus, he feels any steps that can increase the safety of beef should be taken by the industry.

Analysis

After organizing the interview data into the five different categories found in the results section, the project team began looking for issues that were discussed by more than one interviewee. In particular, we wanted to identify areas of controversy and areas of widespread agreement among the individuals who were interviewed. The following analyses address these various issues, and to the extent possible, present all of the viewpoints belonging to the interviewees as well as the perspective the project team has taken on the issue.

More Research is Necessary

One suggestion that became apparent in every interview is that more research needs to be conducted in order to gain a better understanding of BSE. Indeed, Dr. Näf, Dr. Hofer, Dr. Heim, Herr Bucher and Herr Hinder made statements indicating that research is important because there are many questions that remain to be answered with respect to the nature of BSE. This became particularly clear to the project team when each interviewee was asked for his or her opinion on what is responsible for the continuing cases of BSE despite all of the regulations that are currently in place. Every interviewee gave a slightly different answer to this question and some raised concerns over the possibility of spontaneous mutation leading to BSE, vertical transfer and genetic predisposition to BSE. When asked, Dr. Heim stated that there are probably over 30 hypotheses surrounding the cause of BSE, ranging from the plausible to the seemingly absurd. The diversity of answers the project team received for this question underscores the need for

more research to better clarify the widespread uncertainty with respect to the causes and modes of transmission of BSE.

Apart from research needed to elucidate the nature of BSE, there was also a call for research to develop a BSE test for live animals. Aside from clinical examination, which is only reliable in late stages of infection, there is no BSE test for live animals; only post-mortem tests are available. A live test for BSE would provide an extra degree of safety for the food supply because every animal could be tested for BSE before reaching the slaughterhouse. In addition, a live test would prevent unnecessary culling because it would be possible to detect and cull only those animals that test positive for the disease.

In the interview with Dr. Heim it was pointed out that the current BSE regulations have been modified over time to adapt to the increasing knowledge surrounding disease. She also pointed out that because BSE is not completely understood it is probably better to err on the side of caution when making policies and regulations to control the disease. An example of policies adapting to increased knowledge of BSE can be seen in Switzerland's policy switch from entire herd culling to cohort culling in the event of a BSE case. Originally, Switzerland required that the entire herd be destroyed if any animal in the herd was diagnosed with BSE. This was done because there was a lot of uncertainty about whether the disease could be transferred horizontally between cattle. As time passed, statistical evidence began to show that non-related cattle in the same herd as a BSE infected cow were no more likely to have BSE than cattle in herds where BSE never occurred. Because of this evidence and because of the hardship that the herd culling policy imposed, Switzerland decided to change the policy to require only the culling of cattle in the same cohort as a BSE positive cow. This story illustrates the importance of BSE research in

Switzerland. Additional research leads to increased knowledge and that in turn allows for better policy making to take place.

Meat Must be a High Quality Product

A common contention among many of the interviewees is that meat must be produced under strict standards in order to ensure a high quality product. Today in Switzerland, more and more consumers are demanding higher quality control for meat production and there is an increasing market for all-natural meat products. To illustrate this, Herr Elia pointed out that 80-90% of the beef sold in Coop is from strict quality controlled label meat production, and in the year 2002, Bell will produce more organic meat than meat from regular production. This demonstrates the Swiss consumer's demand for top quality meat products.

Dr. Näf and Dr. Hofer both indicate that meat must be produced under high standards because consumers must have confidence in the safety of what they are buying. Because meat is both an important food source and cultural entity it is absolutely critical to ensure the safety of beef to the customer. Cost cannot be an issue where food safety is concerned. This is why Dr. Näf and Dr. Hofer believe that the measures taken to eliminate BSE from the food supply are justified. In fact, Dr. Näf believes that beef producers have a great deal of incentive to go above and beyond the current regulations for eliminating BSE. By taking stricter quality control measures, beef retailers can advertise that their product is superior in quality and safety. The idea is that stricter regulations will increase consumer confidence and this in turn will lead to better sales for the company. An example of this practice can be seen in the way that Bell tests

all cattle over 20 months of age for BSE when they are slaughtered. This is not required by the government but is done because of the demand for safe beef products.

Because consumer confidence is key to the marketability of meat, Dr. Hofer believes that high standards must be maintained, even if it means producing less beef at a higher quality and cost to the consumer. Dr. Näf strongly believes that the rigorous quality control measures required for ISO certification minimize the risk of his products being contaminated with BSE. Finally, Herr Bucher warns that meat imported into Switzerland could be a problem. As a representative of farmers, Herr Bucher maintains that any beef imported into Switzerland should be produced under the same regulations and restrictions that are imposed on Swiss farmers. At the very least, any imported product should have a label that describes the country of origin and that country's BSE regulations.

January 2001 Feed Ban Amendment

In January 2001 Switzerland toughened its feed ban to exclude meat and bone meal from feed intended for any farm animal. Previously, meat and bone meal was banned from feed intended for ruminants but it was allowed in feeds intended for non-ruminants, such as chickens or pigs (Appendix A). The primary reason for strengthening the feed ban was concern over cross-contamination and mixing of feeds in Switzerland. Before the January 2001 measure, if cross-contamination of ruminant and non-ruminant feed were to occur during production, transit, or storage, or if mixing of these feeds were to occur on the farm, there would have been the problem of cattle ingesting meat and bone meal. With the new regulation, cross-contamination

and mixing of feed should no longer be a concern because there is not supposed to be any meat and bone meal in any animal feed.

There is currently a lot of controversy surrounding the January 2001 feed ban amendment. Although the ban decreases the risk associated with cross-contamination and mixing of feeds it creates a new problem. After the useful portions of a slaughtered animal are removed there is a significant amount of protein remaining. Before the January 2001 amendment this protein was recycled into chicken and pig feed but now it must be incinerated. Dr. Näf, Dr. Heim, Dr. Binder, and Herr Elia consider this to be ecologically wasteful and Dr. Heim goes further to say that incinerating the extra animal protein is "ecologically criminal," suggesting an ethical dilemma with the practice. Because of the problem with cross-contamination and mixing of feeds, these individuals seem to believe that the January 2001 amendment is justified at this point but they suggest that recycling animal proteins into feeds for non-ruminants must be allowed in the future after the danger of BSE diminishes. To be clear, these individuals do not advocate the use of animal proteins in feeds intended for ruminants at any point in the future.

In contrast, Dr. Hofer, Herr Bucher, and Herr Hinder argue that the January 2001 feed ban amendment should remain in place permanently. To justify this stance they cite reasons of consumer confidence. Increasingly, consumers are refusing to buy meat that was raised on animal proteins. Instead, many customers wish to purchase meat that was raised naturally. To illustrate this, Bell will produce more organically raised meat in 2002 than meat from regular production. As a result, Dr. Hofer, Herr Hinder, and to some extent, Herr Bucher are reluctant to support any relaxation of the feed ban amendment because of reasons of consumer confidence.

In addition, Dr. Hofer and Herr Hinder argue that all animal offal should be prohibited as food for farm animals. This argument targets minor exemptions to the January 2001 amendment, such as the use of certain slaughterhouse wastes as liquid feed for pigs. Once again they cite reasons of consumer confidence as justification. Dr. Hofer believes that even if the government does not ban liquid feed eventually the market will mount pressure against this practice because many consumers are demanding only naturally fed animals. When Dr. Heim was asked about liquid feed she stated that there is no evidence to suggest that liquid feed is a problem when fed to pigs. Because of this, she believes that it would be excessive and unjustified to ban liquid feed.

Both sides in this controversy make credible arguments. While nobody denies that the January 2001 amendment is ecologically wasteful there is disagreement on whether it should be relaxed in the future if BSE fades as a problem. To some extent, these conflicting viewpoints reflect the different interests of the interviewees. As scientists, it makes sense that the two veterinarians (Dr. Heim and Dr. Binder) support relaxing the feed ban amendment in the future if it is safe to do so. From a scientific point of view the current regulation is ecologically wasteful and only justified because of the problem of feed cross-contamination and mixing. On the other hand, it is understandable that Dr. Hofer, Herr Bucher, and Herr Hinder support keeping the feed ban, because their livelihood relies on beef sales. Because consumers demand naturally raised beef products, they believe that the feed ban is justified regardless of its scientific merit.

It is likely that the consumer will eventually be the deciding factor for this issue. If future consumers are not willing to purchase meat that was raised on animal proteins there will not be recycling of animal proteins into non-ruminant feed, even if BSE is under control and the ban is relaxed. On the other hand, if consumers are willing to recognize that pigs and chickens are

natural omnivores and that there is no scientific justification for excluding meat from their diet, consumers may be willing to purchase pork and poultry that is raised on animal proteins. If this is the case and BSE is under control it would be more ecologically sound to return to the practice of recycling animal proteins into feed intended for non-ruminants. At no point, however, should animal proteins be recycled into feed intended for ruminants. This is not only unnatural (as ruminants are natural herbivores) but it would also restore the risk for BSE to re-enter the system and food supply.

It may be impossible to achieve total safety from BSE

Upon reviewing the interviews it became apparent that it might be impossible to achieve total protection from BSE. Despite all of the knowledge that has been accumulated about the disease, there are still many questions that remain to be answered. For example, a lot of uncertainty remains over what may be the cause of the continuing BSE cases that occur despite all of the regulations that are in place. Because of the long incubation period and the sporadic nature of the disease, it is usually impossible to pinpoint when or how a BSE case originated. In addition, because only post-mortem tests are available, it is impossible to completely assess the current level of infection. Due to these uncertainties, it is difficult for policy makers to establish fair and effective regulations. Furthermore, it is possible that there are gaps in the policy body and therefore some continuing vulnerability to BSE in Switzerland.

Imperfect enforcement of BSE regulations is another matter that may leave Switzerland susceptible to continuing cases of BSE. During the interviews, Herr Bucher, Herr Elia, Dr. Heim, and Herr Hinder indicated that the current BSE regulations look good on paper but they

may not be adequately enforced. It is impossible to completely enforce the BSE regulations because there are simply not enough governmental employees to watch all of the producers all of the time. Because you never really know what is going on when you are not watching, it is impossible to assume complete enforcement unless everyone is being watched all the time. While it is impractical to expect that every producer should be observed all the time, there is room for reasonable improvement in the enforcement of BSE policies in Switzerland. Because of this, the federal government is putting together a central control unit for the enforcement of BSE policies. Dr. Heim believes that once this central control unit begins operating in the fall of 2001 the government will have a better handle on enforcing the regulations that it enacts.

Because it is impossible to have perfect enforcement it would be naïve to assume that there is no non-compliance taking place. Herr Elia warns that there will always be some "black sheep" in the system that do not take the regulations as seriously as they should. Whether purposeful or accidental, there have been documented cases of non-compliance in the past and there will almost certainly be cases of non-compliance in the future. Furthermore, Herr Hinder points out that it is important to remember that there is always a delay between the time a regulation is enacted and that time at which everyone (or almost everyone) is in full compliance. This is to say that enacting a regulation is not like flipping a switch. It takes time for all concerned parties to change their practices to adhere to a new regulation. The fact that there will always be some non-compliance makes it difficult to achieve total safety from BSE.

Even if full compliance could be assured there are still some BSE risks involved in beef production. Dr. Hofer and Herr Hinder indicated that it is not always easy to separate specific risk material from meat intended for human consumption. For example, Herr Hinder mentioned that the spinal cord is difficult to completely remove. Because no process can be 100% perfect

all of the time, it is not possible to be sure that every piece of specific risk material is completely removed from each carcass before butchering.

Finally, it is important to remember that BSE is a global threat. Because Switzerland continues to import between 5-8% of its beef from foreign countries it is cannot be completely immune to problems occurring in other countries. Herr Bucher argues that meat imported into Switzerland should be produced under the same regulations and restrictions that are imposed on Swiss farmers. Until BSE is eradicated worldwide, it will be impossible to achieve total safety from the disease.

Concerns over Eating Beef

Interestingly, every interviewee continues to eat beef. Dr. Hofer and Herr Bucher expressed no reservations at all about eating beef while the others placed some conditions on what they would eat. Dr. Näf, Dr. Heim, and Dr. Binder are comfortable with normal cuts of beef but are distrustful of sausage and hamburger because the contents of these products are not readily identifiable. Herr Hinder will eat any beef product as long as he knows where the animal came from and he is comfortable with its place of origin. Herr Elia will also eat any beef product, but now that he is aware of the quality of different meats he prefers a Swiss product. In fact, the project team got the impression that all of the interviewees would prefer a Swiss product if they were given a choice. The fact that seven different individuals who are well educated on BSE continue to eat Swiss beef suggests a very high level of confidence in the quality and safety of Swiss beef.

Implementation of BSE Policies and Regulations

Switzerland has been quite effective at instating excellent BSE policies and measures. It was the first country after England to establish internal BSE measures. For example, in December 1990 a meat and bone meal (MBM) ban was adopted for ruminants. This was years before other countries enacted similar measures. In addition, the country has enacted some of the most stringent measures. However, despite this, cases of BSE have continued to occur in Swiss cattle herds. Many are quite sure that these "born-after-ban" (BAB) cases of BSE were caused by previous non-compliance by the feed and cattle producers.

This illustrates the problem of policy implementation currently in Switzerland. Dr. Dagmar Heim, Dr. Heinrich Binder, Herr Davide Elia, Herr Heiri Bucher, and Herr Peter Hinder all identified this problem in their respective interviews. In particular, Dr. Heim discussed BSE policy implementation in depth. She was able to relate the specifics of the problem as she is a leading authority on BSE at the Swiss Federal Veterinary Office.

The Swiss Federal government creates BSE regulatory policies. The responsibility of implementing these measures falls mainly upon the individual cantons. This current system of BSE policy implementation raises two significant areas of concern.

The first is inconsistencies in implementation of BSE policies among the cantons. The cantons each have their own individual situations with respect to BSE. That is, they each have among other things different personnel, resources and cattle populations. Dr. Heim indicated that recent inspections revealed discrepancies in implementation. She said some cantons were found to have problems, while others were doing quite well.

The second concern is a lack of information. When asked how well the current policies are being followed by the various beef and feed institutions, Dr. Heim said that the Federal Veterinary Office (BVET) is not completely sure. Since the BVET does not deal with the actual implementation of policies, it is difficult for them to know what is going on all of the time in the various cantons.

To amend these implementation issues, Dr. Heim and Herr Bucher discussed a proposed BSE control unit. The unit would be run on a federal level by the BVET. Essentially, it would act as a federal BSE policy "police" by monitoring and enforcing BSE regulations throughout all of Switzerland.

There are many benefits to having an enforcement unit in Switzerland. These include better implementation of policies, better consistency throughout Switzerland and more information on the Swiss BSE problem. Because of these benefits, the necessity of such an enforcement unit is certainly justified.

This enforcement unit is particularly interesting with respect to the recent animal feed amendment. In fact, it is possible that the unit could put the necessity of the feed ban into question. Since the enforcement unit will be addressing compliance with BSE regulations within the beef industry, it could be able to deal with cross contamination and mixing of feed occurring in the feed and beef institutions. This feed problem was effectively removed with the institution of the January 2001 farm animal feed amendment. However, if the enforcement unit is able to effectively contend with the feed cross-contamination issue, then the question will be, "Why have such an ecologically wasteful feed ban in place?" This is something that will certainly need to be evaluated after the enforcement unit's ability has been assessed.

Current BSE regulations build consumer confidence

The current regulations in place have been successful in building consumer confidence. Dr. Näf believes there is a large commercial benefit to following the current regulations and that any non-compliance would have a negative impact on the members of the beef industry. Remaining non-compliant with the current BSE regulations has a negative impact because it will provide gaps that the disease can get through and increase the number of cases that exist. When more cases of BSE are discovered it destroys consumer confidence and causes a decline in beef consumption. This in turn will decrease the amount of sales in the beef market. The less business that is conducted in the beef industry the more difficult it is for that portion of the economy to survive. Dr. Hofer believes that the total feed ban has aided in eliminating the number of BSE cases in Switzerland since the policy was installed. The total feed ban seems to be excessive according to Dr. Heim but she concluded that it was a necessary measure to take. It is better to over compensate with the current policies and relax them in the future rather than to allow negative results to occur by adopting regulations that are too lax to last the test of time.

Herr Bucher mentioned that he supports the idea of implementing more regulations on imported foreign beef. This idea may come from considering that farmers would benefit from stricter foreign trade regulations since the only other source of beef for Switzerland would come from the Swiss farmers. Also he mentioned that farmers are lobbying for the implementation of testing all cattle prior to being butchered. This measure would increase the quality and safety of the beef in production for the public. This essentially would increase consumer confidence and improve the economic situation of cattle producers and the beef industry. Herr Bucher also goes on to mention that the media and neighboring countries influence consumer confidence in

Switzerland especially when more cases of BSE are discovered in these countries. This is another reason that farmers would like to see stricter trade regulations in Switzerland.

Herr Elia mentioned that he believed that Switzerland was trying to implement good trade regulations by accepting beef only from countries that did not have BSE. This opinion may be based from the idea that Swiss beef retailers benefit from stricter foreign trade regulations. Herr Elia mentioned that the Swiss public is willing to pay for the increased measures taken to increase the safety and quality of beef produced in Switzerland. This idea may be a result of the fact that the more confident consumers are in a product the more likely they will be to purchase it.

Herr David Elia also mentioned during his interview that initially around the year 1990 when the first cases of BSE were identified and policy measures were setup to contain the spread of BSE, beef consumption in Switzerland dropped severely. Later between 1994 and 1996 there were some cases of BSE that slipped through the policy gaps. The discovery of these BSE cases had led to a decline in beef consumption again, but not to the same extent as in 1990. Then in 1999 and 2000 there were a few cases that again slipped through the policy gaps and this brought another decline in beef consumption in Switzerland. These cases between 1999 and 2000 caused a smaller decline of beef consumption than previously in 1994 through 1996. Since the implementation of the very first policy measures taken to eliminate BSE from the human food chain there have been progressively smaller declines in beef consumption. Generally the consensus of the interviewees was that the current BSE related policies have been successful in building consumer confidence except in one case. Herr Hinder believed that to truly restore consumer confidence BSE would have to be totally eradicated. This would be ideal for gaining absolute confidence of the consumer.

Switzerland has the best policies to eliminate BSE from the food supply

There is a general consensus among the interviewees that Switzerland has the best policies to eliminate BSE from the human food chain. This was particularly evident when the individuals were asked which countries have the best policies in place to control BSE. They all stated Switzerland is best or one of the best. This was further seen when the interviewees were asked if they continue to eat beef. Every individual replied that they do. In addition, many gave a strong impression that they prefer a Swiss product when given the choice. This certainly says a lot about their belief in Switzerland's BSE policy measures.

Throughout the interviews many reasons were given to explain why Swiss BSE measures are superior. One of these reasons is that Switzerland has been dealing with BSE for a long time. Switzerland was the first European country to record an internal case of BSE. Because of this Switzerland enacted some of the most important BSE measures quite early. For example, Switzerland enacted an animal offal feed ban for ruminants December 1990. This was years before other countries adopted such a feed regulation.

In addition, with this extra time, Switzerland has been able to discover problems with its policies and measures, and fix them. For example, initially Switzerland utilized herd culling in its infected cattle herds. Over time, the BVET found that herd culling imposed a great deal of hardship on cattle producers. Thus, to relieve this hardship there was a switch to cohort culling. Dr. Heim, Dr. Binder and Herr Bucher all agreed that this policy change was a big step in gaining the support of the Swiss farmers with BSE regulations.

The second major reason that Switzerland's policies are viewed as superior is that they are some of the most stringent a country can enact. The January 2001 feed ban amendment is

clearly evidence of this. The amendment was identified in nearly every interview as being particularly stringent. In fact, very few other countries have such a stringent animal feed regulation.

Because the incubation period of BSE is approximately 4 to 6 years, policies that over-compensate are necessary. Less stringent BSE regulations will only delay the elimination of the disease. They may fall short of their goals and leave the problem unsolved. This illustrates that Switzerland's policies are geared toward the future of BSE and its elimination. Utilizing stricter policies also has the advantage of the ability to relax these policies once the desired level of safety has been reached.

Some remarkable evidence of the superiority of Switzerland's BSE measures is the lack of controversy on the issue over the last few years. BSE certainly has a great potential for controversy. The problem is an agricultural industry issue. In addition, there is great deal of scientific uncertainty to it. This type of problem tends to generate a great deal of debate. A prime example would be genetically modified foods.

BSE controversy has certainly been felt in other countries such as France and Germany. In northern France, farmers recently blocked roads protesting the BSE culling measure in that country. In Germany, there was such a problem that the agriculture minister was replaced. This type of BSE controversy has remained outside of Switzerland. This is a good indicator that Switzerland has instated some of the best policies to prevent BSE.

More regulations and surveillance are necessary for other countries

According to the general consensus of the interviewees more BSE regulations for other countries are necessary. Dr. Näf brought up the point that BSE is a global problem and should be acknowledged as one. BSE has spread throughout Europe and is a threat to the rest of the world. The mobility of livestock and trade in feeds should be a concern of all countries. Other countries need to adopt more regulations and improved surveillance measures for BSE. Dr. Näf believes that countries within the European Union do not have adequate policies in place like Switzerland, but they are slowly approaching the ideal policies. Dr. Hofer and Herr Bucher stated that countries neighboring Switzerland have developed BSE cases that were exploited by the media. They assert that this has a negative impact on the beef industry throughout the region by weakening consumer confidence, thereby reducing sales. Herr Bucher also commented on the foreign imports of beef and how they need to be subject to the same regulations to which Swiss beef is subject. Both Herr Elia and Herr Hinder agreed that there are problems in foreign trade of beef because of the varying BSE regulations from different countries. All of these points illustrate the consensus the members of the beef industry have about other countries' BSE regulations and surveillance methods.

More regulations and surveillance may not necessarily be applicable to all countries. Financially other countries may not be willing to fund the extra precautionary measures that improve consumer confidence. Other countries are not as financially stable as Switzerland and consumers may opt to change their diet rather than pay for higher quality beef. Also cattle may be subject to different conditions than they are in Switzerland. Primarily, in Switzerland cattle are raised to produce milk or to be slaughtered for beef, while in other countries they can be used

more as beasts of burden rather than a source of food. This could lead to complexities in other countries if they attempted to implement Swiss BSE regulatory policies.

The Swiss public is willing to pay for increased safety measures in beef production. Not all countries are willing to accept the responsibility of paying more for beef for increased safety measures. The Swiss may have certain cultural ties to beef that they are not willing to give up by changing their diet. Other countries in which beef consumption is not as regular may not be as receptive to accepting the Swiss model for BSE regulations. People who that do not consume beef daily may be more likely to simply change their diet than accommodate to the costs of strict BSE regulations.

More regulations and surveillance are ideals for all countries. BSE is a problem that should be acknowledged by all countries because of the mobility of livestock and feeds. Swiss BSE policies can be used as a model for policy makers in other countries who wish to regulate their beef industries to prevent the spread of BSE.

Conclusions and Recommendations

Upon scrutiny of the discussions presented in the analysis section, the project team developed some final conclusions and recommendations. The following arguments represent our ultimate impressions on the issues surrounding BSE in Switzerland. Where necessary, we have offered recommendations that would likely improve the way that Switzerland handles the problem of BSE. We hope this report will foster discussion on the issues presented within so that the Swiss government and the other organizations involved in beef production can work together to optimize the system that controls BSE in Switzerland.

Support more Research on BSE

Although everyone called for more research on BSE, only Dr. Heim mentioned that her organization is devoting resources toward ongoing study of the problem. To our knowledge, none of the other organizations that were interviewed are spending money for active research on BSE. From our point of view, the potential benefits that could be obtained from BSE research would far outweigh the initial costs. Because research reduces the uncertainty surrounding an issue, it supports efforts to achieve consensus on policy approaches. For example, research contributing to a BSE test for live animals would be extremely valuable because a live animal test would reduce or eliminate the uncertainty over how many cattle are currently infected with BSE. Since theoretically every animal could be tested before slaughter, a test for live animals would provide an extra degree of safety for the food supply and could support consensus on relaxing the current culling policy and on relaxing the current feed ban. Indeed, past events have

shown that research leads to an increased understanding of the problem and that in turn leads to safer, more effective regulations. Other BSE related issues that deserve more research include the following:

- Although most people agree that the spread of BSE is caused primarily by feed containing BSE contaminated meat and bone meal, there are still questions regarding the possibility of spontaneous cases or vertical transfer. Reducing this uncertainty through research would allow for better risk assessment and better control of BSE.
- Another interesting approach to solving the BSE and vCJD problem lies in developing effective treatments and cures for these diseases. Research on the possible treatments and preventative measures discussed at the end of the section entitled "Prion Diseases" in the literature review would be beneficial.
- Research on alternative uses for specific risk material and other slaughterhouse byproducts would help reduce the ecological wastefulness of today's practices. Potential uses for these byproducts as fertilizer and fuel should be explored.

Because of the need for answers to these problems, we recommend that the organizations involved in beef production consider pooling some of their resources to fund independent research on BSE. These organizations include Bell AG, Micarna SA, Centravo AG, Interferm AG, the cantonal farmer unions, the federal government, and any other organization involved in producing beef. Support for an independent research foundation or funding independent university research would be optimal because this would avoid any conflict of interest suspicions that might arise if in-house research were conducted.

Finally, Dr. Heim pointed out that it is important to keep an open mind about the BSE controversy. Since there is not enough scientific evidence to answer all of the questions surrounding BSE it is important to remain objective and let the body of evidence speak for the validity of a particular idea or hypothesis.

Improving Consumer Confidence

As Britain is evidence, BSE can be especially damaging to a country's beef industry. One of the major reasons for this is the issue of consumer confidence. In fact, at this time in Switzerland, consumer confidence is the most significant BSE related problem. The beef industry and policymakers are now not so concerned with preventing Swiss cases of vCJD. Rather, they are trying to increase and stabilize consumer confidence in Swiss beef. Ultimately the way to increase confidence with respect to BSE is to end the discussion that surrounds it. Herr Hinder emphasized this in his interview. This of course can only occur once there are no more cases of BSE in Switzerland.

Though many of Switzerland's BSE regulations are designed to improve consumer confidence, the January 2001 feed ban amendment is particularly aimed at doing this. However, with the possibility of spontaneous occurrences, vertical transfer, and a multitude of other proposed hypothetical transmission methods, even the feed ban amendment could fail at finally eliminating BSE from Switzerland.

Because of this it is evident that other courses of action must be taken to increase and stabilize consumer confidence in Switzerland. There are many ways to accomplish this. Some of the ones, which were discussed throughout the interviews, were: testing all animals for BSE

prior to being butchered, labeling programs, working closely with consumer groups and educating the public on BSE measures. While these are all likely ways to increase consumer confidence, it seems the most productive is educating the public.

This consumer education has been a problem in the past. Dr. Heim and Herr Bucher gave an example of this in their interviews. They said that Swiss consumers did not know important regulations had been adopted years before outbreaks in France and Germany occurred. So, when the Swiss public began seeing French and German news reports on the BSE crises in those countries, they began to think Switzerland had similar BSE problems. Thus in reaction to these media reports there was a drop in Swiss beef sales, particularly in the French speaking Geneva area.

It is possible this would not have occurred had the public been well informed on the Swiss BSE protection measures. Evidence of this was seen in our interviews when each individual was asked if they continue to eat beef. Now, all seven interviewees displayed apt knowledge of Switzerland's BSE measures and they all continue to eat beef. In fact, many gave the impression that they would prefer a Swiss product when given the choice.

Thus, it is clear to the project group that informing the public is key to addressing confidence problems. There are various ways this could be done. Dr. Heim discussed how the BVET recently ran a public information campaign to inform the public on the Swiss BSE measures. This certainly helped. However, it seems that the industry needs to take a more active role. After all, the industry will benefit most from increased consumer confidence. The major companies such as Bell, Micarna, Migros and Coop certainly need to take a more active role in this respect.

Who should bear the costs of BSE?

Dr. Hofer brought this fundamental question to the team's attention. It is one that cannot be easily answered either. There are many costs related to BSE. The regulations that are adopted need adequate funding to be implemented by the authorities. The accumulation of specific risk material (SRM) in slaughterhouses and partial compensation of cattle producers are issues that cannot be resolved without increased funding. Adequate funding for these costs is necessary to assist in the elimination of BSE in Switzerland.

Compliance with the current BSE regulations is not 100%. An alternative to induce compliance among the members of the beef industry would be a system of monetary fines. A fine based on a percentage of the income of the non-compliant individual or business in the beef industry could be in enacted. This way an individual cattle producer or a large corporation, for example, could be fined to provide an added incentive for compliance while not financially devastating the respective member of the beef industry.

Ideally this money then could be allocated to compensating the compliant members of the beef industry. Money from these fines could be used to implement regulations, contain specific risk material (SRM) in slaughterhouses and compensate cattle producers. This money could also be used to provide funding for testing all animals prior to butchering as well as funding for research on the cost and risks of SRM use in fertilizer. Testing all animals for BSE prior to butchering will theoretically reduce the number of cases that pass into the production line. This practice should increase consumer confidence, which leads to an increase in sales. Researching the use of specific risk material (SRM) as fertilizer could provide another source of revenue for cattle producers and increase the percentage of cattle used productively. It would also reduce the

amount of waste generated by animal processing, thereby reducing the amount of energy required for incinerating the cattle remains. These recommendations both require an adequate source of funding. By funding these recommended programs, the overall level of consumer confidence can be raised. This would potentially increase the sales of beef, thereby improving the economic situation of the Swiss beef industry.

Ideally this recommendation would provide assistance in implementing the current BSE regulations, provide funding for the compliant members of the beef industry, increase consumer confidence and safety, as well as, provide a new source of revenue for cattle products if applicable. This recommendation would cover several cost aspects of the beef industry and assist in maintaining a consistently clean and reliable supply of beef to the public.

Better implementation of BSE policies

At this point in time Switzerland has enacted sufficient BSE regulations and policies that have increased the safety of Swiss beef products in regards to BSE. Implementation of the current BSE regulations is the problem today in Switzerland. Specifically, the areas of concern are inconsistency between cantons in the quality of their implementation and a lack of information on implementation.

To amend these problems the BVET will be activating a control unit later this year. The unit's main goal will be to address compliance issues by monitoring and checking the industry year round. The unit will of course be run by the BVET and will monitor all of Switzerland. Thus, any inconsistencies in policy implementation between the cantons will be addressed much more effectively. As an added benefit, the unit will also increase the knowledge and

understanding of Switzerland's BSE problem. This is certainly a great help as information is key in a policy situation such as BSE.

Because of these benefits, it is the opinion of this project team that the enforcement unit is a necessary component of Swiss BSE measures. Additionally, the project team thinks that after the unit has been active for some time its effectiveness and ability should be assessed. Since it will be a new entity it is difficult to say at this time what the unit's ability will be. Unforeseen difficulties will no doubt arise and reduce the unit's capacity.

By determining its ability, the assessment would aid in formulating or changing policies and regulations. Such an assessment would provide beneficial information on whether the unit would have the capacity to address the cross-contamination and mixing of feeds problem. That is, it could help determine if the control unit could increase compliance in the feed and beef production industry so that mixing of feeds is not such a problem. If the unit could do so, it would certainly be a major factor in relaxing the January 2001 farm animal feed regulations.

Swiss Policies as an International Model

The first case of BSE on the European mainland, which could not be attributed to an animal imported from Great Britain, was reported in Switzerland in November 1990. Since then, Switzerland has devoted extensive effort to monitoring BSE and developing effective and fair regulations for controlling the disease. Despite some minor issues, the general consensus among the interviewees and the project team is that Switzerland has the best policies in place to control BSE. In comparison, Germany and France only recently enacted the same MBM regulations that Switzerland enacted in 1990, and as a result, these countries are suffering from more BSE related

scandals and a greater loss of consumer confidence than Switzerland ever experienced. It is difficult to recommend that every country adopt the same regulations as Switzerland, because each country is unique and what may be good for one country may not be good for another. For example, because the United States has never confirmed a case of BSE it would be excessive for the United States to ban animal proteins from feeds produced for non-ruminants. Nevertheless, because Switzerland has effectively dealt with its BSE problem for 10 years, it would make sense for policy makers in other countries to look at Swiss policies as a model when developing their own regulations.

Finally, because BSE is a global threat, we believe that there would be a benefit in enacting some BSE regulations at the level of the European Union or the United Nations. Given the serious threat that vCJD poses to human health and the devastating economic impact that BSE can have on a country's system of agriculture, it would make sense to enact some preventative measures to help protect the rest of the world from the problems experienced by Western Europe. Once again, because every country is unique it is difficult to suggest one body of regulations for the entire world. Nonetheless, certain fundamental policies, such as the ban on feeding meat and bone meal to ruminants, are important for any country with extensive beef production. Once again Switzerland's policies could act as a model for developing international policy.

Appendix A

The following is a chronological listing of BSE-vCJD related regulations in Switzerland taken from the Swiss Federal Veterinary Office, "BSE: Regulations" (Swiss Federal Veterinary Office, 2001) and "TSE Status Of Switzerland" (Swiss Federal Veterinary Office, 1998).

June 1990

Switzerland instates an official import ban for live cattle, meat and by-products from cattle and meat-and-bone meal from Great Britain. This ban was essentially in practice since 1988 because no import permissions were given.

8 November 1990

The brain, spinal cord, eyes, tonsils, spleen, thymus and intestines of cattle above the age of 6 months must be removed as inedible offal. Fat and lymph nodes of the mesentery were can only be used for industrial processing of fat

1 December 1990

- Feeding meat-and-bone meal (MBM) to ruminants is banned. MBM can still be fed to non-ruminants.
- Switzerland requires notification of any BSE cases followed by an epidemiological investigation.
- BSE suspected animals must be slaughtered and their brains examined for evidence of BSE.

- Switzerland requires incineration of the carcasses and organs of TSE-affected animals. All offal from TSE-suspected ruminants must be incinerated.
- Semen, non-fertilized oocytes and embryos from BSE affected animals must be destroyed.
- Marketing of milk from BSE-suspected or affected cows is banned.
- Direct offspring of BSE affected cows must be tattooed and banned from export.
- Meat-and-bone meal can only be imported from approved suppliers.
- The head, spinal cord and organs from healthy animals in herds with scrapie-affected animals must be incinerated.

February 1993

- High-risk animal offal must be processed at 133°C for 20 minutes at 3 bars of pressure. This high-risk animal offal includes the brain, spinal cord, eyes, tonsils, spleen, thymus, intestines, visible lymph-nodes and nerve-tissue of cattle above the age of 6 months. The requirement before this called for processing at 120°C for 30 minutes or at 130°C for 20 minutes. The use of this processed high-risk animal offal is permitted for use in animal feed for non-ruminants.
- Meat-and-bone meal imports are only allowed from authorized suppliers processing high-risk animal offal and offal from ruminants at 133°C for 20 min at 3 bars of pressure.

May 1996

- The brain within the skull, spinal cord, eyes and tonsils of perished cows must be incinerated. In addition, fallen stock must also be incinerated.

- Meat and bone meal can be fed to farm animals only under the condition that no cadavers and no brain within the skull, spinal cord, eyes, and tonsils of cattle above the age of 12 months have been used in the meal.

September 1996

- All direct offspring of cows affected by BSE must be destroyed.

December 1996

- All bovines born before December 1, 1990 on farms that have experienced a BSE case must be destroyed. If the affected animal was born after 1 December 1990 (date of implementation of the feed ban); the affected animal carcasses must be disposed of as animal waste. If the affected animal was not born and raised on the same farm, analogous measures must be carried out in the herd of origin. (This restriction was in effect until 1 July 1999)

- Live cattle and small ruminants can only be imported from countries that have prohibited the feeding of mammalian protein to ruminants. In addition, any imported animals must be born 18 months after the feed ban.

- Meat products can only be imported from countries having the same specific risk material (SRM) ban as Switzerland. Additionally, the product is allowed for importation if it has special guarantees.

January 1998

- The use of mechanically recovered meat from the vertebral column of cattle, sheep and goats is banned from being used as food for humans.

- The use of the skull, vertebral column, brain, spinal cord, eyes, tonsils, thymus, intestines and spleen from cattle, sheep and goats is banned as raw material for the production of gelatin, tallow, amino-acids and peptides.

July 1998

- All bovine animals must be examined and registered:

  – from the holding in which the BSE affected animal was held prior to killing,

  – from the holding in which the BSE affected animal was born or raised and

  – kept in the same holdings mentioned above and in the same birth cohort (one year before and one year after the birth date of the BSE affected animal).

- The use of the bones of the vertebral column, the sacrum and the tail of cows is banned as food for humans. After heat treatment at 133°C at 3 bar for 20 minutes it may be used for animal feed for non-ruminants.

- Tallow for feeding purposes must be treated for 20 minutes using a temperature of 133°C.

- All specific risk material that has to be incinerated must be stained with a dye.

July 1999

- All cattle born one year before and after a BSE affected animal from the farm where the animal was born and raised must be destroyed. The carcass must be incinerated. This marks the change from herd culling to cohort culling.

- Blood meal is banned from being fed to ruminants.

January 2001

- The following items are banned as feedstuffs for farm animals: meat meal, meat and bone meal, greaves meal, greaves expeller, bone meal, blood meal, gelatin produced from ruminant byproducts, poultry meal and hydrolyzed feather meal.

- Extraction fats are banned from being fed to all farm animals.

- The import or export of meat waste materials and intermediate products made from them is banned. This especially applies to meal and extraction fats.

- The use of fishmeal as a feedstuff for ruminants is banned. Feedstuffs for pigs, poultry and fish may only be made with fishmeal if the manufacturing company has notified the authorities and a record of the mixtures is kept.

- Subject to stringent conditions, the use of certain slaughterhouse waste, which has been designated as not harmful to health by the Meat Control Authority, may still be fed in liquid form to pigs.

- Meal of animal origin is prohibited for use in fertilizer production in Switzerland. This meal must be incinerated.

Appendix B

Table B.1: This table illustrates that the government is taking a majority of the role in funding the compensational costs of the BSE problem in Britain (FSA of Great Britain, 2000).

Costs per year - £million

	Over 30 Month Rule	Feed ban	SRM	Total
Industry	95	14	18	127
Government	400	2	23	425
Grand Total	**495**	**16**	**41**	**552**

Table B.2: This table illustrates the beef imports that have taken place between European Union countries and Britain and Non-European Union countries and Britain. Swiss imports are illustrated on the Non-European Union countries portion (BSE Controls Review, 2000).

The following statistical information is measured in tonnes.

European Union countries UK imports of beef meat and offal September 1999 to August 2000

	BOVINE CARCASS MEAT				Bovine offal	Corned beef	Other bovine meat & offal preps	
Country	**bone in Fresh**	**bone in frozen**	**boneless fresh**	**boneless frozen**				**Totals**
Irish Republic	27,032	1,850	31,963	21,974	7,379		17,667	107,865
Netherlands	1,558	169	4,723	2,421	3,310		785	12,966
France	145	726	534	1,318	303	2,463	84	5,573
Germany	313	8	162	854	1,641		1,064	4,042
Denmark	547	18	1,100	87	290		997	3,039
Spain		179	156	1,887	14		7	2,243
Belgium	650	9	473	258	81		477	1,948
Italy	4		125	641	233		99	1,102
Sweden	1		1	10	524			536
Greece				41				41
Totals*	**30,252**	**2,958**	**39,236**	**29,490**	**13,774**	**2,463**	**21,179**	

Non-EU countries UK imports of beef meat and offal September 1999 to August 2000

	BOVINE CARCASS MEAT				Bovine offal	Corned beef	Other bovine meat & offal preps	
Country	**bone in Fresh**	**bone in frozen**	**boneless fresh**	**boneless frozen**				**Totals**
Brazil		49	4,695	15,208	174	43,304	8,232	71,662
Argentina			1,643	276	479	6,642	695	9,735
Uruguay		144	3,106	1,500	108	4,018	250	9,124
Australia			6,706	19	84		5	6,814
Namibia			5,590	597				6,187
Zimbabwe			4,904	255		504	423	6,086
Botswana			3,686	705		292	83	4,746
New Zealand		5	214	119	839		8	1,185
Switzerland			22	208	14	353		597
Mauritius							593	593
Swaziland			483				17	500
USA			1			34	148	183
South Africa			63	15		17	17	112
Thailand						5	14	19
Jamaica						17		17
Panama							13	13
Paraguay				11				11
Canada	1		3	4				8
Croatia							5	5
Poland							5	5
Totals*	**1**	**199**	**31,095**	**18,916**	**1,695**	**55,186**	**10,509**	

Table B.3: This table illustrates the change in the size of farms in Switzerland. The number of Swiss stock farms have decreased. (http://www.about.ch/welcome.html, 2001)

Agricultural acreage and stock farming (in ha)	*1990*	*1998*	*1999*	*Change in % 1990-99*
Open arable land	312,606	299,361	293,949	-6.0
Cultivated grassland	90,319	113,116	115,933	28.4
Natural grassland and pasture (Excl. summer pastures)	634,719	632,428	626,799	-1.2
Vineyards	12,403	12,839	12,921	4.2
Fruit growing	7,336	7,816	7,786	6.1
Other	11,107	12,845	14,511	3.,6
Total	**1,068,490**	**1,078,405**	**1,071,899**	**0.3**

Stock farming	*1990*	*1998*	*1999*	*Change in % 1990-99*
Beef in thousands	1,858	1,641	1,608	-13.5
Pigs in thousands	1,776	1,487	1,453	-18.2

Appendix C

The following set of questions comprise the core set of questions that were asked at each interview:

1. Are the current regulations sufficient for the long-term control of BSE?
2. Do you believe that the government adequately enforces the BSE regulations it enacts?
3. Do you believe that current BSE regulations are being closely followed by other institutions involved in beef and feed production?
4. What may account for the continuing cases of BSE considering all of the governmental regulations that are in place?
5. Are the efforts and difficulties associated with the BSE regulations so burdensome that some people may disregard these policies?
6. BSE regulations are designed to enhance food safety. Are the increased efforts associated with these regulations justified by the increased measure of the safety the regulations may provide?
7. Do you think that the current regulations will enhance the public's confidence in the beef supply?
8. Do you think that any of the current regulations for controlling BSE are unwarranted?
9. Are additional regulations desirable or undesirable?
10. Which country has the best policies in place to control BSE? Why?
11. Do you perceive any weaknesses in Switzerland's current policies? If so, what may need to be done to remedy these problems?

12. Do you continue to eat beef?

In addition to the core questions that were asked at each interview, the project team developed questions that were applicable to only certain organizations involved in beef production. These questions were designed to gain addition insight into each facet of beef production. They have been separated by group and listed below:

Animal Feed Industry (Fritz Näf)

1. Does cross contamination continue to be a problem?
2. What kind of methods do you have in place to prevent cross-contamination of feed during production/transit/storage?
3. Are you confident that the Swiss Federal Veterinary Office has adequately explained BSE and its regulations? Is additional education necessary?
4. Do you believe that farmers have an adequate understanding of BSE and its related regulations? Is additional education for farmers necessary?
5. Do you think that farmers are keeping feed intended for different animals separate? If not, what could be done to remedy this problem?
6. What do you do to ensure that BSE does not contaminate your feed?
7. How long will the health risks associated with cross contamination continue to be a problem?

Specific Risk Material Processing (Hans Hofer)

1. How difficult is it to separate SRM from meat intended for human consumption? Are these regulations adequate?
2. Do you believe that the punishments for violating regulations are severe enough to discourage non-compliance?

Farmer's Union (Heiri Bucher)

1. Are farmers satisfied that their views are being conveyed to the governmental regulatory agencies?
2. Do you believe that the regulations requiring the slaughter of all animals in the same cohort as a BSE infected animal are justified? Are these policies too excessive?
3. Are you confident that the Swiss Federal Veterinary Office has adequately explained BSE and its regulations? Is additional education necessary?
4. How difficult is it to keep feed intended for different animals separate?

Beef Processing (Davide Elia and Peter Hinder)

1. What countries do you obtain your beef from? Have demands from consumers/markets affected this?
2. Are you confident that this country(s) has adequate means to detect and prevent BSE?

3. How difficult is it to separate SRM from meat intended for human consumption? Are these regulations adequate?

Swiss Federal Veterinary Office (Dagmar Heim)

1. Do you feel that the Federal Veterinary Office has adequate resources to effectively contend with BSE?
2. How confident are you in the culling methods for animals sent to slaughter? Could these be improved upon?
3. Are you confident in the ability of the beef processing industry to keep specific risk material out of food intended for human and animal consumption?
4. Do you believe that farmers have an adequate understanding of BSE and its related regulations? Is additional education for farmers necessary?
5. Do you believe that feed producers have an adequate understanding of BSE and its related regulations? Is additional education for the feed industry necessary?
6. How confident are you in the current methods for recognizing BSE in live animals? Should more money be allocated to surveillance of these animals?
7. Do you believe that spontaneous mutation is responsible for some cases of BSE?

Zürich Cantonal Veterinary Office (Heinrich Binder)

1. Are farmers satisfied that their views are being conveyed to the governmental regulatory agencies?

2. Do you believe that the regulations requiring the slaughter of all animals in the same cohort as a BSE infected animal are justified? Are these policies too excessive?
3. Are you confident that the Swiss Federal Veterinary Office has adequately explained BSE and its regulations? Is additional education necessary?
4. How difficult is it to keep feed intended for different animals separate?

Appendix D

In addition to the four categories of results that are presented in the main body of the report there is also a category for individual viewpoints. This category is presented in Appendix C rather than in the main body of the report for two main reasons. The first reason is that the project team identified far more excerpts belonging to the viewpoint category than for any other category. To include all of these excerpts in the main body of the report would have interrupted the flow of information. Second, some of the viewpoints are repetitive of excerpts that are in the other four categories. Therefore, to avoid the problem of a drawn out and repetitive results section, the project team chose to include individual viewpoints in Appendix C.

The project team identified the following excerpts as viewpoints belonging to Dr. Näf:

- BSE is a global problem and should be handled accordingly. Mobility of the disease from country to country can prove to be a problem. Dr. Näf believes that more global regulations and surveillance are necessary.
- The policies currently in place in Switzerland are already very strict and restrictive. Dr. Näf does not believe that much more can be done in terms of policies. The fact that the link between BSE and vCJD is not 100% proven is another reason that he believes it is difficult to make more policies at this time.
- Unless there is an increase in the number of BSE/vCJD cases in the future he believes that the policy base should not become more stringent.
- Dr. Näf believes that there is very close supervision throughout the beef and feed industry in Switzerland.

- No additional education is necessary for feed producers.
- The cantonal veterinarian system and the Federal Veterinary Office adequately inform farmers of BSE. There has also been a lot of information conveyed to farmers through newspapers, magazines, and television. It is important for farmers to have a good understanding of BSE.
- Dr. Näf believes that England and Switzerland have the best policies to deal with BSE because these countries have had the most exposure to BSE. He believes that these countries have applied the lessons learned from this experience to create better policies.
- Although other EU countries do not have policies that are as sufficient as Switzerland's, they are catching up.
- Dr. Näf is confident in the current Swiss regulations. He said one shouldn't have 100% confidence because it would be foolish to do so. However, he is more confident in Switzerland's policies than other countries. He does not feel that there are any weaknesses in the policies.
- Dr. Näf feels that the January 2001 amendment to the animal feed ban is excessive. He says that it is an ecological crime to destroy so much usable animal protein.
- The total feed ban should not continue for non-ruminants in the future. Dr. Näf believes that this policy was taken too far in an attempt to make Swiss beef more marketable.
- Dr. Näf believes that beef retailers have a great deal of incentive to go above and beyond the current regulations for eliminating BSE. By utilizing better quality control measures beef retailers can advertise that their product is superior in quality and safety. Stricter regulations increase consumer confidence and that leads to better sales for the company.

- Dr. Näf believes that the current BSE regulations aid the entire beef production system because they build consumer trust for the industry.
- Dr. Näf feels that because of the commercial benefit associated with the regulations, individuals cannot afford to risk non-compliance with the current regulations.
- Dr. Näf believes that some regulations are in place more for political reasons rather than scientific ones.
- Because meat is a cultural entity and because the industry lost so many customers due to fear over BSE, the measures taken to restore consumer confidence are justified
- Having a responsive system is key for surviving in the beef industry. Changes in regulations and market demand require this.
- Dr. Näf suggests that there is probably some genetic factor that leads to TSE susceptibility in some certain animals. He believes that if this is that case, current breeding and artificial insemination practices can amplify the problem.
- Because Dr. Näf believes that the tendency to contract BSE is a matter of heredity, he suggested that cohort culling is a necessary BSE control method..
- Dr. Näf believes that it is possible that there could have been accidental mixing of feeds on farms due to human error. In addition, Dr. Näf indicated that sometimes farmers would feed sick cattle chicken or pig feed because of the increased nutrient content. He also believes that there is no real way to prevent these mistakes. With the total feed ban, however, this should no longer be a problem.
- Dr. Näf believes that the current animal feed ban will eliminate the problems caused by mixing feed and cross contamination.
- Ruminants should not eat meat and bone meal because they are natural vegetarians.

- Having a good tracking system is critical to ensure safety of beef. The accountability required for ISO9001 certification increases Dr. Näf is confident that BSE will not contaminate his products.
- The potential for health problems associated with cross-contamination are of course theoretical risks but there is no way to know how much of a risk cross-contamination posed in reality.
- Dr. Näf said that there is always going to be the risk of BSE and vCJD if spontaneous cases occur.
- Dr. Näf believes that eating a normal cut of beef is safe. He believes that eating hamburger and sausage is more risky because one does not always know what these products contain.
- Dr. Näf suggests that if consumers still lack confidence in the current regulations to eliminate BSE from the food chain they have the choice to alter their diet to exclude beef.

The project team identified the following excerpts as viewpoints belonging to Dr. Hans Hofer:

- Dr. Hofer believes that for the most part the regulations in place to control BSE in Switzerland are sufficient.
- Dr. Hofer feels that Switzerland reacted late in initiating BSE policy measures. The problem was known to exist in the UK in the 1980s and he questions why Switzerland waited until 1990 to make its first policy. He does believe, however, that Switzerland did better than most countries in enacting legislation, for example, better than Germany and France.

- Dr. Hofer believes that other institutions involved in beef and feed production are closely following the current BSE regulations.
- Dr. Hofer is not really sure what the cause may be of the continuing cases of BSE. Because of the long period of incubation there is a lot of uncertainty over how the disease may have been caused. Perhaps some of the continuing cases are due to lingering infections. In addition, one cannot even be entirely sure of the actual degree of current infection, both in animals and in humans. Nevertheless, Dr. Hofer is confident that the measure that have been taken have reduced the cases of infection and that the regulations in place are good. Only time will tell of the validity of the many theories surrounding the cause of BSE.
- Dr. Hofer believes that the increased efforts associated with the current BSE regulations are justified by the increased measure of safety they may provide. Dr. Hofer feels that if any relaxation of policies is to occur, it should not be taken too far. He also feels that in the future, animal proteins will not be used in any feed applications because of economic and consumer confidence reasons. He goes on to say that getting rid of BSE is the primary goal no matter what the costs and efforts of doing so may be. Finally, he feels that meat must be a high standard product because consumers must have confidence in the safety of what they are buying.
- Dr. Hofer hopes that the current regulations will enhance the public's confidence in the beef supply. Consumer confidence is key to the marketability of meat. It is critical to have this confidence, even if it means producing less beef at a higher quality and cost to the consumer.
- Dr. Hofer does not believe that any of the current regulations for controlling BSE are unwarranted.

- All animal products should be banned from farm animal consumption. Nature did not intend herbivores to eat other animals.
- Dr. Hofer does not feel that removal of specific risk material is difficult to do. However, he does say that there is probably some small amount left behind in the slaughter process. It depends on the skill of the slaughterer. Even with good careful regulations there will always be some risk involved because no process can be perfect all of the time.
- Dr. Hofer believes that the punishments for violating regulations are severe enough to discourage non-compliance.
- Dr. Hofer feels that the Swiss system of surveillance and control is better that of other countries.
- Dr. Hofer does not perceive any weaknesses in Switzerland's current policies aside from the failure to ban liquid feed produced from animal protein. Dr. Hofer believes that eventually the market will mount pressure against the liquid feed because many consumers are demanding only naturally fed animals.
- Dr. Hofer does not worry about eating beef.

The project team identified the following excerpts as viewpoints belonging to Dr. Dagmar Heim:

- With respect to the regulations being sufficient for long-term control of BSE, she feels that the current measures are adequate, if not overkill. Of course, public opinion plays a role in supporting stricter measures.

- If additional regulations were desirable they would be enacted. Right now there are certainly enough regulations, perhaps too many if you feel that the total feed ban is a bit excessive.
- Dr. Heim believes that Germany has overreacted to its BSE problem and has enacted some unreasonable regulations, for example, Germany requires an entire herd to be culled in the event of a BSE case.
- Dr. Heim does not seem to feel that there are any more existing weaknesses in Swiss policies. The weakest point may be in implementing the policies that Switzerland has enacted and this is why the development of a central control unit is taking place.
- Dr. Heim doubts that animal proteins will ever be included in cattle feed again.
- Dr. Heim believes that the implementation of regulations is always a little tricky. Once the central control unit begins operating in the fall of 2001 she believes that the government will have a better handle on enforcing the regulations that it enacts.
- Dr. Heim is not completely sure how well the current BSE regulations are being followed by other institutions involved in beef and feed production. She believes that the central control unit will help shed some light on this issue.
- She does not believe that the efforts and difficulties associated with the BSE regulations are so burdensome that some people may disregard these policies.
- Dr. Heim believes that it is fair to impose BSE regulatory policies when there is scientific research data or a reasonable doubt to support the decision.
- Dr. Heim believes that the increased efforts associated with the BSE regulations are justified by the increased measure of safety that they may provide.

- The most important ban took place in 1990 when MBM was banned from being fed to ruminants. She feels that since then, most of the policies have been minor in comparison and that at this point nothing important has been missed.
- Dr. Heim believes that many of the regulations are a mix between good science and a political tool to enhance consumer confidence.
- Dr. Heim believes that Switzerland has good policies to protect humans from health risks associated with BSE.
- Dr. Heim thinks that the current regulations for controlling BSE will enhance the public's confidence in the beef supply.
- Dr. Heim is confident that there is no problem in keeping SRM out of meat intended for human consumption.
- Farmers have been well informed about the clinical signs of BSE. Since the average herd size in Switzerland is only around 15 cattle, the farmer knows all of his cattle by heart. Because of this, the farmer will be the first to recognize any abnormal behavior in a potentially infected animal. Veterinarians have also been well informed about the clinical manifestations of BSE. In addition, surveillance vets at slaughterhouses have been ordered to look and touch each cow before slaughter. By touching in various areas, the surveying vets can observe the reaction and determine if the cow should be suspect for BSE. Since there are no BSE tests for live animals (aside from clinical examination) this is really the best that can be done at this point.
- Although she does not believe that spontaneous mutation or vertical transfer is responsible for all of the continuing cases of BSE in Switzerland, she feels that it is difficult to assess for sure what the actual cause is. This is because practitioners, pathologists, etc. all disagree on

what the causes may be. Since there is not enough scientific evidence to completely support or refute all of the hypotheses regarding the cause(s) of BSE, Dr. Heim chooses to keep an open mind and let the body of evidence speak for the validity of a particular hypothesis.

- Dr. Heim enjoys beef and continues to eat it. She will not, however, eat sausage because there is no telling what may be in a sausage. She prefers to be able to recognize the origin of a cut of meat before eating it.
- Dr. Heim indicates that there is no evidence to suggest that liquid feed containing slaughterhouse waste is a problem when fed to pigs. Because of this, she believes that it would be excessive to ban liquid feed at this point. She indicated that if liquid feed were being fed to cattle it is happening at a very low level and therefore is not a significant problem. Finally, it would be ecologically criminal to waste these valuable animal proteins.

The project team identified the following excerpts as viewpoints belonging to Herr Bucher:

- Herr Bucher believes that the current regulations in Switzerland are sufficient for the long-term control of BSE. He does state that the January 2001 regulations could have been taken a little earlier but at this point we should be in a position where we see very little cases.
- Herr Bucher believes that in general other institutions involved in beef and feed production adequately follow the current BSE regulations. Of course there has been some non-compliance, but this non-compliance was probably due to a mistake and not a purposeful action. The central control unit will help not only by enforcing regulations but also offering education to prevent these mistakes.

- There have been so many negative events in the past in the industry as a result of BSE that there is no incentive to risk of non-compliance.
- Herr Bucher believes that most farmers are satisfied with the current regulations.
- There are many theories surrounding the cause of BSE. For example, just like in humans, spontaneous cases of BSE may be possible. If this is the case, we will have to learn to live with low levels of BSE.
- The efforts and difficulties associated with BSE regulations are not so burdensome that some people may disregard these policies. For the farmers it is not really difficult to follow the policies because most of the burden lies with feed producers and slaughterhouses. Because the farmers are not as affected by the regulations, Herr Bucher does not really believe that there is much incentive for non-compliance.
- Everything has to be done to ensure food safety. Cost cannot be an issue when food safety is concerned. Furthermore, it is the goal of everyone involved in beef production not to lose the confidence of the consumer public. For these reasons the regulations are justified.
- Herr Bucher does not believe that any of the current regulations for controlling BSE are unwarranted. Instead he believes that every possible policy gap must be closed as quickly as possible. It is better to go one step too far now and then pull back in the future if deemed necessary. Because there are many things that we still do not understand about the disease Herr Bucher maintains that all of the regulations in place are warranted.
- Herr Bucher concedes that from a scientific point of view the total feed ban of January 2001 is a complete ecological waste. He argues, however, that the danger of cross-contamination before the ban and the criticism by customers over feeding animal proteins to animals justifies the January 2001 measure.

- At the moment all of the MBM regulations that are in place are desirable. Herr Bucher believes that it is logical that feed was the cause of the problem.
- The Schweizerischer Bauernverband is always in contact with the governmental regulatory agencies. Herr Bucher feels that sometimes their views are heard and sometimes they are not. With respect to BSE, however, Herr Bucher believes that there is good communication between the Bauernverband and the relevant authorities.
- Herr Bucher does not believe that it is difficult to keep feeds intended for different animals separate if people are paying attention. Usually feeds are kept in separate places anyway. Mistakes could be made by human error but this is probably not a very large problem. Herr Bucher believes that the problem of cross contamination was more caused by feed producers.
- Great Britain and Switzerland have the best policies to control BSE. All the other countries have waited too long to install their policies to eliminate BSE.
- Herr Bucher has no problems with eating beef.

The project team identified the following excerpts as viewpoints belonging to Herr Elia:

- From Bell's point of view the current regulations are sufficient for the long-term control of BSE. Herr Elia believes that they are absolutely sufficient from both a commercial and scientific point of view.
- Herr Elia is more or less sure that other institutions involved in beef production are closely following the current BSE regulations. He stresses that it is important to remember that there will always be some "black sheep" in the system. For example, some cattle producers may try to avoid the regulations by using old stocks of feed. In addition there may be some non-

compliance with feed producers. Of course these examples of non-compliance are rare occurrences.

- The regulations can be somewhat burdensome to farmers. Because feed is the largest budget item in their work, some farmers may try to skirt the regulations to save money. This has to be expected.
- Sometimes the increased efforts associated with the BSE regulations are justified, sometimes they are not. When safety is low, a small amount of effort will achieve a relatively large increase in safety. On the other hand, when safety is high, it takes a large amount of effort to achieve even small increases in safety. At some point when safety is high enough, increased efforts are not justified by the small increases in safety that they yield.
- Herr Elia believes that consumers in Switzerland acknowledge the efforts made in Switzerland and that the consumers believe that Swiss beef is safer than in the EU.
- 80-90% of beef sold in Coop is from label meat production. In the year 2002 Bell will produce more 'BIO' meat than meat from regular production. This illustrates the Swiss consumer's demand for 1st rate quality over low prices.
- In reality, the risk of BSE is so low that many of the regulations may be considered unnecessary. On the other hand, food (especially meat) is so important that ensuring food safety is of utmost importance.
- Herr Elia points out that the link between BSE and vCJD is not 100% proven.
- Food regulations are important because they affect everyone in Switzerland and in a broader sense they affect everyone worldwide.
- Herr Elia does not believe that any more regulations are desirable in Switzerland.
- Herr Elia believes that farmers do everything to put foreign products in a bad light.

- From a scientific point of view Herr Elia is absolutely confident that Switzerland has adequate means to detect and prevent BSE.
- Herr Elia does not think that it is difficult to separate SRM from meat intended for human consumption. He also feels that the regulations in Switzerland are adequate in this respect.
- Herr Elia is confident that Switzerland has the best policies in place to control BSE.
- Herr Elia does not perceive any weaknesses in Switzerland's current policies. He feels that Switzerland is going in the right direction with its policies.
- Herr Elia continues to eat beef. He did not even stop eating beef when he was studying at a university in the UK. Because of the small risk to humans (even in the UK) he did not see any reason to stop eating beef. Now that he is aware of the quality of different meats Herr Elia prefers a Swiss product.

The project team identified the following excerpts as viewpoints belonging to Herr Hinder:

- Micarna believes that it is important to work together with consumer groups, not to fight them. For example, Micarna stresses the importance of animal rights. The company is currently lobbying for better treatment of pigs. Some of Micarna's requests include allowing pigs to go outside, providing proper bedding for the pigs, and maintaining a minimum of at least 1 square meter of space per animal.
- The most important goals are for Micarna to have a safe product and satisfied customers.

- Other institutions involved in beef and feed production may not be closely following the current BSE regulations. Once again, the government cannot see everything that is going on and you can never be entirely sure about that which you do not know.
- Herr Hinder criticizes the feed industry for only doing the bare minimum required by governmental regulations. He feels that they should have taken a leadership role and taken stricter measures earlier on. For example, Micarna mandated that they would not accept pigs that were fed MBM as early as 1995. Many feed manufacturers did not stop putting MBM in pig feed until the January 2001 regulation.
- One thing that we do know is that there has been some non-compliance going on. There are well known cases of cattle being fed chicken or pig feed (sometimes by accident and sometimes not). We cannot really know what is completely going on in practice because it is impossible to watch every farmer all of the time.
- Herr Hinder certainly hopes that the BSE regulations are not so burdensome that some people may disregard them. He does not feel that they are too burdensome for Micarna. Herr Hinder believes that most of the regulations are necessary and furthermore that most people accept this. Of course you don't always know what is going on behind the scenes.
- From Micarna's point of view, the increased efforts associated with the BSE regulations are justified by the increased measure of safety they may provide. The most important thing that Micarna can do is to ensure the safety of its meat to the customer. Although Herr Hinder concedes that some people would not agree, he feels that with all the knowledge we have about BSE today we have to believe that the increased efforts are justified.

- The ban on using blood and bone meal for fertilizer is excessive. Other than that, Herr Hinder believes that all the other regulations are warranted, especially since we do not know everything about the disease.
- Herr Hinder does not really have confidence in the ability of these other countries (US, Argentina, and Brazil) to detect and prevent BSE because he knows how they produce their beef. There is no problem with their beef now because BSE has not been introduced to these countries. If BSE were to appear, however, these countries would have great problems because their policies and regulations are not adequate to prevent the proliferation of BSE.
- Herr Hinder believes that Switzerland has the best policies in place to control BSE. For one thing, Switzerland has dealt with BSE for over 10 years. Today there is little import or export of animals and feed (This helps reduce external pressure). In addition, Herr Hinder believes that in general Switzerland is very careful and works hard to do the right thing and to do it right the first time.
- Herr Hinder continues to eat beef but he will not eat no-name beef. It is important to him to know where his food comes from.

The project team identified the following excerpts as viewpoints belonging to Dr. Binder:

- The current BSE regulations in Switzerland are sufficient.
- Dr. Binder believes that the current regulations do enhance the public's confidence in the beef supply.
- Dr. Binder believes that there are two main reasons for the continuing cases of BSE. The first is that the incubation period of the disease is between 4 to 6 years and therefore it can

take up to 6 years to see the full effect of a policy change. The second reason is that there was probably some contamination of cattle feed with animal offal.

- Dr. Binder believes that spontaneous cases of BSE can occur but maintains that this would not greatly contribute to the continuing cases of BSE.
- Dr. Binder believes that Switzerland has the best policies to eliminate BSE.
- Although beef producers are good at following the current regulations there is always room for improvement.
- Dr. Binder continues to eat beef but he has stopped eating sausage.

References

Aguzzi, A., and Weissmann, C. "Prion research: The next frontiers." Nature 23 Oct. 1997: Vol. 389, pp. 795-798.

Almond, J., and Pattison, J. "Human BSE." Nature 2 Oct. 1997: Vol. 389, pp 437-438.

BSE Controls Review, "Common Questions," 2001
http://www.bsereview.org.uk/data/common_q.html

BSE Controls Review, "UK imports of beef meat and offal September 1999 to August 2000," 2000
http://www.bsereview.org.uk/data/uk_imports.htm

The BSE Inquiry, Volume 16 Reference Material Chapter 1, 2000
http://www.bse.org.uk/report/volume16/chapter1.html

Cnn.com, "Timeline: How the Crisis Unfolded", Jan. 15, 2001
http://europe.cnn.com/2000/WORLD/europe/UK/10/25/bse.timeline/.

Dealler, Steve, "BSE is a new disease. You should realize its history," 1998.
http://sparc.airtime.co.uk/bse/hist.htm.

European Commission: Food and Veterinary Office. "Final Report of Veterinary Mission to the United Kingdom (Northern Ireland) with Regard to the Implementation of Commission Decisions 98/272EC and 94/831/EC, Council Regulation (EC) No 820/97/EC and Commission Regulation (EC) No 716/96," 2000.

FSA of Great Britain, "Food Standards Agency Review of Bovine Spongiform Encephalopathy (BSE) Controls Final Report," 2000.
http://www.bsereview.org.uk/data/final/final%5fcontents.htm

Guardian Newspapers Limited. "BSE crisis: timeline," 2001
http://www.guardianunlimited.co.uk/Print/0,3858,4081978,00.html

Hill, A.F., Desbruslais, M., Joiner, S., Sidle, K.C.L., Gowland, I., Collinge, J., Doey, L.J., and Lantos, P. "The same prion strain causes vCJD and BSE." Nature 2 Oct. 1997: Vol. 389, pp. 448-450.

International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers' Associations (IUF), "EU Beef Crisis Plan Lacks Protection for Industry Workers," 2000.
http://www.iuf.org/iuf/Press/001204.htm

Jacob, Merle and Hellstrom, Tomas. "Policy Understanding of Science, Public Trust and the BSE-CJD Crisis." Journal of Hazardous Materials (2000): Vol. 78, pp. 303-317.

Lacey R.W., "Bovine Spongiform Encepalopathy: A "Progress" Report." British Food Journal (1994): Vol. 96(7), pp. 46-48.

Lacey, Richard, "How Now Mad Cow?", 1994 http://www.mad-cow.org/~tom/lacey.html

The Lancet, "The Phillips Report on BSE and vCJD", 4 Nov. 2000: pp. 1535.

Masters, C.L., and Beyreuther, K. "Tracking turncoat prion proteins." Nature 17 Jul. 1997: Vol. 388, pp. 228-229.

Niggli, Urs. "General Information on the Situation of Agriculture in Switzerland." 2000.
http://www.organic-europe.net/country_reports/switzerland/default.asp

Oakley, Robin. "Analysis: Hope and Blame in Britain." CNN.com. 28 Oct. 2000 http://www.cnn.com/2000/WORLD/europe/10/26/bse.oakley/index.html

Perler, L.; Heim, F.; Geiser, F.; Muller, H.K.; Kihm, U. "10 Jahre BSE in der Schweiz", 2001 http://www.bvet.admin.ch/tiergesundheit/d/ausbild_beratung/tierseuchen/bse/bse-ch/bse10j/SAT_BSE-09_00.htm

Prusiner, Stanley B. "Prions – Nobel Lecture." Proceedings of the National Academy of Sciences (1998): Vol. 95, pp. 13363-13383.

Roe, Emery. Narrative Policy Analysis: Theory and Practice, Duke University Press, Durham and London, 1994, pages 2-19

Rohwedder C. "German Officals Quit Posts." The Wall Street Journal Europe Wednesday Jan 10, 2001 (front page).

Rohwedder C., Vitzthum C. "Mad-Cow Crisis Drives Farmers to the Brink." The Wall Street Journal Europe Wednesday Jan 10, 2001 (front page).

Scientific Steering Committee "Report on the Assessment of the Geographical BSE-Risk (GBR) of Switzerland" BSE – Mad Cow Disease, July 2000 http://europa.eu.int/comm/food/fs/sc/ssc/out136_en.pdf

Swiss Federal Veterinary Office. "BSE: Regulations" BSE – Mad Cow Disease, 2001 http://www.bvet.admin.ch/tiergesundheit/e/ausbild_beratung/tierseuchen/bse/massnahmen/1_index.html

Swiss Federal Veterinary Office. "Swiss BSE Surveillance Program to Continue" BSE – Mad Cow Disease, 2001 http://www.bvet.admin.ch/tiergesundheit/e/ausbild_beratung/tierseuchen/bse/bse-ch/surveillance_progr.pdf

Taylor, D.M. "Inactivation of prions by physical and chemical means." Journal of Hospital Infectivity (1999): Vol. 43.

Swiss Federal Veterinary Office. "TSE Status Of Switzerland" BSE – Mad Cow Disease, November 1998
http://www.bvet.admin.ch/tiergesundheit/e/ausbild_beratung/tierseuchen/bse/bse-ch/tse_switzerland98.html

U. S. Department of Commerce (USDC), "Switzerland ECONOMIC TRENDS AND OUTLOOK" - National Trade Data Bank, September 3, 1999, pg 5

welcome.html, "Agricultural acreage and stock farming," 2001.
http://www.about.ch/economy/index.html

World Health Organization: Department of Control Disease Surveillance and Response. "WHO Infection Control Guidelines for Transmissible Spongiform Encephalopathies." 1999
http://www.who.int/emc-documents/tse/whocdscsraph2003c.html

Acknowledgements

It is at this point that our team would thank everyone who made this project possible. Without your help and participation we would not have been able conduct this research. Our team would like to thank the following people in no particular order.

Dr. Heinrich Binder
Herr Heiri Bucher
Herr Davide Elia
Dr. Frau Dagmar Heim
Herr Peter Hinder
Dr. Hans Hofer
Dr. Fritz Näf

In addition we would like to extend our gratitude to Dr. Caspar Wenk who provided us with valuable information and access to the Swiss beef industry. Dr. Wenk offered his guidance and valuable insight into the beef industry and has aided our team in producing our final report.

We would also like to thank professor Kent Rissmiller, a social science professor at Worcester Polytechnic Institute, for helping us to improve our research techniques and our ability to approach problems from different perspectives.