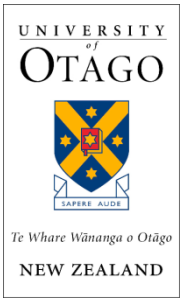
University of Otago



Future Food: Fiction and Reality

Emily Gordon

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science Communication

Centre for Science Communication, University of Otago, Dunedin, New Zealand

December, 2010

Abstract

At present, a relatively small number of corporations and individuals control the majority of the world's food cultivation, manufacturing and distribution. The number of different species we eat globally is decreasing, while the number of food products is increasing dramatically. Essentially, we can eat when and where we like and we do not have to participate in food production or even its preparation in order to do so. However, all this convenience has come with a cultural cost, a cost to our knowledge and community, to our family, to our health and ultimately to our connection with food. To effectively re-establish a connection with our food supply it must be once more dragged into the public consciousness. This requires more than simply a discussion amongst interested parties and activists; it requires the embedding of food issues within the fabric of our everyday lives, within our popular culture. To do this it is necessary to reach beyond traditional boundaries and include fictional entertainment, of all types in the processes of science communication.

This thesis is about disconnection from food and the part that science communication can play in restoring it. The thesis is broken into two parts. The first part is a written component that uses futuristic science fiction film as an example of how science communication can address past, present and future food concerns. Disconnection from food is damaging our culture, environment and health. The problem is complex and multilayered, affecting everything from economics to health, however this thesis discusses what I consider the three main elements behind this disconnection (namely loss of food control, lack of knowledge regarding food content and a fading food culture). I examine specifically how science communication, in the form of fictional film, addresses these concerns.

The second thesis component is a 25-minute documentary film, produced in response to a segment about pig farming that appeared on Television New Zealand in May 2009. *Three Little Pigs: A Curly Tale*, which uses a semi-fictional storyline to help actively engage the audience and communicate the problem of disconnection between food production and society.

Acknowledgements

This thesis could not have been completed without the invaluable support of my supervisors. In particular Jennifer Rock whose excellent advice and encouragement made the writing process straightforward and enjoyable. Also Ross Johnston for his advice at the beginning of this year regarding the written component, and especially for his beneficial and constructive feedback and support in the production of the film.

I am also very grateful to Neil Harraway our executive producer on *Three Little Pigs*, who was very generous with his time and happy to help us in any way. His very concise notes were particularly helpful during the editing process.

I would also like to thank the Centre for Science Communication and everyone there who helped me on either the film or the written component, particularly Sue Harvey, Robert Brown, Wiebke Hendry, Phil Davidson, and the Class of 2010. Thanks to Sophie Parker and Wendy Dodds for proofreading the thesis, your time was much appreciated.

And last, but certainly not least I would like to thank George Dawes who was a great film partner to have throughout the year and a excellent person to collaborate with.

Thank you to everyone who supported me in any respect during the completion of this project.

Emily Gordon

Table of Contents

Introduction

When I was very young, just four or five years old I witnessed a family friend kill and skin a goat outside the front door of our home. The event was so significant for me that for years afterwards I refused to eat meat, even long after the memory of the goat had faded. I was in general a fussy child, but my mother could not afford to pander to my complaints so I ate what I was given or I went without. Compared to many other children growing up in the 1980s, my brother and I had what some might call a somewhat unusual diet. Mum's garden provided almost all our vegetables, including a number of little known greens, which my father used to refer to as weeds. In recent years, many of these greens have become en-vogue and for sale in the average supermarket, but at the time they were out of the ordinary.

In addition to the vegetable garden, there were a scattering of wild fruit trees, that we children knew how to find, and at different times of the year, we had access to a combination of lemons, mulberries, grapefruit, feijoas and blackberries. The lemon tree in particular I remember had large ugly looking fruit with thick skins, something that most urban consumers would look on with suspicion. Also growing up in a region that was, for the most part, surrounded by dense bush, we had a reasonable understanding of what could and could not be eaten among the native plants in the wild.

As a child I believe I had a relatively good connection with my food, but living in a rural environment, where people grew their own produce, made their own cheese with milk from their own cow, often fished and hunted for meat and even on occasion brewed their own beer, I was lucky. Few people today can claim to have the same experience and once I began living in cities I became increasingly aware of just how different my childhood was from the general population. Most people, and I now include myself in this description, have lost their connection to food and that loss is having a significant impact on society.

This thesis is about that disconnection; from the factors that cause it, to the part that science communication can play in restoring it. The problem is complex and multilayered, affecting everything from economics to health and this paper merely represents what I see as the overall trend. A more in-depth discussion would take much longer and is a task for another time.

I have chosen to study this disconnect through the use of popular culture, in this case fictional film and its impact, and reflection of reality on the public consciousness. Fiction can be an important tool in developing ideas and changing attitudes and it was with this in mind that I applied it in two different ways to this thesis.

The thesis is broken into two parts. The first part is a written component that discusses what I consider the three main elements behind our disconnection from food (namely loss of food control, lack of knowledge regarding food content and a fading food culture) and how science communication, in the form of fictional film, addresses these concerns. The second part of the thesis is a 25-minute documentary film called *Three Little Pigs: A Curly Tale* (Gordon and Dawes, 2010). The film investigates a single example of disconnect as it applies to the pork industry in New Zealand and uses a semi-fictional storyline to help communicate the problem and educate the audience.

It must be clarified here that while the film and the written component share a common thread and overall objective (both demonstrate the value of using fictional storylines to re-establishing our connection with food) they are not created of or for one another but are separate yet connected parts of the overall argument. The written thesis is a broad-based discussion of current food issues and the potential benefits of using fiction, in this case science fiction, to highlight these issues in the modern world, while the film investigates a single issue in the form of pig farming. It also takes the idea of using fiction one step further by demonstrating how this process could begin, with the amalgamation of fiction and fact in the documentary form. In this case, it uses fairytale rather than what would generally be classified as science fiction, showing that science and fiction can be applied in many different forms.

For the written thesis, it was essential to narrow down the choices of films to study and as a result set some parameters. In doing so, I necessarily rejected a number of films that could have offered a valuable contribution to this discussion.

To begin with, I limited my selection to feature length films; those that had received a general release in mainstream theatres and were therefore known to the general public at the time of their release, whether or not they were viewed. Of these films, I chose those that had been produced after the publication of *Silent Spring* (1962) by Rachel Carson, widely credited

with beginning the environmental movement. I then focussed specifically on films that highlighted a possible future rather than those set in the present. I chose to look at futuristic films because such films have the ability to present a possible final outcome of the current situation and therefore highlight both current issues and current anxieties. Within this category of films, I choose those that either had a storyline about the food supply, or in which the food played a crucial or poignant role. Unfortunately, few films fit these specifics. As a result, some of my choices, such as *The Matrix* (1999) and *Avatar* (2009) are simply an investigation of seemingly minor scenes that nonetheless strongly highlight the unique and important part that food plays in our lives and the part it will continue to play in the future.

Once the films had been chosen, I studied them for common themes and discovered that all highlighted issues of food control, food content and a loss of food culture. Using these three elements, I then began researching to see how the issues expressed in the films related to real life situations. I discovered that even those concerns highlighted in films from the 1970s, continue to be felt today, despite this such issues very rarely appearing in our popular culture, although food itself is littered throughout. This seems to me a large part of the problem with regard to disconnection from food and something that could be lessened with science fiction.

The written thesis begins with a chapter focussing on the question of food control. Beginning with a brief history of ancient food control, it moves on to look at a prediction of future food control as demonstrated in the 1970s film *Soylent Green* (Fleischer 1973). The rest of the chapter is entitled *Food Control in the 21st Century*, and looks at this control in the current day from seed to supermarket. It is separated into three parts, each examining a different area of food control. It begins with an investigation into the level of control in the seed industry with a look at the US company Monsanto. This is followed by a discussion of the New Zealand based Fonterra and the impact of globalisation and control in the dairy industry, it ends with an investigation into the worldwide concentration of the food retail industry.

Chapter Two examines the content of our food, and questions how much we actually know about it. The chapter begins with a discussion about the prediction of our future food content, with a look at three films that highlight these concerns, *Soylent Green*, *Silent Running* (Trumbull 1972) and *No Blade of Grass* (Wilde 1970). It then investigates these concerns in a section entitled *What Are We Really Eating?*, which considers the contents of

our present day food. To do this is I have separated the section into three parts each highlighting an aspect of our modern day food content. Beginning with the worldwide decrease in crop variety and its dangers with regard to disease and climate change in *Measuring Our Losses,* and moving on to *More Choice With Additives,* which looks at how we have replaced natural variety with artificial variety in the form of processed foods. The final part in this section, *Laboratory Agriculture,* talks about the future of artificial food, particularly with regard to biotechnology.

In Chapter Three, I discuss the continuing loss of our food culture and what this means for our communities, families and health. The chapter begins with an overview of food's wider meaning and significance to our lives, besides being simply a source of nutrition. Separated into three parts this section is entitled *Our New Food Culture*. The first part, *A Grain of Knowledge,* uses the film *Idiocracy* (Judge 2006) to considers how the loss of agricultural knowledge and ritual is breaking down rural community cohesion. What follows is a discussion in *Value and the Family Meal* of the meal scene in *Soylent Green* and how this relates to the modern family meal and devaluation of food. The final part in the section, *Sickly Sweet – A Sugar Coated World*, debates the impact of sugar on our society, from its early production and connection with the slave trade to its current day impact on our health. It compares the virtual reality world in *The Matrix* (Wachowski and Wachowski 1999) to the insidious nature of sugar in the modern world. The final section in Chapter Three, entitled *Time for a Revolution* discusses the rising food counterculture that is appearing all over the world, and highlights such initiatives as the Slow Food movement, Guerrilla Gardening and Fair Trade.

Finally, Chapter Four discusses science fiction and its potential as a form of science communication in addressing our disconnection from food. The first part of the chapter uses the recent film *Avatar* (Cameron 2009) to highlight the concern we feel about our increasing impact on the planet and our nostalgia for a bygone way of life. A discussion on the use of science in documentaries, in particular those that feature food issues, follows. The third section *Science Fiction as Science Communication* argues the benefits of implementing fictional narrative as a form of science communication. In the final section of Chapter Four, I discuss the use of these principles in the production of my own film and suggest that achieving a reconnection between people and their food is possible through storytelling.

Overall, my thesis argues that our continuing disconnection from food is damaging our culture, environment and health. However, by applying key tools of science communication, such as fictional narrative, to popular culture, we can highlight problems and issues within our food system and help to re-establish the connection to food.

Chapter One – Who controls our food?

"We are the flour in your bread, the wheat in your noodles, the salt on your fries. We are the corn in your tortillas, the chocolate in your dessert, the sweetener in your soft drink. We are the oil in your salad dressing and the beef, pork or chicken you eat for dinner. We are the cotton in your clothing, the backing on your carpet and the fertilizer in your field."

(Cargill corporate brochure 2001 cited in (Murphy 2006)).

1.1 A History of Food Control

Since the beginning of our existence on this planet there has been inequality with regard to resources; it is after all, as Fernandez-Armesto (2002) pointed out, the very nature of evolution by natural selection. However with the advent of agriculture, this ability to control resources became even more pronounced due in part to the division of labour that the system allowed (Hodson and Sullivan 2007). Surpluses created through agriculture supported development of other industries and employment not directly involved in food production, such as craftsman, artisans and ultimately rulers (Hodson and Sullivan 2007). In fact, it is these very surpluses and how they were organised and exchanged that have created the types of complex societies that we call "civilization", without which the world would be a very different place (Pilcher 2006). Without the surpluses from agriculture, it is unlikely that I would be writing this paper, we would not have infrastructure, academia or even Hollywood blockbusters and we certainly would not have the audience to appreciate them.

However, despite the huge benefits that agriculture brought with it, there were also a large number of concerns not previously encountered by humans. With rising surpluses came rising population, which led to increasing problems. In fact, of the four apocalyptic horsemen three could be said to have came hand in hand with agriculture: pestilence, famine and war. While hunter-gatherers had been susceptible to sickness through food poisoning and certainly injury, chronic diseases and plagues were almost unheard of until the rise of sedentary farmers (Diamond 1997). Also complete reliance on a small variety of crops, as opposed to a wide selection of seasonal plants and animals (as hunter-gatherers were), lead to widespread

famine when crops failed; a situation made even more devastating as populations grew (Beardsworth and Keil 1997). Unlike nomadic hunter-gatherers, sedentary farmers could not pack up and follow the food. Finally, and most importantly for this chapter, with food surpluses came control, control of land suitable for farming, control of the food itself and control of its distribution. Control in turn ultimately led to conflict both within nations and between nations, as people fought for resources (Hodson and Sullivan 2007).

In these early agricultural societies, the ruling classes controlled the food. They made decisions about where surpluses would go and to whom, with most generally favouring their own needs over the needs of others (Fernandez-Armesto 2002). Even in China, where surpluses were handed out widely to the masses in times of famine, the elite were well provided for (Pilcher 2006). For example, in Chinese culture, rank was reflected by the number of dishes an individual ate in one sitting, with higher officials eating as many as eight different dishes, while the lower ranks ate half as many (Pilcher 2006). In Mexico also the elite controlled food distribution and therefore consumed the majority of the harvest (Pilcher 2006). Mayan nobles were taller, stronger and probably more fertile than their lower ranked colleagues. They were, in effect, more capable of maintaining their position and that of their kin. In Egypt, food surpluses were used to support work on the pyramids, monuments that reflected the Pharaoh's wealth and power (Roberts 2008). In the dark ages, medieval monasteries gained power by responding to increasing demand. They quickly understood that by controlling access to their land, food surpluses and the retail industry that sprung up around it, they could accumulate a considerable amount of wealth and power (Fraser and Rimas 2010). During this period the monks and secular government implemented sales permits that restricted the access of other food producers to markets, thereby monopolising the food retail sector as well (Fraser and Rimas 2010).

By the middle of the millennium, food control was becoming global. Demand for spices had expanded to such an extent that private merchants from Europe and South East Asia fought to keep control (Pilcher 2006). The Dutch East India Company ultimately won out and went on to establish the world's first multinational company, with a monopoly in the spice trade that lasted throughout the 17th century (Robins 2006). Meanwhile, in the Caribbean millions of African slaves worked and died, growing sugar cane for the European market, and making the West Indies the largest producer of sugar in the world (Standage 2009). Back in Europe and the Americas control of the sugar and spice trade made the

merchant classes extremely wealthy and their riches began to rival that of the historical ruling classes (Standage 2009).

Except for spices, long distance travel of food goods was relatively restricted until as late as the 17th century, allowing local producers to continue supplying their communities (Mintz 2006). And while food surpluses led to a greater degree of social differentiation, most farmers still maintained a reasonable level of self-provisioning during the first few thousand years of agriculture (Wilk 2006). Even after the collapse of the Roman Empire, which had supported many people in the urban centre of Rome with imports of grain from as far away as Egypt, European subsistence farming remained (Roberts 2008). However, things were about to change, by 1600 many regions in Europe had exceeded their carrying capacity, with populations so large that they needed to look elsewhere for food surpluses (Roberts 2008). So, by the time of the industrial revolution came, the production and distribution of food was also set to be transformed (Mintz 2006).

Canning, freezing and new transportation methods meant that food could come from almost anywhere (Roberts 2008). Also it increasingly became clear that growing one's own food was no longer viable or indeed fashionable (Roberts 2008). As the industrial age wore on and new methods of food production became cheaper and more efficient, the number of people growing food decreased dramatically while the number of people controlling it decreased even further. The sheer cost of sustaining the output required for this style of processing, meant that many farms and indeed farmers were swallowed up by large industrial companies and became simply part of the food supply machine (Fernandez-Armesto 2002). Meanwhile, at the other end of the food supply chain, large and profitable chain stores replaced small retailers. The problem became so apparent, that by the beginning of the 20th Century, many reformers began to question the wisdom of allowing such a small number of giant corporations to control such a large amount of economic power (Pilcher 2006). The depression of the 1930s further exacerbated the situation. In the United States, New Deal reforms, while trying to reduce surpluses, ended up assisting the wealthiest farms to the detriment of the poorest (Pilcher 2006).

By the late 20th century, almost half the world's population lived in the urban environment. This was even higher for Western countries where most cities housed well over 80% of the nation's population (CIA 2010). The result is that today a huge majority of the

global population rely on others for *all* their food, with most having little understanding of where it comes from. It is now corporations that control the world's food and consequently, money that determines its distribution. As Fraser and Rimas (2010) point out a small number of companies around the world determine how and what we eat and this number is getting smaller everyday, while the population gets bigger. In the United States, just four companies slaughter 80% of the beef, just three export 81% of the corn and 65% of the soybeans (Fraser and Rimas 2010). Over half the global banana produce is handled by two companies; Chiquita and Dole (Roberts 2008). It has been estimated that as of 2005 just 500 global companies controlled 52% of the world food product (Wagenhofer 2005), an incredibly small number when we consider how many people they have to feed. Food control has been a major issue in human populations since the beginnings of agriculture. However, unlike in historic populations, food supply is no longer in the hands of rulers, elected or otherwise (Pilcher 2006). The faceless corporations that now control our food supply are not responsible for the health and welfare of all the world's citizens, only the company shareholders. Government can regulate if pushed, but in a capitalist society, only money talks. Unfortunately, those with little money have little voice, especially when it is a choice between eating or not.

1.2 *Soylent Green* and the Future of Food Control

So how far will this control of food actually go and what will be the consequences? The 1970s science fiction film *Soylent Green* (Fleischer 1973) presents a frightening possibility. While the film highlights a number of environmental, social and political concerns, arguably the most frightening is the control of a limited food source.

In *Soylent Green*, the human population has exploded, most plant and animal life on the planet extinguished, and one company, the Soylent Corporation, has sole control of the staple diet. Soylent green, red and orange are coloured wafers, dished out to the starving masses at selected times during the week. Only the very rich live on rare and expensive fruit, vegetables and black market meat (Fleischer 1973). *Soylent Green*'s New York City, and indeed the whole world, is in the grip of a devastating famine, due in part to overpopulation, but also climate change and mass extinctions. As a detective, the main character Thorn, (played by Charlton Heston) shows that there is some kind of order operating in the city, but it never becomes clear from whom he receives his wages. Is there still a democratic

government in power or has the Soylent Corporation swallowed it up too? It is hard to know. What is clear however, is the degree to which the people are dependent on this giant corporation for their very survival. Moreover, survival seems to be all life has become. A life of sleeping on streets, while waiting for the next batch of tasteless food to arrive, does not seem like life at all. In fact, the Soylent Corporation's control, we could argue, goes so far as to own the people themselves, like they would livestock, and as it turns out that is exactly what they are. As Lipschutz (Lipschutz 2006) points out, in this film people have become the ultimate resource with the only outgoings, the energy required to keep them alive long enough for they themselves to be processed into food.

So the question is, how likely is such a scenario? Science fiction often takes public fears and exaggerates them to the extreme for the purposes of entertainment, but it also has the power to present possible outcomes of a current scenario (Allan 2002), thereby allowing audiences the opportunity of seeing for themselves what could come of such predictions. I will explore this idea further in chapter four but for now the question remains, is there a basis for the public fears in the first place?

In the late 1960s and early 1970s when *Soylent Green* came out, the world was just waking up to the consequences of capitalist industrialism, not as simply a social problem, as recognised earlier on in the century, but also as an environmental problem (Bailey 2000). In addition, globalisation was making people increasingly aware of the worldwide impact of our continued expansion. It was becoming apparent that a choice someone made in one country could now dramatically affect the life of someone else half a world away. However, in the 1970s it was the combined threat of rising inflation, mounting population growth and environmental destruction that were most on people's minds (Bailey 2000; Belasco 2006). When combined with rising fuel costs due to the energy crisis in the Middle East, it became clear that a food supply dependent on oil was would not be sustainable in the long run (Belasco 2006). Consequently, the first Earth Day held in April 1970 sought to highlight these problems. For Harry Harrison writer of *Make Room, Make Room* (1966) the book that *Soylent Green* was based on, overpopulation was the greatest problem, but the film took this concept further to demonstrate the consequences of such a population explosion (Lipschutz 2006).

Interestingly, more than 35 years later, overpopulation is no longer at the forefront of people's minds, despite a global population almost twice that of 1970. Currently at just under

8.5 million, the possibility of New York City reaching a population of 40 million in the next 12 years is now looking highly unlikely (USCB 2009). In fact, while the global population is increasing and in many developing countries this increase is substantial, the rate of the increase worldwide has actually slowed (CIA 2010). Globally annual births have been steadily decreasing over the last twenty years, with the number of births now at 140 million each year compared to 173 million in 1990 (PRB 2010). Overpopulation while still a major concern is not the focus of fear it once was. Instead anxiety has skipped from the cause to the symptoms, pollution is still an issue, as is the extinction rate of other species, and climate change has become enemy number one.

However, it is the level of food control (a issue present in the film but not fully investigated) that I consider one of the major problems in our food supply today and one that often affects other highlighted issues. At present, a relatively small number of corporations and individuals control the majority of the world's food cultivation, manufacturing and distribution (Weis 2007). This control has encroached slowly and quietly as larger farms brought up their smaller neighbours, until the majority of food production is in the hands of just a few huge high-yield farming operators, manufacturers and food retailers (Ramey 2010). As in previous centuries, these food-controlling entities wield considerable power, through financial, societal and governmental pressures. However, unlike previously, they are not rulers and do not act for the common good.

1.3 Food Control in the 21st Century

1.3.1 Monsanto – Better Seed for a Brighter Future?

Arguable the poster company for food control at the level of seed production is the US giant, Monsanto. Founded in 1901 Monsanto began as a chemical company known for the production of such chemicals as polychlorinated biphenyls (PCBs) and from the 1940s the herbicide 2-4-5-T, which was later mixed with 2-4-D to make Agent Orange (Tokar 1998)[1]. Right from the beginning, the company had a stake in the food industry. They began with a foray into the food additive business as early as 1904 (Guerrante, Antunes et al. 2010). More markets followed with the production of pharmaceuticals in 1912. However, it was not until

[1] This article is a reprint of the lead story in the nearly suppressed issue of England's Ecologist magazine (see Z December 1998).

1969 that Monsanto acquired a small group of companies that specialized in the production of corn hybrids and the beginnings of their interest in seeds and genetically modified crops began (Guerrante, Antunes et al. 2010).

Over the next 25 years, Monsanto looked at ways that they could use their newly acquired technology to increase agricultural output. Despite such early beginnings it was not until the mid-1990s that Monsanto saw the biggest growth in this area, with the commercial production of Genetically modified[2] (GM) crops including corn, cotton and soybeans among others (Stiegert, Shi et al. 2010).

Scholars and commentators alike have written copiously on Monsanto and its products and practices, mostly surrounding the biotech industry (Tokar 1998; Cohen and Morgan 2008; Hindo 2008; Ramey 2010). However, debating the pros and cons of GM crops as they apply to health and conservation is not the purpose here, those issues I will discuss further in Chapter Two. Instead, this section will focus on how Monsanto's business practices, and the overall increasing concentration of the seed industry, directly affects the control that farmers around the world have over their own farming choices.

The system works like this. Monsanto develops GM seed in a number of staple crops such as corn, soybean or canola. With the inclusion of unique genes, the plant becomes a distinct variety and is eligible to be patented in the US under the Plant Variety Protection Act (PVPA) and the Patent Act (PA) (Winston 2008). Many, such as the Roundup Ready® varieties are resistant to Monsanto's own herbicide brand Roundup® (Monsanto 2010). This means that the farmer can spray Roundup® on his or her entire crop to kill the weeds, without killing the crop itself, a process that is both more efficient and in effect cheaper for the farmer. However, to grow these crops a famer must buy seed from a licensed Monsanto distributor.

So far, this all seems fair enough, but here is the catch. Unlike non-patented seed retailers, Monsanto do not actually sell the seeds to the distributor (Winston 2008). With contracted protections they sell the license to distribute seeds, the farmer in turn while acquiring the seed does not buy them he simply buys the license to grow them (Winston 2008). Both the license to distribute and to grow Monsanto products come with a series of

[2] Genetic modification or genetic engineering is the direct human manipulation of an organism's genetic material to create a new unique organism known as a Genetically Modified Organism (GMO).

restrictions all designed to ensure that Monsanto can retain control over their product (Winston 2008). These restrictions mean that a farmer cannot save seed, sell seed or modify seed owned by Monsanto. It also means that distributors cannot sell licenses to farmers on Monsanto's blacklist. These are farmers *accused* or *suspected* of selling, saving or modifying Monsanto patented seeds; the restriction does not discriminate between the accused and the guilty (Winston 2008).

These restrictions take control away from farmers in three ways. First, as Monsanto farmers they no longer have the ability to develop their own plant varieties, something which has been done throughout the history of agriculture (Kastler 2005). Historically farmers would save the best seed from the season for planting the next year, thereby selecting for the best traits in a season's crops. Over time, this allowed crops to adapt to local conditions, increased yield and in general become more efficient. However, because the farmers cannot save their seed, they must rely solely on the Monsanto Company for their crop's traits, many of which were originally developed with an American Mid-west climate in mind (Herrera-Estrella 2000). Many farmers who have taken up Monsanto crops around the world, particularly in drought prone areas have found that the modified crops are unsuitable for the local environment or that yields were not as great as expected (Shiva 2004).

Secondly, Monsanto's seed restrictions have further reduced the farmers' already limited financial control, by tying them into a vicious cycle of payments that many are unable to fight their way out of. Among the world's 1.4 billion farmers, 75% rely on saved seed for their seasons planting (Koons 2004). However, increasingly farmers are "paying for something they once took for free" (Fraser and Rimas 2010). Farmers who plant Monsanto crops must pay for a new batch of seeds not once but every year, in addition to the pesticides and herbicides that go along with the seeds (Winston 2008). Cash-strapped farmers are often encouraged by Monsanto to take out loans to pay for expenses, entrenching them even further in the system and in the debt (Glover 2007). This problem is perpetuated with the continued concentration of transnational seed companies, which some researchers believe has led to an overall increase in the price of seed (Stiegert, Shi et al. 2010). This means that if the rate of corporate seed industry concentration continues, conditions will only get worse for farmers.

Finally, there is the problem of choice. Industrial farming restricts farmers to a very narrow variety of crops. The choices that a farmer makes with regard to the type of crops he or she wants to grow are for the most part dictated by the commercial seed companies, with

some staple crops given priority over others (Roberts 2008; Ramey 2010). This means that many farmers find themselves growing monocultures, from which they find it increasingly hard to switch. Exacerbating this problem, according to a 2004 documentary *The Future of Food*, is that companies like Monsanto buy up seed patents in an effort to get control of the market (Koons 2004). The film estimated that, in 2004 Monsanto already owned as many as 11,000 patents. This gives them the ability to sue any farmers in North America caught growing patented crops, a prerogative that they have put into action on more than one occasion already, despite evidence to suggest that crops can be the result of accidental cross breeding (Chandler and Dunwell 2008). The film also suggests that once Monsanto patents a seed, they can forcibly stop the growing of that variety completely, in order to promote their own specially developed seed. If this is the case, could it lead to the extinction of some plant varieties? This is worrying when you consider that plants being patented for their unique properties are those traditionally used in medicines or for added nutritional value (Murphy 2006). A future under this regime is a bleak one and leads us to question how we can regain control of our food if, before it is even grown it is already owned.

Monsanto say that their technologies will feed the world and that their methods simply protect them: "Patents are necessary to ensure that we are paid for our products and for all the investments we put into developing these products." (Monsanto 2010). Many agree. Last year Forbes named Monsanto, company of the year. In the article announcing this they wrote:

> "In economic terms, the company is a winner. It has created many billions of dollars of value for the world with seeds genetically engineered to ward off insects or make a crop immune to herbicides: Witness the vast numbers of farmers who prefer its seeds to competing products, and the resulting $44 billion market value of the company." (Langreth and Herper 2010)

If the objective is to make money then, yes, Monsanto deserves its place as company of the year. However, food production should be about more than making money, after all, food itself is about much more.

1.3.2 Milk For Life – Fonterra and Globalization in the Dairy Industry

Another issue with regard to control is the effect of globalisation. Once they reach a certain size many companies find that to expand they have to look for opportunities outside their home country (Lapoule 2010). Such an example exists in the New Zealand-based global

dairy giant Fonterra. Fonterra controls the large majority of the dairy market in New Zealand and as such is New Zealand's biggest company while at the same time being the largest dairy exporter worldwide (Evans 2004). This was not always the case; in the 1930's, the number of cooperative companies involved in dairy in New Zealand was more than 400 (Fonterra 2009). However, by 2000 this had dropped to just four, two of which controlled 95% of the industry (Fonterra 2009). Up until this point the New Zealand dairy industry could be said to be relatively competitive at the domestic level, but with just two large cooperatives essentially controlling the industry, this was no longer the case (Evans 2004). During 2001 four became three with the amalgamation of the two biggest cooperatives to form Fonterra. By 2002 the changes to the dairy industry had led to the disbanding of the former New Zealand Dairy Board, unrestricted dairy export and the acquisition by Fonterra of the former Dairy Board assets (Fonterra 2009). The Fonterra cooperative had become the biggest dairy company in New Zealand controlling 96% of milk produced (Evans 2004).

Originally representing approximately 13,000 dairy farmers, the justification for the formation of Fonterra was a hope by farmers that a bigger company would be able to compete more effectively on a global scale and therefore give farmers higher milk payouts (Evans 2004). Once Fonterra formed, that is just what they endeavoured to do. By entering into partnerships with many companies worldwide, such as Nestle, Kraft and Masterfoods, Fonterra was quickly able to establish themselves as a force in the international dairy trade, exporting their products to over 140 countries throughout the world (Stringer, Tamasy et al. 2008). To maintain year long supply they also proceeded to open manufacturing plants in regions throughout North and South America, Asia and Australia, thereby allowing them to access local milk, in times of decreased New Zealand supply.

Like other farming sectors, dairy in New Zealand has continued to see a dramatic decrease in the number of individual farmers while maintaining an increase in output. In 1994, New Zealand had more than 16,800 dairy farms; ten years later, this number had dropped to 12,810 (MfE 2007). The number of farmer shareholders in Fonterra has also decreased; the company now has approximately 10,500 dairy farmer shareholders, down by around 2,500 since its formation less than 10 years ago (Fonterra 2009). However, Fonterra still collects 89% of the country's milk, most of which is produced for export (Fonterra 2010). This is because the number of dairy cows has risen dramatically. In fact since 1979 it has

doubled, with dairy cattle in New Zealand now numbering 5.9 million - more than one milking cow per New Zealander (Bascand 2010).

While the globalization of Fonterra and the success of the dairy industry in general are seen by many as a positive result for the New Zealand economy, there are a couple of downsides. The most important for this section is the impact that the size of such a large industry has on the country. Worldwide dairy farming and dairy processing pollute the environment through the release of nutrient loaded runoff, carbon emissions and erosion. The New Zealand dairy industry is no exception (Jay 2007). Many consider New Zealand dairy farming low-cost, but as farms throughout the country become more concentrated, environmental pressures get greater. In fact, some believe it unlikely that a country the size of New Zealand can sustain this level of low cost production without dire consequences to the environment (Jay 2007). Despite policy to limit the impact of its industry, Fonterra and the dairy industry in general, continue to face pollution claims (NZPA 2006; NZPA 2010). In some cases, the individual farmers or the company incur large fines, but in other cases, they obtain free licence to pollute. In 2006 Fonterra was granted the right by Horizon Regional Council to release up to 8,500 cubic metres of wastewater per day into the Manawatu River, for the next 15 years (NZPA 2006). Then in 2010 they requested even more with a 22-year extension to continue dumping in the Manawatu's tributary the Mangatainoka River (Chug 2006). This came just two months after signing an accord to clean up the Manawatu (Chug 2006).

Unfortunately, Fonterra is less concerned with the environmental impacts of their operations, than they are with increased profit. In a study of New Zealand dairy farms Jay found that there was little incentive to consider environmental impacts "beyond the farm gate" (Jay 2007). The simple fact is that, of the 1,281 million tonnes of milk produced by Fonterra in the year 2009/2010, New Zealanders consumed only a fraction (Fonterra 2009). However, the country takes the whole brunt of the production's environmental impact. This would be somewhat acceptable if there was some move to mitigate the industry's impact, but in many cases, regulation is negligible, blocked or simply ignored. The Clean Streams Accord designed to clean up our rivers and streams has shown that the non-compliance of farmers in the Waikato doubled between 2009 and 2010, from 10% to 20% (Balme 2010).

The situation is no different for greenhouse emissions. At 48%, New Zealand's greatest greenhouse gas emissions come from agriculture and yet those industries will be the last to enter the Emission Trade Scheme (ETS), the policy designed to reduce our carbon emissions (Jiang, Sharp et al. 2009). Even once they have entered and are required to pay for their emissions in 2015, they will be eligible for government assistance up to 90% of a still to be determined baseline (MAF 2010a). Ironically, instead of considering green solutions such as planting trees to offset their emissions, many dairy farmers seem to believe that the only way they will be able to afford the ETS costs will be to increase their livestock numbers (FFNZ 2010), a conclusion that seems ludicrously short-sighted and counterproductive.

So how do Fonterra and the dairy industry in general continue to get away with it? The answer is simple. New Zealand dairy is big business, as an industry it makes up 30.8% of NZ foreign export and contributes 12.6 to the GDP (Dana and Schoeman 2010). The government recognises the global and economic importance of the industry and they do not want it to fail. Fonterra has a lot of market power, particularly within the domestic environment and, as has been observed with other companies in this position, market power not only has the ability to effect price but also the laws and policies directly connected with the company's industry (Murphy 2006). Unfortunately the size of dairy's contribution to this country's GDP along with the decreasing number of New Zealand farmers involved in the process mean that a fair amount of political sway is held by an ever decreasing number of people. Once again, we see the control of our food and all that implies ending up in the hands of the few.

1.3.3 Global Supermarket Chains and the Consumer

Finally, at the end of the line we find the supermarkets and other food retailers. This is the point where the average person enters the supply chain and it is one of the most concentrated industries worldwide. Almost a quarter of the global market share in retail is controlled by just 15 companies (Vander Stichele and van der Wal 2006b). These companies turn up time and time again as leading supermarkets in countries all over the world. At 6.1% market share, the US company Wal-Mart holds top spot globally (Murphy 2006). Not only is this company the top in retail sales overall, it is also the top in food retail alone. Yet it only has about half the stores of Carrefour at second place which also places in the top ten in Latin America, Asia, Africa and Europe (Vander Stichele and van der Wal 2006b; Kumar 2008). But these two are not alone, multinational supermarket chains like Wal-Mart (USA),

Carrefour (FR) and Tesco (UK) have taken control of the food supply in three ways: industry concentration, global expansion and private labels (Vander Stichele and van der Wal 2006b).

Competition in the food retail business is intense as companies fight for customer control and loyalty. In mature markets, competition has created intense industry concentration, with very few companies controlling large regions. This is particularly true in Europe where Wal-Mart's 1999 buyout of the European based supermarket ASDA, and other acquisition in Germany led to a series of agreements between rival firms (Colla and Dupuis 2002). The deal put Carrefour on shaky ground as Wal-Mart's biggest competitor, and caused them to merge with another big French retailer, Promodes (Colla and Dupuis 2002). Just four years later in the UK, a buyout offer by Wm Morrisons for Safeway created a bidding war between the major UK supermarkets. Finally, after involvement from the Competition Commission, Wm Morrison's took over the company and the brand of Safeway ceased to exist (BBC 2004).

However, this battle for control has also had another effect: global expansion. To compete effectively supermarkets rely on population growth to sustain the required annual influx of new customers (Kumar 2008). This is a particular problem in developed countries, where (as stated previously) population growth has slowed considerably. This loss of customer supply has forced major supermarkets to look outside their country of origin for profits. The search has led many food retailers to the three high-growth sectors of China, India and Russia, where many smaller specialty stores are slowly disappearing to make way for the large superstores (Lapoule 2010). In India consumers are increasingly shopping at the newly arrived supermarket chains rather than the more traditional family run stores, with 53% saying they want to see more Western-style supermarkets (Kumar 2008). Elsewhere, in Latin America 70% of the large grocery retailers are multinational and their immense market power is slowly squeezing the local chains out (Vander Stichele and van der Wal 2006b).

Finally, large supermarket chains have found another way to maintain their control and that is with private labels. Private labels are the supermarket's own brand, promoted and sold in the supermarket often at the expense of other food manufacturers (Vander Stichele and van der Wal 2006b). This strategy has become so successful that private labels now represent 12% of global processed food retail (Vander Stichele and van der Wal 2006b). This, along with marketing strategies such as selling shelf space to high paying suppliers, has limited the

profits of many other food companies, particularly smaller or less-known brands (Murphy 2006). Those who can not afford high priced shelf space, or are too small to sufficiently supply a large supermarket's needs, generally fall by the wayside and are replaced with bigger, more productive brands (Murphy 2006). Yet again, industries are creating corporate control in the food supply chain and are once more limiting our choices.

The news may not be all bad however. Unlike the farming and processing sectors of the supply chain, at retail level consumers have the power, if they wish to use it, and in some cases, they have. Consumer pressure brought fair trade products to European shelves, labelled GMOs and got rid of battery farmed eggs (Murphy 2006). Unfortunately, making choices like this is difficult. Consumers are limited by many things such as religious beliefs, moral issues and personal health requirements, not to mention the potentially higher grocery bill, that comes with many such choices and many consumers are unable or simply unwilling to go that far. The other issue is knowledge. To truly understand who controls your food source requires a considerable amount of research, as I have discovered. Globalization, industry concentration and complexity of the food supply chain means that to understand the full history of one chocolate bar could take hours of research and most people just do not have that time. The issue of food control is paradoxical. In many ways, it allows us the kind of comforts that we have come to expect in the 21st century, but as food control increases, we have to question how long this comfort can last. With only one planet and an economic system reliant on growth, there is really only one thing companies can do to expand and that is swallow up other companies. Currently the world of *Soylent Green* seems unlikely, but if we want to realise it, allowing giant global companies to reap profits at the expense of small suppliers, biodiversity and the environment, is just the way to do it.

Chapter Two: What's that in my soup?

Mary had a little lamb
and when she saw it sicken
she shipped it off to Packingtown
and now it's labelled chicken

New York Evening Post 1906 cited in (Pilcher 2006).

2.1 *Soylent Green* to *Silent Running*

By the end of *Soylent Green,* the audience has discovered that the high protein food product believed to be a sourced from the ocean is actually processed human flesh (Fleischer 1973). However, what is more frightening is that manufacturing of the product seems due to necessity rather than purely for profit. The oceans are dying and with it the last source of nutrients, ocean algae. With nothing left, the human species must break the last food taboo and begin eating each other. As Detective Thorn is carried away wild and clearly insane from his discovery, he begins shouting to anyone who'll listen "Soylent Green is people!" However, we the audience realise that it is too late; the people must cannibalize each other or starve. The scenario shows a human population so removed from the production of their food that they are wholly unaware of what it actually contains.

The ultimate outcome of *Soylent Green* is mass famine and starvation as the number of available food products gets fewer and fewer. In *Soylent Green,* the main culprit is population, followed closely by its symptoms, pollution and climate change. However, in a little known earlier film *No Blade of Grass* (1970), the culprit is viral (Wilde 1970). Based on a book of the same name by John Christopher, the film explores the potential impact of a deadly plant virus that attacks grasses, including wheat, rice and maize. With such a reliance on these crops worldwide, an event like this would be devastating, and in the film, it is. The country, this time England, descends into anarchy as starving people turn on each other in desperation.

Two years after *No Blade of Grass,* another film, *Silent Running,* gave us a solution to the problem of decreasing crops, but at a cost (Trumbull 1972). Once again humans have decimated all the earth's natural resources, however in this film genetically engineered and artificial foods, have entirely replaced natural food. On the deforested Earth, a laboratory manufactures all food, while the general populous regard natural food as strange and inedible. The entirety of the planet's remaining natural plant and animal life, live on a space station orbiting the earth. Unlike *Soylent Green* and *No Blade of Grass,* the hero of *Silent Running,* Freeman Lowell, appears to be the only character that places any value in the natural resources at all. When he and his crewmates on the space station are ordered to destroy the last remaining forest, he must turn renegade in an effort to save them.

These three films highlight potential future problems with our food system and the disconnection that comes with those problems. The number of different species we eat globally is decreasing, while the number of food products is increasing dramatically (Weis 2007). At the same time, many of us are unaware of just what we are eating. Much of this has to do with market pressure and food control. As fewer farmers produce a smaller variety of crops under high-yield conditions, food manufacturers are continually forced to make more products out of fewer ingredients in order to remain in competition. This leads to the addition of cheaply made artificial additives or the creation of GMOs that allow for a new spin on an old product. Moreover, consumers have come to demand a particular standard. Food products must look, taste and smell the way we have come to expect, any deviation is commercially unacceptable (Wilk 2006). A classic example is the carrot. Naturally, this vegetable comes in a range of colours with varieties in red, white, yellow and purple (BBC 2008). However, due to some patriotic Dutch farmers in the 17th Century, consumers now expect orange carrots and so that is what they get (BBC 2008).

2:2 What are we really eating?

2.2.1 Measuring our losses

One particularly powerful scene in *Soylent Green* reflects clearly the loss of biodiversity. On discovering the horrible truth about Soylent Green, Thorn's friend and colleague Sol can take it no longer and chooses to "go home". In the world of *Soylent Green* "going home" is voluntary euthanasia. For Sol the process begins with an injection and ends

with a film in which he sees the world as it once was. This is the world he has told Thorn about, one alive with biodiversity. As Sol watches deer frolic across the screen and birds fly through a sun filled sky to the sounds of Beethoven, Thorn stands peering through the window, awestruck by his first glimpse of the biodiversity now gone. “I told you.” says Sal. “How could I know?” replies Thorn, “How could I ever imagine?”

The changes to our food system have also come with some losses. The first of these is in biodiversity and genetic variety. Some estimate that over human history, approximately 7,000 different species have been cultivated as food crops, with each species producing thousands of different varieties (Weis 2007). However, currently only about 30 different crops feed the world, providing 95% of our energy requirements. Of these, just four staple crops (rice, maize, wheat and potato) make up 60% (FAO 2010a). Worse still, among these crops the number of individual varieties is often extremely limited with just a fraction of the cultivars widely grown. The FAO have recognised that since the Green Revolution many crops, particularly rice, wheat and millet, have suffered extreme genetic erosion (FAO 2010b), with many landraces and native varieties replaced by modern hybrids, breed specifically for high-yield.

To highlight this loss one only has to look to rice as an example. One of the most highly consumed food crops worldwide, rice is second only to wheat. Until the Green Revolution and the beginning of industrial farming practices, there were an estimated 110,000 rice varieties in India alone (Deb 2009). Today just a few thousand species remain. In the area of West Bengal there were once 5,600 varieties grown, today this number has dropped to 610 and these are only grown on the most marginal farms (Deb 2009). Another classic example is the potato. Originally, from South America, the potato has grown to become the fourth ranked food commodity and number one vegetable in the world (Secretariat 2008). According to the FAO, 2007 saw a global potato production of approximately 320 million tonnes, of which 72 million tonnes came from China alone (Secretariat 2008). Despite this, just one subspecies of potato is grown outside the Andes. Within this subspecies there are estimated to be 5,000 different varieties. However, this diversity is lacking in worldwide production with just a few varieties widely grown (IYP 2008).

This narrow selection is due in part to industrial crop cultivation, which has continually concentrated on products with increased yield, long shelf life, uniformity and

robustness - in other words, the ability to travel well without bruising (Pawlick 2006). This means that certain varieties tend to be favoured over others. Many countries have taken this variety favouritism a step further with a series of restrictive seed laws. In France the process began in 1949 when the government issued a decree outlawing the trade (for sale or otherwise) of any agriculturally important seeds not listed in a national catalogue (Kastler 2005). Then in 1966, the initiative spread throughout Europe with the creation of a common catalogue covering all countries in the European community. This meant that a farmer must register his or her own specially developed crop in order to sell it or even give it away. To get a seed type registered with the catalogue, the plant variety must be distinctive, uniform and stable and in many cases have value for cultivation (Louwaars 2005). As Kastler points out, for many cultivars this is just simply not practical, their natural variety often make them both unstable as a cultivar type and non-uniform with each individual product appearing sometimes vastly different from one another (Kastler 2005).

Variety may be bad for commercial agriculture but it is crucial for biodiversity. In addition, the registration price of between 5,000 and 15,000 Euros may simply be more than a small farmer can afford (Kastler 2005). This means that farmers, who are no longer legally allowed to share their own cultivar between each other, are once again reliant on corporate seed producers. In recent years the law has been relaxed with unlisted varieties (known as non-varieties) available as heirloom crops and for conservation, but there are still restrictions on what is sold commercially (Europa 2010). Governments say that they have done this to protect consumers from economic dangers, arguing that with non-varieties consumers can never be sure what they are going to get (Louwaars 2005). With a stable, uniform crop at least the consumer knows they are getting the same deal as the next guy.

However, limiting variety can be dangerous on another level and even more so when you consider the fragility of our current food system. By relying so heavily on a limited number of crops, we are opening ourselves up to potentially disastrous consequences. The importance of having large biodiversity among food crops is twofold. Firstly, as highlighted throughout history, variety is essential for protecting against disease. The potato blight and subsequent potato famine in Ireland between 1845 and 1850 was due to restricted diversity in both the number of crop types grown and genetic variety among individual crops (Fraser 2003). Like many staple crops today the potato variety in Ireland at the time was most commonly grown for its productivity. Very little thought was given to its disease resistance,

storability or even palatability. Secondly, the population had for the most part stopped growing the traditional combination of grain and livestock in favour of a potato monoculture. This meant that when the potato blight did hit and spread quickly through the genetically similar plants essentially wiping out that year's harvest, the population, with nothing to fall back on, simply starved. In this way monoculture not only limits genetic variety in the crops we do grow, it also limits choice in crops we can eat.

In addition, despite all our technology and scientific knowledge in the area of agriculture, the disease threat has not disappeared and while many industrial seed companies are continually looking at ways to develop disease or pest resistant varieties, often by creating GMOs, the results are limited. These actions only protect against currently identified plant viruses or diseases, they are unable to protect against future strains and do not protect against any environmental changes the plant may face (Jones 2009). This is particularly crucial with the threat of climate change, which could see disease vectors becoming established in previously unaffected areas. The recent *Pseudomonas syringae pv. actinidiae* (PSA) scare in New Zealand kiwifruit is just such an example of this phenomenon (MAF 2010b). Originally discovered in Japan, the virus has since caused widespread damage to Kiwifruit crops in Italy, but until recently had not been found in New Zealand (MAF 2010b). However, from November 2010 this had all changed with a number of New Zealand orchards confirming the presence of the disease and others showing symptoms (MAF 2010b). Kiwifruit, while not a staple crop, is a relatively important industry in New Zealand and as such, a virus such as PSA has the potential to do considerable damage. However, what is possibly more worrying is the fact that no one is quite sure how the virus came to be here, with some suggesting it could have been in residence for some time and has only now had the right climatic conditions to make its appearance felt (MAF 2010b). While this event could be bad for the New Zealand economy, it will not lead to worldwide famines, however if such a thing was to happen to a staple crop such as wheat, rice or maize the results would be crippling. The food system is further endangered by modern agri-businesses, who discourage public food storage schemes, often actively campaigning against them because of the effect of stockpiles on price (Murphy 2006). Particularly in a period of climatic and environmental instability, that could have us facing dramatic changes to both crops and their diseases. It is not the time to be focusing all our attention on such limited variety.

On the other hand, genetic variety is not the only loss to the current food system. In Pawlick's description of the American food system he claims that many fruit and vegetables have also lost nutritional value over the last century (Pawlick 2006). Tomatoes, he says contain 30.7% less vitamin A and 16.9% less vitamin C today, than they did in 1963. Many others agree. A UK study conducted by Anne-Marie Mayer, looked at the changes in mineral composition in twenty different fruits and vegetables over fifty years (Mayer 1997). She did this by comparing mineral tables from a series of UK food composition studies carried out at various times since 1936. What she found was that there had been a considerable decrease in mineral content for raw fruit and vegetables throughout the period. In fact, the only mineral that did not show significant decline was potassium, at 94% of historical values (Mayer 1997). A US study on 43 garden crops also found decreases in minerals across the board (Davis, Epp et al. 2004). The researchers in both studies suggested that the decrease in nutrition might be related to increased yield, meaning that while the plant itself may produce more or larger produce, the original mineral content does not increase but is in fact diluted across the harvest. Studies on wheat varieties have supported this conclusion, showing a negative relationship between some minerals and increased yield (Fan, Zhao et al. 2008). However, loss of nutrition is not restricted to crops alone, meat has also lost its nutritional value. Since 1963, US chicken has lost around 52% of its vitamin A and 25 to 40% of its potassium (Pawlick 2006). So if we are not getting overall more nutrients with increased yield, what are we getting? As it turns out, we are getting three things, sodium, fat and carbohydrates. For example, the US tomato has gained 200% in sodium (Pawlick 2006).

Both *Soylent Green* and *Silent Running* warn us of the possibility of species extinction. As the impact of climate change begins to take effect, the potential for the spread of disease vectors, evolution of new viruses and loss of arable land will put increased pressure on the small number of crops we currently rely on. It may seem unlikely but crop extinction is possible; *The Future of Food* (2004) suggests that of the many vegetables grown around the world at the beginning of the 20th century, 97% are now extinct (Koons 2004). Our food options are already narrowing. If unutilised varieties are ignored simply because they are inconvenient they will began to disappear and we will be left with no alternative but to continue with what we have. One of the characteristics that allowed humans to become so successful is our ability to adapt to changing conditions (Barnes 2007), but the more comfortable we become the less we seem inclined to embrace this quality. Unfortunately, soon we may not have a choice.

2.2.2 More choice with additives

While crop varieties continue to decrease, consumers could be forgiven for not noticing, because the number of available food products has actually increased dramatically. The average US or Canadian supermarket offers 12,000 different items for sale with new products appearing regularly (Weis 2007). Almost 100% are processed to some degree, with many known to food manufacturers as value-added products (Blatt 2008). Some of these new products are simply the result of packaging in a more convenient way, a single serving or pre-sliced for example. This allows food processors to make several different products out of just a few staple ingredients. However, another way they can do this is by adding a variety of ingredients to the product called additives. Additives generally refer to artificial colourings, flavourings and preservatives, however in this paper I will also include salt, fat and added vitamins under this banner (Sugar could also be included here but I will be discussing sugar separately in chapter three). According to the United States Food and Drug Administration (USFDA), there are approximately 2,800 food additives and 3000 chemicals approved for consumption internationally (Blatt 2008). As a group, additives are often visually indistinguishable from the item of food as a whole and largely unrecognizable to the average consumer with many simply indicated by numbers. They can arguably be separated into three groups: those that make a product last longer, those that make it look and taste better and finally those that make the product more nutritious (Blatt 2008; Roberts 2008). Vitamins may come into this category. Most people probably assume that their food contains enough vitamins and minerals, but this is often no longer the case for reasons that will be explained in more detail later (Roberts 2008). Some substances serve more than one role, such as salt (sodium chloride), which functions as both flavouring and a preservative (NZFSA 2010).

Processed food is not new. Some form of processing has gone into food production for centuries as people found new ways to make their food taste better or last longer. Historically, drying, salting or cooking foods, were the most commonly applied preservation methods. The traditional Portuguese dish *Bacalhua* made from codfish is an example. Despite current preserving methods, the codfish is still primarily dried or heavily salted in Portugal and is so popular, that some suggest there are over 1,000 recipes for using it (Sciolino 2008). Drying and salting in particular are still common components of food preserving, but industrial food manufacturers now use a variety of other methods as well, often in the form of artificial preservatives (CSPI 2009). In New Zealand there are 30 different approved preservatives and as the New Zealand Food Safety Authority website

states, they control the growth of mould, bacteria and yeast that can cause the food to deteriorate (NZFSA 2010). Europe on the other hand, has 37 such approved products (UK 2010). Like other food additives, preservatives generally appear on the label as an internationally recognised three-digit number (NZFSA 2009). This is because long scientific names take up too much room on a label and threaten to mar the effect of the packaging, something that is increasingly being used for advertising (Silayoi and Speece 2007). Unfortunately, these numbers generally mean nothing to the average consumer, making identification of what we are actually buying even more obscure. Recognising this fact, the NZFSA have produced a 16-page pamphlet designed to help people through the process (NZFSA 2009). It lists every additive approved for sale in New Zealand and its allocated number, a document that seems helpful until you realise it is still just a list of scientific names and associated numbers, requiring a chemistry degree to truly understand it. In spite of this, preservatives, as the NZFSA say are "used to improve the safety of food," so it may be that we are able to live with not understanding what they actually are (NZFSA 2010).

However, 99% of additives are not preservatives, they are instead colours, flavour enhancers, thickeners, acidity regulators, stabilizers and anti-caking agent, plus many more (Blatt 2008). All these substances are added to a product to make it more appealing to the consumer. Like preservatives, they also have a series of numbers and colourful names associated with them, none of which help to explain to the average consumer what they are actually doing there. Some are natural and some artificially created, but regardless of their origin these substances have for the most part transformed the food manufacturing industry, making food processors experts in manipulation (Blatt 2008). Initially added to food to restore colour, flavour and texture lost during processing the creation of these substances is now an industry in itself (Roberts 2008). The reality is that without them many processed foods would be grey, tasteless sludge, making them completely unappealing and therefore unsalable. So why not replace what is missing with natural components? The answer is simple, cost. Naturally produced colours and flavours are becoming increasingly expensive and often supply is so limited that it cannot meet demand (Roberts 2008). That is where food engineers come in. It is a food engineer's job to put the sparkle back into processed food and they do this so well that most of us never question why a can of peas, something that is naturally green, needs that extra green food colouring.

However, expansion in this industry has gone beyond just restoring what was once there. It has also led to the development of completely new products. Here we can once again use the potato as an example. This seemingly plain vegetable now forms the basis for a considerable array of processed food products (Keijbets 2008). In fact, between one and two thirds of potatoes consumed in developed countries are in the form of French fries or potato chips. The potato chip has far surpassed its original form (plain with salt, generally called "*Ready Salted")* with a huge variety of increasingly elaborate relatives. Potato chips now come in a variety of different cuts from wafer thin or crinkle cut to extra thick. There are different cooking methods such as kettle fried, light plus or original and they have flavours that range from the simple "*Ready Salted*" to the "meat and vege" flavours of *Roast Lamb Mint* or *Chicken and Herb* (Foodtown 2010). The success of food engineers at developing these products is clear with a quick browse through your local supermarket. A search on the New Zealand Foodtown website for "chips" brings up over 150 different products of which over 120 are potato chips (Foodtown 2010), an extremely unnecessarily large number when you consider that only genuine difference between them is the combination of artificial flavours and the company that manufacturers them. Yet, this is only the potato-based chips, it says nothing about the whole selection of copycat chips made from other vegetables and grains, particularly corn of which there are many (Foodtown 2010).

So, what contribution do processed foods make to our diet in the way of nutrients? Well the answer is not much. As discussed previously vitamins and minerals are increasingly disappearing from our fresh crops, however, this is nothing compared to the amount lost from processed food (Blatt 2008). One of the first steps in processing grain is refining, designed to extend shelf life and make grains easier to digest. Unfortunately, by removing the husks, refining also strips the majority of the nutrients from the grain. In vegetables, the loss of their skin also causes nutrient loss. This is where most of the goodness lies and peeling is a common practice in vegetable processing. While initially food manufacturers had no way of solving this problem, as soon as a method became available, they began the process of re-adding nutrients. As the number of diet related health problems have increased, so has the market for dietary supplements (Pawlick 2006). With such a rising interest in health and wellbeing, is it too cynical to say that food manufacturers have seen the potential for a lucrative new market? By advertising a product as healthy, they have been able to retain control of and even expand a market that might have been lost to them otherwise (Roberts

2008). So the question is, how healthy are these products and can we trust a food manufacturer's assertion of their relative benefits? This is where the issue gets tricky.

In 2004, two New Zealand high school students discovered that claims made by the company GlaxoSmithKline regarding the vitamin C content of their blackcurrant drink Ribena were false (Newstalk ZB, NZPA et al. 2007). While the ready-to-drink Ribena label stated a vitamin C content of 7mg per 100ml, the company now admits that in reality the drink has no vitamin C at all. More recently in the US, the FDA has began investigating the health claims of food producers and vowed to put in place front-of-package labelling regulations, after a voluntary initiative called Smart Choices was criticised for misleading consumers (Nestle and Ludwig 2010). The initiative, started by many of the country's largest food manufacturers, was a front-of-package tick that allowed consumers to see quickly and easily whether a product was healthy or not (Neuman 2009). Unfortunately, the actual nutrition criteria for the label seems to have been almost non-existent with products such as the high sugar breakfast cereal Fruit Loops given the green tick, to the horror of many nutritionists.

Obviously, relying on food manufacturers for nutritional information is unwise, but even if nutritional content is confirmed by an independent body or included as a mandatory requirement as it is in New Zealand, is there a difference between nutrients that are naturally present in whole or minimally processed food and those added later to highly processed foods? Unfortunately for food manufacturers, it seems there could be. For a start, the interactions between various nutrients and other phytochemicals in food are complex (Nestle and Ludwig 2010). This means that while an individual substance may have positive effects on health in one case, their effect may minimised or completely eradicated in another case (Nestle and Ludwig 2010). In the words of Marion Nestle, "The claim […] that a refined breakfast cereal could boost a child's immune system due to the presence of few antioxidants is tenuous at best" (Nestle and Ludwig 2010). In other words, including just a few of the missing nutrients may not be enough to get the benefit of them; it may require the addition of other vitamins and minerals as well. Iron intake for example is facilitated by the presence of vitamin C and vitamin A, but casein proteins coming from eggs and dairy may do the opposite and inhibit iron absorption (Lopez and Martos 2004). It is becoming increasingly clear that a diet of processed foods does not give an individual their necessary nutritional intake, no matter how much they eat (Markovic and Natoli 2009). Practitioners in Australia

have noticed large numbers of obese and overweight individuals with unusually low nutrition levels that seem to be the result of eating high-energy food, with few vitamins and minerals (Markovic and Natoli 2009).

The inclusion of additives in food has made understanding what we eat extremely difficult - a fact highlighted by US writer Steve Ettlinger, who wrote an entire book on the 39 ingredients that make up the United States' culturally iconic Twinkie (Ettlinger 2007). In *Twinkie, Deconstructed* Ettlinger discovered that while 8 of the ingredients are various GMO corn by-products, now found in anything from baked goods to batteries, the Twinkie also contains minerals mined from the rock beneath Wyoming and chemicals commonly found in plastics. A combination that seems not only unappetising but also inedible. However despite this, the Twinkie has annual sales of $200 million dollars a year (Grindlinger 2008). This startling information makes you question whether people really know or care what they are eating. And the answer is, probably not. Modern food processing has become so sophisticated and so reliant on artificial additives that many consumers no longer recognise the taste, look and smell of the real thing, preferring instead the imitation (Roberts 2008). Home cooking is no longer just the process of cooking whole foods in the home, but is now a "flavouring", added to products from baked goods to roasts.

2.2.3 Laboratory Agriculture

Silent Running is not only a film about loss of biodiversity but also the replacement of that biodiversity with artificial organisms and products. In a scene early on in the film, Lowell's crewmates scorn him for his insistence in eating natural produce. His response is frightening and as he inflicts a tirade of abuse on the other men, we begin to see signs of the strain that being the sole caretaker of the Earth's biodiversity is having on him.

The fear that Lowell feels in *Silent Running* with regards to the loss of nature continues to be felt more than thirty years later. In Margaret Attwood's 2004 novel *Onyx and Crake* (2004*),* the two main characters Jimmy and Glenn (otherwise known as Crake) live in a futuristic world filled with strange hybrid creatures and bizarre sounding foods (Atwood 2004). One such product grown in the laboratory is Chickennobs, essentially a genetically engineered chicken product, consisting entirely of drumsticks. This is a world where genetic engineering rules, as huge biotech corporations separate their employees with their families

from the rest of the world, while their creations run rampant. However, is it all just science fiction? Well, possibly not. While discoveries in both physics and chemistry dominated the 20th century, Rifkin predicts that the 21st century will be the age of biotechnology (Rifkin 1998). For the scientists involved in its development and the science fiction writers who have imagined it, the potentials of biotechnology must be exciting (Wadley 1989). But for members of the public, and indeed many of those in the scientific community, there is the fear that pulling this particular thread will unravel the very existence of life, as we know it. Of course, biotechnology is not just about food, it has consequences for almost all areas of human life and could impact on the planet in ways not yet imagined, positive or negative (Wadley 1989). Because of this, debate has been raging over the use of biotechnology since almost the beginning of its conception.

Despite all the changes that agriculture has undergone since the industrial revolution, arguably none have been more controversial than the development of biotechnology. Biotechnology is described generally as the process of moving genetic material from one organism to another (Wadley 1989). Unlike previous agricultural breeding, biotechnology gives the developer the ability to be very specific with regard to the traits they want the organism to express and therefore speeds up the breeding process considerably (Roberts 2008). The breeder selects a single gene or group of genes that control a trait and inserts it into the cell of a donor. While this process sounds like a quick and effective way of doing something that would take traditional plant breeders years to complete through crossbreeding and hybridization, there is a remarkable difference and that is the sexual barrier (Blatt 2008). In biotechnology, it is theoretically possible to take genes from any living organism and put them into the cell of another, regardless of the genetic relationship between the two. More than any other food production, biotechnology is the stuff of science fiction and unlike most previous agricultural innovations. These completely novel products have opened up a world of possibilities so vast that many of us are yet to even comprehend them (Rifkin 1998).

So, what are the pros and cons of biotechnology as they apply to our food supply? On one hand, biotech companies and geneticists claim that with this sort of technology at our fingertips we could feed the world in an efficient and sustainable way (Wadley 1989; Garcia and Altieri 2005; Roberts 2008). Development of drought-tolerant, pest resistant varieties could allow farmers in marginalised areas, particularly Africa, to grow crops that would support their families and their countries without the need for many expensive inputs

(Thomson 2008). Specific genes could also be isolated to allow the production of crops with increased minerals, vitamins and enzymes (Garcia and Altieri 2005). We could even grow crops to include vaccines, protecting millions from infectious disease. While this all seems very exciting and positive, in contrast others claim that releasing such products into the environment without the proper research could lead to ecological and medical disaster, and that biotech corporations have spent too little time and money investigating the potential problems (Garcia and Altieri 2005). Many ecologists argue that gene-flow between GM crops and related wild species or conventional crops could lead to species contamination or create super-weeds (Chandler and Dunwell 2008). The concerns are not unwarranted, hybridization and gene flow between conventional crops and related wild species is well documented and there is no reason to assume that GM crops will be any different. In fact, there is evidence to suggest that gene flow has already occurred in a number of species. As early as 2002 there were reports of oilseed rape super-weeds in Canada, resistant to more than one herbicide due to accidental crossings (Randerson 2002).

On the other hand, medical concerns are less clear. So far there has been little evidence to suggest that GMOs are unsafe for human consumption (Blatt 2008). However, while we may have mapped the human genome and can identify the genetic make up of many other species, there is still much we do not know about genes and their functions. The evolutionary processes at work on genes happen over hundreds of generations and therefore the results of our genetic experiments may take many years to appear (Rifkin 1998). It is for these reasons that many scientists urge caution when developing GMOs for sale on the global market.

Unfortunately, the reality is that GMOs are already here, with many of us already eating them whether we realise it or not (Miller 2008). The first GMOs began commercial production in the mid 1990s. Since then they have continued to expand in distribution from their 1996 coverage of 4.2 million acres in 6 countries to 309 million acres in 25 countries by 2008 (Stiegert, Shi et al. 2010). The most common GM crops are soybean, corn, canola and cotton. While this does not seem like a large number of crops, the products from these are present in a huge range of foods. In fact, it has been estimated that two thirds of the processed food in an American supermarket contains some amount of GM crop; none are labelled (Blatt 2008). In Europe where growing GM foods is highly restricted, labelling is in place but only on large ingredients that are the direct product of a GM plant (UK 2010).

Enzymes and additives grown with GM microorganisms do not require labelling and neither does meat or dairy from animals fed on GM grain. In New Zealand the labelling laws are little stricter and state that food and food ingredients require labelling when

> "Novel DNA and/or novel protein is present in the final food. It also requires labeling of food and ingredients where the food has altered characteristics." (FSANZ 2010).

The rule has some exemptions. Highly refined food or processing aids where the novel DNA or novel protein has been removed due to processing, flavours which are present in less than 0.1% of the final food and food prepared at point of sale does not require labelling (FSANZ 2010). Unfortunately, even in New Zealand, all GMO labelling (except on whole food) is relegated to the back of the packet where it is found in small letters along with all the other indistinguishable ingredients.

However, GM crops may only be the beginning and lab based food just in its infancy. Rifkin (1998) suggests that the future will see an increasing number of food products grown in the lab in giant bacterial baths of tissue culture, and not just plants (Rifkin 1998). In September 2010, the USFDA began discussing the approval of GM salmon for sale (Taylor 2010). AquaBounty, the company manufacturing the product, say that the modified fish will give salmon farmers the ability to raise fish in half the time it takes a conventional salmon farmer. At this stage the FDA have asked for more research with regard to the salmon issue. While most believe it is safe, they are not ready to make a decision that may come back to bite them (GMO 2010). However, approval is probably only a matter of time; animals have already been engineered for use in pharmaceuticals and at least one other company has applied for commercial approval, this time to market pigs (Berger 2010). Although, there are also other ways that human designed animal products could enter the market, the USFDA has already ruled that cloned animals and their offspring are safe to eat, although presently the expense has limited their production to breeding stock only (Swezey 2008). In the Netherlands, Dutch scientists have been growing pork in the lab since 2006 (Edwards 2009). By extracting cells from a live pig and growing them in a solution of nutrients, the scientist have managed to grow pork meat, although its soggy consistency still leaves something to be desired.

Biotechnology is a complex and volatile issue and one that is unlikely to be resolved in a hurry. On the one hand, the potentials are vast but the *Frankenstein* (1818) archetype

gives us a pause. In these stories, the creation or manipulation of life forms, real or artificial, usually ends in disaster for the human creator. The immoral implications associated with stories of these creations, from *Frankenstein* to *Jurassic Park* (1993) are so strong that it is hard to shake the feeling of doom they conjure up. Therefore it is necessary before releasing such a powerful tool, that we determine which part is a just a cultural fear of the forbidden and which is justifiable caution. Unfortunately, when it comes to making money many people are not willing to wait for that answer.

As consumers, we continually contradict ourselves by wanting more variety at the same time as standardised products. We want to visit the supermarket and find carrots year round, but only those that are orange and of a regular size. This pressure forces farmers to grow stable regular food crops, with strength for portability, but little genetic variety. It forces food processors to turn to artificial additives for preservation, flavour and presentation, while scientists use biotechnology to create crops and livestock that to do it all, but faster and more efficiently. However just like *Soylent Green* and *Silent Running,* many people today are essentially unaware and often uninterested in the true content of their food. The process to discover it is simply too complicated and even with that knowledge, many of our choices are already limited despite the variety we may see in the supermarket.

Chapter Three: The Meaning Of Food

"Just a Burger? Just a burger. Robin, it's so much more than "just a burger." I mean... that first bite-oh, what heaven that first bite is. The bun, like a sesame freckled breast of an angel, resting gently on the ketchup and mustard below, flavors mingling in a seductive pas de deux. And then... a pickle! The most playful little pickle! Then a slice of tomato, a leaf of lettuce and a... a patty of ground beef so exquisite, swirling in your mouth, breaking apart, and combining again in a fugue of sweets and savor so delightful. This is no mere sandwich of grilled meat and toasted bread, Robin. This is God, speaking to us in food."

(Marshall Eriksen - How I Met Your Mother (Fryman 2005))

3.1 The Loss of Traditional Food Culture

As the above quote shows, food is about much more than simply nutrition and sustenance. Across the world food has a deeper meaning that can be religious, symbolic or cultural. For Christians, bread and wine is not just an accompaniment to the evening meal but also represents the blood and body of Christ (Bynum 1997). For the Chinese to serve a fish whole is a sign of good luck (Fong 2000), while the pavlova has long been regarded by New Zealanders as an iconic example of their ingenuity, even if the Australians disagree (Johnston 2010). However, individual foods are not the only things that hold significance, we also find meaning and ritual in the way we grow, prepare and eat food, as well as in who performs these roles and when and where they occur (Beardsworth and Keil 1997). There is meaning; from the way we discuss food, to how we use it and everything else in between. As described in Chapter One, the rise of agriculture lead to a proliferation of art, technology and infrastructure, essentially creating the culture we now live in. However, food itself also has a culture. From the beginning, ritual and religion surrounded its production and consumption, communities grew up around food production centres and the harvest was an event in which all members could play a part (Beardsworth and Keil 1997). However, in the last century these practices have altered considerably and in multiple ways. Fast and convenience food has changed the way we prepare and consume meals. Globalisation, air travel and freezing technology have allowed the transport of exotic and previously rare foods. Industrial farming practices and capitalism has nullified the need for local community involvement (Weis 2007).

We no longer have to go without a type of food simply because it is rare or out of season. We can eat when and where we like and we do not have to participate in food production or even its preparation in order to do so. However, all this convenience has come with a cultural cost, a cost to our knowledge and community, to our family and to our health.

In this section I refer to culture in the general anthropological sense, not as a particular cultural practice specific to an individual group but rather as "the integrated pattern of human knowledge, belief, and behavior that depends upon the capacity for learning and transmitting knowledge to succeeding generations" (Inc. 2011). Food culture is hard to quantify, as we cannot determine it by yield or profit, yet despite this examples are not difficult to find. Unlike food control and food content, representation of food culture is clear in film and other popular fiction. In fact, food and meals often play a vital role in developing character, bringing out emotions or highlighting aspects of cultural, religious or philosophical significance (Bower 2004). In many cases, films present these examples as simply everyday aspects of the overall story. However, since the 1980s there has been an increase in the number of films in which food is a central character (Zimmerman 2009). These so called "food films" such as *Julie and Juliet* (2009), *Big Night* (1996), *My Fat Greek Wedding* (2002) and *Like Water for Chocolate* (1992) are generally about feasts, cooking and family. According to Zimmerman *The Godfather* (1972) is a perfect example. Here food scenes serve to emphasis the cultural elements of the Italian mafia family and tie together the disparate issues of tradition, loyalty, religion and murder (Zimmerman 2009). Many food films highlight community and togetherness, with most assuming and building on a cultural understanding of food. However, fewer demonstrate how the loss of such understanding affects our relationship with food and with each other.

By starting with the community as a whole, followed by an investigation of the family and finally the individual, this chapter will show how our modern food system has altered the very components that make up human culture; knowledge, belief and behaviour. Eroded traditional knowledge has disrupted communities, changes to the way we eat has transformed values and altered family dynamics. Meanwhile continued reliance on a single food, sugar clearly demonstrates how such changes effect the individual.

3:2 Our new food culture

3.2.1 A Grain of Knowledge

In the 2006 movie, *Idiocracy,* average American citizen Joe Bauers awakes 500 years in the future to a world in which the entire human population is so stupid that he is by far the most intelligent person on the planet (Judge 2006). Junk food is the only food available and an electrolyte rich drink called Brawndo has almost entirely replaced water, which is for toilet use only. Enlisted to solve the problems of the world, Bauers discovers that future humanity has lost the simple knowledge of farming and are irrigating their crops with Brawndo, causing them to fail. In his efforts to save the people of this future world, Bauers must re-educate them on the basics of agriculture, often coming into conflict with their firmly held, but inaccurate agricultural beliefs.

Knowledge is an important component of human culture and indeed food production but, much like our food supply, traditional agricultural knowledge is being replaced by industrialized farming practices (Balick 2007). Global forces such as the Green Revolution drastically affected traditional knowledge in much the same way that they affected biodiversity (Brodt 2001). Once farmers maintained a delicate relationship with the environment, using predators to control pests, animal waste for fertilizer and a number of farming practices such as crop rotation and fallowing to restore nutrients, however this is no longer the case (Blatt 2008). Among industrial farmers, modern systems that rely heavily on artificial inputs and a significant amount of fossil fuels have ultimately supplanted these practices. In the US the system has become so unsustainable that for every calorie of food produced, it takes more than a calorie of fossil fuels (Blatt 2008). Meanwhile local customary cultivation, based on hundreds of years of experience within a particular regional environment and an understanding of the local plants and animals, falls into disuse and eventually disappears. This loss of knowledge extends from cultivation to medicine, as products with a greater potential for profit replace many species once used widely.

Loss of knowledge affects more than just the individual; it affects the whole local district, breaking down neighbourly bonds and community cohesion. Traditionally all members of the rural community had a part to play in the production, harvest and processing of the produce, but with industrial farming and manufacturing this is no longer the case.

Knowledge, unlike biodiversity is not genetically inherited, for knowledge to survive it must be taught (Balick 2007). Traditionally, the younger generation acquired this agricultural wisdom from their elders, often through working on the farm that they would some day inherit. However, industrial practices and modernization have begun to threaten this chain of experience. Worldwide, the number of people involved in the practice of agriculture is decreasing while their average age is increasing. In Japan, the number of rice farmers has shrunk by half since 1990, and the majority of those that are left are aged 60 or over, with no younger ones taking their place (Fackler 2009). In 2002 the US Bureau of Labour Statistics calculated the average age of full time US farmers as 55 years, non-farm labour on the other hand had an average age of 40 years (Blatt 2008). Once these farmers would have passed their farm and their teachings on to their children, but many members of the younger generation no longer see farming, certainly small farming, as an economically viable option (Balick 2007). This position is understandable when we consider the degree to which the profession of farming has decreased in status and profitability over the last century. Farmers across the world are increasingly finding it harder and harder to stay afloat using modern agricultural methods, let alone traditional ones. In the United States 330 farm operators walk off their farms every week, often selling out to large corporations that run the farms through absentee owners, machines and a few specialised employees (Blatt 2008). Others, in despair, take measures that are more drastic. The suicide rate amongst British and Canadian farmers is double the rate of suicide in the general public (Miller 2008). While in India, rural communities have seen a rash of deaths due to the deliberate ingestion of farmyard chemicals (Shiva 2004).

These events have a significant impact on rural communities. In farming regions the world over, community cohesion is beginning to break down as farmers, once reliant on the support of their friends and neighbours for help with the harvest, use new technology and cheap migrant labour instead. A good example of this exists in the town of Bosa on the Italian island of Sardinia (Counihan 1997). At the beginning of last century the staple food and symbol of life in Sardinia was bread. Wheat was a major crop and while a single farmer generally ran the farm alone, sometimes with the help of a male relative, the harvest and processing was a job that involved the cooperation of many members of the Bosa community. The women in the family took the harvested wheat to the mill and once in the form of flour, they made it into a variety of breads, all with different significance. This too was a communal process, with many women congregating in another's home where they would exchange

gossip, recipes and skills. In this way, the women could gain a picture of the town's social environment while passing on their values, morals and knowledge to the next generation.

However, since 1960 the grain culture in Bosa and much of Sardinia has decreased significantly (Counihan 1997). This was partly due to political changes in Italy itself, but also had a great deal to do with agricultural modernisation. Tractors and machines took the place of people, while new bakeries opening in the town, relieved women of the time consuming process of bread making. With the decline of bread making came a decline in other home processing such as tomato preserves, salting olives and drying figs; all products now brought from the local supermarket which requires little social interaction. Many Bosaian people welcomed these developments, seeing it as a form of independence, in which they are no longer required to open their home to the prying eyes of their neighbours (Counihan 1997). And it is easy to see how a move away from such a time consuming and labour intensive lifestyle would be appreciated, however true independence may be a myth. It seems to me that in reality, the people of Bosa are, like the rest of us, more dependent than ever and this time on a worldwide market, that cares little for the needs of the individual or the small regional community.

Described by some as devolution, the loss of traditional knowledge is an increasing concern worldwide as it affects individual farmers and communities alike. In recent years, there have been efforts to protect such knowledge, but many people appear more concerned with the question of ownership and legal protection than with preservation. Farming is not the romantic rustic lifestyle often depicted in popular fiction, it is business, just as the products created are simply commodities. The rituals and customs that were once embedded in food and farming are quickly disappearing and so, unfortunately is our connection to them.

3.2.2 Value and the Family Meal.

The loss of traditional agricultural knowledge is not the only cultural change that the current food system and technology has brought upon us. Convenience and fast foods are also changing the way we prepare and eat our food, a change that has an impact on more than just the kitchen. The roles and meaning of food may vary according to the culture, age or gender of the individual, however, there are elements of food culture that we all share and one of the most recognisable is the family meal.

Soylent Green portrays this most recognisable act in food culture through a pitiful piece of black market meat and the meal that it becomes. When we first see the meat, it is being purchased from a seedy basement by the mistress of a wealthy Soylent Corporation executive, later, during his investigation of the executive's murder, Thorn (our hero) steals the meat and takes it home to his housemate and colleague Saul, who cooks it. As Saul and Thorn sit down to eat we see food tradition played out, Thorn sets the table while Saul serves the meal. They sit across from one another, saying nothing but communicating nonetheless. The scene highlights some of the everyday ritual aspects of food and in doing so renews our appreciation of them. Through the sharing of the meal, the two characters come together and this sharing is reflected three fold. Thorn provides the food, while Saul cooks it, but it is the common experience that is most important. The simple act of sitting down at a table together to eat is something that Sol remembers from a bygone era and he passes this custom on to the younger Thorn who is unfamiliar with the ritual. The two men savour every bite of the meal; even the single pathetic leaf of lettuce is a bounty from God. The appreciation we see in the faces of Thorn and Saul over such simple fare is something we rarely see in the developed world where such ritual is dwindling and food is taken for granted.

Despite our recognition of the home-cooked family meal depicted in many films and television shows, in reality home-cooked family meals are on the decrease. Fast food and ready-made meals have changed the way we eat. Previously, we may have sat down to a family meal in the home, however this is increasingly becoming a meal out or at least in front of the television (Beardsworth and Keil 1997). Estimates suggest that Australians eat up to a third of their meals outside of the home (Burns, Jackson et al. 2002). In addition, with the increase in convenience and fast foods, people can eat whenever and wherever they want. Some scholars have argued that this move from eating in the private home to eating in the public space has lead to a change in values, specifically through a loss of the traditional rituals associated with food and food sharing (Beardsworth and Keil 1997).

One study on the family meal defined it as a meal eaten together in the home with all the resident members of the household. The study investigated the importance of the family meal on children and pre-teens. It found that pre-teens who ate a family meal an average of 5 to 7 times a week, were two times more likely to be aware of clear family boundaries, positive adult role models and positive peer influence, than those that ate one or less family meals a week (Fulkerson, Story et al. 2006). Even after controlling for family support and connection,

the family boundaries and expectations remained significant among the group. It has been suggested that these sorts of results might show the impact of the family meal on psychosocial well-being of adolescents (Eisenberg, Olson et al. 2004). Of the participants, 26.8% reported eating an average of seven family meals per week compared to 33.1% who said they ate between two and zero family meals per week. The study also compared the average number of family meals with healthy behaviours, while controlling for family connectedness and socio-demographics, and found that the number of family meals inversely correlated with the level of substance abuse and illegal acts. In other words those teenagers who had regular family meals were less likely to engage in risky behaviour, than those who had two or fewer family meals a week.

Children are not the only ones that benefit from the family meal. Evidence suggests that the cook may also gain something from the food preparation. A study on mice published this year argues that the effort that goes into acquiring a meal may influence an eater's perception of its palatability (Johnson and Gallagher 2010). The mice were placed in cages with two levers that when pushed produced two different sources of food. For one of the levers, the researchers slowly increased the effort required to dispense the food, until the mice had to push the lever a total of 15 times before they gained the reward. What they found was that afterwards when mice were given free access to the two food types, they were significantly more likely to choose the one that had required the greater effort during the study. The study appeared to show that the degree of effort required in gaining food actually increased its palatability and may have even changed the "… representation of the food itself." (Johnson and Gallagher 2010) Researchers suggested that this might be an evolutionary response to food scarcity, when a higher degree of effort is required for successful foraging.

However, for most of us, foraging requires very little effort at all and without home cooking or baking neither does food preparation. So, does this mean that we find food less palatable? It is hard to say, but evidence does suggest that overeating in obese individuals may contribute to a reduction in neural response, meaning that if a person is already sated they may not experience the same enjoyment from continued eating as someone who is hungry (Stice, Yokum et al. 2010). Researchers have suggested that this lack of response may led to continued overeating as the eater does not gain the reward they expect. In other words,

the more we eat the less satisfaction we get and it could be argued, the less value we place in our food.

It is evident in the developed world how little value we place in food just by the very amount we waste. Estimates suggest that food wasted in the US and Europe could feed the world three times over (Humphries 2010). In the US, food wastage has increased by 50% since 1974 (Humphries 2010). In fact, this wastage and devaluation of food is so rife it has become a sport, the sport of competitive eating, in which competitors endeavour to outeat their rivals. The sport is so popular that it has a governing body, the International Federation of Competitive Eating (Blatt 2008). It holds over 80 eating competitions across the US every year, some of which screen on the popular sports channel ESPN (IFOCE 2010). The number one ranked eater is 25 year old, Joey Chestnut from San Jose. In 2007, he broke the hot dog eating world record by devouring 66 hot dogs and their buns in just 12 minutes (IFOCE 2010). With the number of people starving around the world, it is hard to justify such squandering. In fact, competitive eating seems like the ultimate disconnection from food.

The reality is that a meal like the one portrayed in *Soylent Green* is not a cause for celebration in the current day. Food so surrounds us that we do not see its value as a source of nutrition or as a vital part of our culture. Rather than savouring the experience of a meal, we are increasingly distracted by other things or gulping down a bite with little regard for its significance. In fact, our relationship with food has become so warped, that the IFCE's description of Joey Chestnut as "… truly an American hero and a national treasure" (IFOCE 2010) really says it all, making us wonder what Thorn and Saul would think about our culture.

3.2.3 Sickly Sweet – A Sugar coated world

In the 1999 movie *The Matrix*, computer programmer Neo discovers that the world in which he lives is simply a virtual reality projected onto all human minds by artificially intelligent machines (Wachowski and Wachowski 1999). In this way, the machines exert control over the human population and in the process convert the energy from their inert bodies to power themselves. Once rescued from the chamber in which his body has been enclosed, Neo enters a real world that is lacking most of the luxuries and comforts he has come to expect, even the food is runny, colourless and bland. This is not a movie about food, but contains a number of scenes that demonstrate just how important food is to us, as something more than just a necessity. For one character, the taste of a virtual steak is enough

for him to give up his freedom and return to the virtual reality, despite his knowledge of it. This shows that the taste of food is maybe as, if not more, important in the human minds than nutrition.

If any single food can be compared to the insidious nature of the Matrix, it is sugar. Much like the character in the film, globally we continue to eat large quantities regardless of the health, economic and historic knowledge we have about it. In fact, sugar has had an impact on human culture for centuries, an impact that is only getting greater.

The majority of sugar comes from the widely cultivated plants, sugar cane and sugar beet (FAOSTAT 2010). As an additive it acts in much the same way as any added flavour, it makes the product taste more appealing. However, few food additives can claim to have the global impact that sugar does. From the communities who grow it, to the people who eat it, sugar has an effect that is historic, destructive and insidious. Like the virtual reality world in *The Matrix*, sugar has become so much a part of our food that often we do not even notice it. Even those who try to avoid sugar, still regularly reach for the sweetener.

Sugar has a dark history. From early in its production it was a hub for slavery. The Arabs, who in the 12th century first cultivated it on a large scale, did so using East African slaves (Fraser and Rimas 2010). However, the Atlantic slave trade sustained sugar production throughout the 17th century and ultimately turned it into one of the first global food commodities. Initially the use of sugar was as a spice or like a medicine, while products such as honey and fruit satisfied the role of sweetness (Mintz 1997). However, in the 1600s this began to change and throughout that century sugar consumption increased to a level that allowed even the general population access to it (Mintz 1997). By the end of the 18th century, Europeans were eating an average of 13 pounds of sugar per capita annually. As Britain struggled to support its growing population with local food production, sugar provided the answer, contributing a considerable amount of calories to the average diet (Standage 2009). In the 19th century, calorie intake from sugar rose from 4% of total calories to 22% (Standage 2009). Often used to sweeten tea, it gave industrial factory workers the energy they needed to get through a long shift, while the tea itself kept them alert. Meanwhile as Britain consumed, plantation owners got rich on the profits; the era of capitalism and globalisation had begun.

While the impact of sugar on Europe was significant, both economically and socially, it was nothing compared to the impact of the slave trade. In the 400 years that the slave trade was active, slave merchants shipped about 11 million Africans to the New World (Standage 2009). If they survived the voyage, the slaves became workers in the sugar plantations. The work was arduous and often dangerous and many died. However, situated as the plantations were, miles from the centre of consumption, Europeans were for the most part unaware of these brutalities, until, in 1791 Europeans began to express their opposition to the slave trade through a sugar boycott (Standage 2009). Public demonstrations followed and soon the subject of slavery had become a major social issue, one which people were willing to fight for, using their only means of influence, buying power. Some estimates suggest that at its peak, three thousand people had stopped using sugar (Standage 2009). It may not sound like many but, if nothing else, the sugar boycott drew attention to the problem. Unfortunately, by the time the slave trade ended, the damage was done, and as a consequence the people of the New World still feel the effects of Europe's initial sweet tooth today, along with their freedom, the African slaves lost their homes, families and culture, losses which continue to influence race relations and policy in the Americas today.

However, despite the abolishment of slavery, sugar production continues to affect the lives of its producers, particularly in developing world. The worldwide price of sugar is volatile and many smaller plantations struggle to compete globally with larger enterprises who often find protection in government subsidies and tariffs (Fairtrade 2010). Unfortunately, boycotting unfair sugar trade in the modern day is not so easy. While globally we may produce a huge amount of sugar, about 1,682,000,000 tons just of sugarcane last year (FAOSTAT 2010), we buy relatively little of it as individual product. For example, it is estimated that the French consumer eats an average of 27 kilograms of sugar each year, but only 20% of that is consumed through direct use, the rest comes from the huge number of processed and convenience foods available (Drouard 2009). This means that consumers have little ability to influence the sugar market through ethical purchasing.

On the other hand, fair trade for sugar producers is far from the only problem associated with the global sugar trade. Our increased consumption of sugar over the past century or so has lead to a series of chronic health problems, which we have yet to come to terms with. Sugar and artificial sweeteners have been connected to diseases such as dental decay, obesity, diabetes, food addiction, and attention deficit disorder (Avena, Rada et al.

2008; Ifland, Preuss et al. 2009). Yet, despite this we continue to consume sugar at an alarming rate. In Mexico, excessive sugar consumption due to a prevalence of processed food has been linked to the rising rate of diabetes, now Mexico's fourth leading cause of death (Pilcher 2002). Between 1970 and 2000 consumption of sugar and its imitations increased by more than a third in the US, a factor which some consider a leading contributor in the obesity epidemic currently afflicting the country (Roberts 2008).

However, what is even more incredible is the part that sugar actually contributes to our nutrition. As a food item, refined sugar consists of 99.9% sucrose and almost no other nutritional value, it has been referred to by some physicians as "empty calories" (Mintz 1997). In other words, except as a source of easily absorbed energy sugar gives us almost nothing else. Ingestion of such high energy foods creates a short lived rise in blood sugar, giving a quick burst of energy that soon passes leaving the individual hungry and dissatisfied (Blatt 2008). Substitutes for sugar work slightly differently, but many researchers still consider them to have a negative impact on health. High fructose corn syrup (HFCS) for example, a very common sugar substitute in the US, is believed to completely bypass the feedback loop that tells the body it is full (Roberts 2008). Many argue that this leads to overeating, which when combined with high fat content is a major contributor to the obesity epidemic worldwide.

The question then arises, if sugars are so damaging to our health why do we continue to eat them in such large quantities? Unfortunately, the answer is not obvious. Taste is clearly a contributing factor but it may go deeper than that. A passion for sweetness may be an evolutionarily developed response for recognising high energy content in plants or may have evolved as an indication of ripeness in fruit (Mintz 1997). We are not the only creatures that seek out sweet-tasting food, most animals have a love of sugars (Breslin and Spector 2008). Indeed, natural sweeteners are important, particularly as metabolic fuel for the brain, however, it seems unlikely that we would have eaten them naturally to the degree we currently guzzle them, and those that we did consume would have been seasonal and unrefined.

The effects of sugar are significant. As one of the first global food commodities, sugar has had hundreds of years to become entrenched in our food system. In fact, it has had such an effect on our tastes and culture that, as a population many now seem unwilling or simply unable to give it up, regardless of what it is doing to their health. The craving for

sweetness has led to other artificial alternatives, but these too appear to be doing damage (Yang 2010). Some studies have shown that unlike natural sweeteners, artificial sweeteners such as saccharin, do not fully activate the reward pathway, a reduction in this reward response may contribute to obesity by encouraging the eater to continue eating after they are sated (Yang 2010). Many of us have become like the character in *The Matrix,* instead of choosing freedom settles for a life of slavery to the machines all for the price of a virtual steak.

3:3 Time for a Revolution

The news is not all bad. A growing section of the community realise that the modern food system is flawed, and are choosing to make changes to the way they live. They do this in a huge variety of ways, by taking back control, making ethical or healthy purchasing choices and generally becoming aware of both the process and the effort required to make the food they eat.

Interestingly the recession has helped the cause. Over the past two to three years, garden centres in New Zealand have reported increases in the sales of vegetable seedlings and fruit trees (Press 2007). In the Waikato alone, there has been a 22% increase in the number of home vegetable gardens (PureNZ 1999-2010). In 2002, the Housing New Zealand Garden Awards judges saw a significant rise in the number of food-related entrants. The vegetable category increased from 17.5% of total entrants in 2004 to 26% in 2009, with the biggest boost coming from urban areas (HNZ 2009).

However, growing vegetables at home is not always possible, especially as apartment and city dwellers increase. Fortunately there are alternatives, community gardens in particular are gaining popularity in many cities, the implementation of which are beneficial to more than just the food supply (Voicu and Been 2008). Studies on community gardens in California have shown that they can improve the health, knowledge and physical activity of the local inhabitants (Twiss, Dickinson et al. 2003). While another study, based in New York, identified the positive effects that the gardens have on community cohesion, particularly among immigrant groups (Saldivar-Tanaka and Krasny 2004). In addition, some researchers found that community gardens in schools facilitated the development of gardening at home, with a 20% increase in home gardens among students who had participated in a gardening programme in the city of San Bernardino (Twiss, Dickinson et al. 2003).

Another option is Guerrilla gardening, a generally illegal movement, where people identify unused or uncared for spots of ground, on traffic islands, under train bridges or in vacant lots, and transform them into gardens (Reynolds 2004). The movement has been growing in popularity since 1996 when 500 activists carried out an illegal planting near the Thames in South London (Buhr 2010). It has since spread to cities all over the world from Canada and the USA to South Africa and Australia (Galvin 2008; Buhr 2010). While Guerrilla Gardening refers to any kind of illicit planting, not just food crops, many activists still choose to plant fruit trees and vegetables. There are websites devoted to the practice and in London, Richard Reynolds, an active proponent of the gardens, sometimes conducts a 90 minute tour of London plots, showing off an array of different produce (Buhr 2010).

On the other hand, for those people that do not have the time or ability to do their own planting, there are farmers' markets. Farmers' markets are on the rise; last year 10 new markets opened in New Zealand, taking the total number of farmers' markets in New Zealand up to 50 (PureNZ 1999-2010). The number seems small but it represents an increase of 25% in a single year. In the United States there are currently more than 5,000 operating markets and increase of 84% in the last decade (Holben 2010), while in Britain the number has risen from zero in 1997 to 500 farmers markets today (Spiller 2007). Because the sellers must also be the producers or manufacturers, farmers markets connect the consumer directly with the farmer, thereby cutting out the middleman, decreasing travelling distances and maintaining freshness (Spiller 2007). It also allows consumers to ask questions regarding production methods or food origin (Spiller 2007).

Moreover, changes are not simply limited to *how* people acquire food; many people are considering *what* they buy too. Health concerns about sugar, salt, fat and additives are just the beginning. There is also an increasing awareness of how food is grown and what kind of impact this growth has on the environment, community or individual. Such concerns have encouraged people to demand more information about their food in order to make a more informed choice. Increased access to information and product labelling has shown in a change in buying practices. In New Zealand organic sales have increased from $140 million in 2005 to more than $485 million (Willer 2010). Consumers globally are also becoming aware of the impact that their coffee, tea and chocolate consumption is having on growers and despite the extra expense, an increasing number of people are choosing to buy Fair Trade. However, the Fair Trade label covers many more products than just coffee, tea and chocolate.

As an organisation, Fair Trade ensures producers receive a fair price for their product (Fairtrade 2010). In 2007, Fair Trade sales increased by 47% worldwide (Pérez 2008). The biggest increase was in Sweden where sales went from 16 million Euro in 2006 to 47.5 million in 2007, a 166% increase (Pérez 2008).

Finally, there are groups like the slow food and local food movement both of which seek to make changes to the entire culture of eating. The Slow Food movement, started by Carlo Petrini in 1986, set out to preserve traditional and local food practices and cuisines (SFI 2010). Currently it has over 100,000 members in 150 countries worldwide. It is an organisation devoted to reconnecting people to their food and promotes itself as an alternative to fast food culture through three main principles, "good, clean and fair". Their website defines these principles in the following way:

" GOOD a fresh and flavorsome seasonal diet that satisfies the senses and is part of our local culture; CLEAN food production and consumption that does not harm the environment, animal welfare or our health; FAIR accessible prices for consumers and fair conditions and pay for small-scale producers." (SFI 2010).

The local food movement on the other hand, is less an organisation and more a way of life. "Locavores," as the activists call themselves, are individuals who choose to eat a diet comprised completely (or almost completely) of local food (Time.com 2006). Originally known as the "100-mile diet" the local food movement began in 2005 when a group of San Francisco locals challenged others living in the area to spend one month eating food that came exclusively from a 100 mile radius around their home. Many of these people have since taken up the practice year round, citing both taste and the environment as a reason to switch.

Unfortunately, to effectively follow either the slow food or local food movement it is necessary to know where your food comes from. In New Zealand, this is difficult as country of origin labeling is limited and not mandatory. Despite calls from the public, the New Zealand government refuses to include country of origin labeling on all products. They claim that to include such a label will be complicated and costly, costs that will ultimately be passed on to the consumer. However, according to the New Zealand Green party there is another reason. If New Zealand insists on putting country of origin labels on import, they cannot argue when other countries want to place country of origin labels on our exports, specifically dairy, beef, and lamb.

In addition, while these are movements are all positive steps, many initiatives are still restricted to a small section of the community and are limited by external factors. Take the example of free-range eggs. In the UK 42% of eggs are free range, but what does free range actually mean? In the US the Department of Agriculture, requires that for free range eggs chickens must be allowed access to the outside, but makes no mention of how long a period that access must be (USDA 2010). Therefore, while consumers may see the free-range label on the supermarket shelf, there is no guarantee that it actually indicates what they think it does and many people are not aware of the differences.

There are also concerns raised by some that a complete reliance on alternative food methods will reduce production, increase prices and ultimately lead to more people going hungry (Pollan 2010). Still others argue that by banding together as a community many of these problems can be overcome. However, regardless of the disagreements the fact is that our current food system is unsustainable and unsatisfactory to many consumers around the world.

Chapter Four: Fiction and Reality

"Individual science fiction stories may seem as trivial as ever to the blinded critics and philosophers of today, but the core of science fiction, its essence, has become crucial to our salvation, if we are to be saved at all."

Isaac Asimov

4.1 *Avatar* and a Case of Nostalgia

The setting for the James Cameron-directed blockbuster *Avatar* (2009) is off world. The location is the colony of a moon, Pandora. Here humans have come to mine the ridiculously named mineral *Unobtainium*, which they hope to transport back to earth for a profit. With the discovery of a large source of the valuable mineral beneath a village of the *Na'vi* (Pandora's indigenous people), a conflict arises between the miners and the inhabitants.

The contrast between the humans and the *Na'vi* is stark; while the humans are greedy, ruthless and content to rape the earth for everything it has, the *Na'vi* endeavour to live in harmony with their surroundings. The indigenous ethos is to make as little impact as possible and to respect every living thing. The *Na'vi* are so aware of their surroundings that they seem to feel physical pain on slaughtering a hunted animal. Therefore, to minimize the harmful effects of their activities they pray and express thanks to each creature killed for food. The *Na'vi,* unlike their human counterparts, are a people with a strong connection and understanding of their food.

The basic story of *Avatar* is not new and like many films that have come before, most notably *Dances with Wolves* (1990), it highlights the conflicts that occur between two groups with opposing cultures. However, it also displays nostalgia for a bygone way of life, one that many urbanites may think is still out there (experienced by others) but in actuality is disappearing everywhere.

The image of the farmyard used on packaging and in brochures to sell products or as portrayed in movies like *Babe* (1995) and *Charlotte's Web* (2006), is no longer the place from

which our food comes and probably never was. In order to re-establish our connection to food, we must be able to separate the myth from the reality. However, this is easier said than done. Perceived dangers of disease and contaminants prevent the public from visiting a large number of farms, particularly those that carry livestock. In addition, the food system is so complex that it is difficult to discern what you are eating or where it comes from. The question is, how do we ensure this understanding and maintain connection among the wider public, without endangering farms, damaging local and national economies or confusing consumers? The answer is education and this is where science communication comes in.

4.2 Science Communication in Documentary

The application for science communication is broad, from museum exhibits to podcasts and everything in between. However, for the sake of space and consistency I am going to limit my discussion to film, both fiction and nonfiction.

While the past has seen the production of a few non-fiction food films, in recent years there has been an increase in the number and profile of these films. A look at the academy award nominations for best documentary show that four films featuring food have been nominated in the last ten years, compared to three in all the years previous (Academy 2010). Films such as *Food Inc* (2009), *King Corn* (2007) and *Super Size Me* (2004) have all gone a long way to highlighting problems with the food system particularly in the USA. *Super Size Me*'s story of a man (Morgan Spurlock) who spends a month eating only McDonalds is shocking and illuminating but, more than that, it endeavours to communicate the science behind the diet (Spurlock 2004). Spurlock's regular visits to his three doctors along with his self-imposed "rules" take the form of a science experiment and the results are significant. *Super Size Me* is not without its critics, one of which not surprisingly is McDonald's themselves, however regardless of this the film has made an impact (Veltman 2004). A study conducted in 2007 looked at how *Super Size Me* had influenced young adult's understanding of diet and nutrition (Cottone and Byrd-Bredbenner 2007). It found that the participants who watched the film had significantly increased short-term knowledge regarding fast food and dietary health in general, potentially leading to a change in behaviour.

Arguably, one of the most popular and economically successful documentaries of all time is Al Gore's *An Inconvenient Truth* (Guggenheim 2006). This film much like *Super Size*

Me, was found to increase knowledge and understanding of the subject matter, this time about climate change (Nolan 2010). An increase in climate change knowledge was observed in the month following the viewing of Al Gore's film, suggesting that with a greater understanding of the basics the participant was more attuned to subsequent information about climate change gained through other news and media sources (Nolan 2010).

Unfortunately, while these films effectively communicate the issues, their audiences are relatively limited because they arguably tend to appeal primarily to those who are already converts to the cause. Without the budget or the engaging storylines of a fictional film, non-fiction films often fail to gain the attention of those unfamiliar with the subject matter. For example, *An Inconvenient Truth* made almost $50 million worldwide at the box office, with a US domestic release into 587 theatres, not to mention the two academy awards it won (Gray 2010). On the other hand, this does not even come close to the more than $540 million that *The Day After Tomorrow* (2004*)* made worldwide (Gray 2010). It too was about climate change, released two years earlier, it was not even a contender for the academy awards and yet it screened in almost three thousand more cinemas in the US than *An Inconvenient Truth* (Gray 2010). In light of these figures, we cannot ignore the potential influence of fictional movies; for while non-fiction films are invaluable for portraying science, fiction makes the most impact.

4.3 Science Fiction as Science Communication

In the past, film critics have considered science fiction as nothing more than an alternative form of fantasy, this is clear with a browse through the average bookseller or DVD rental store, where science fiction is inevitably lumped in with the dragons, elves and wizards of the fantasy genre. A view that is not entirely uncalled for; it is true that science fiction can often contain fantastical elements, but it also has the potential to be something much more.

Scientists, unlike critics, see science fiction as more than just fantasy, many believe that rather than helping the cause of science, it has in fact been detrimental to scientific education (Kirby 2003b). The power of popular culture is such that it can dramatically affect real-world beliefs regardless of accuracy, as one scholar Kevin Padin commented

"… A picture is not only worth a thousand words; however inaccurate, it may be worth a

wealth of documented evidence to the contrary". (Cited in (Kirby 2003a)).

However, science fiction has the potential to make a considerable contribution to science communication in a number of ways. Firstly, unlike fantasy, science fiction has the ability to predict, arguably a very scientific pursuit. In fact, every night on the television we get the benefit of a scientist's prediction in the form of the weather forecast. Predictions, like fiction are not reality, but we use them all the time to make decisions about the future, from cancelling a picnic on account of forecasted rain to developing policy due to predictions of climate change.

Such predictions in fiction may be useful for highlighting risk and initiating discussion about the future. This effect is seen clearly with *The Day After Tomorrow* which not only stimulated a huge amount of discussion surrounding climate change before and after its release, it also appears to have had an impact on risk perceptions (Lowe, Brown et al. 2006). While the film did not have the level of detail and scientific information of that expressed in *An Inconvenient Truth*, a study conducted in the UK suggests that the film not only changed attitudes and raised concern about climate change, it also made audiences more conscious of other environmental risks (Lowe, Brown et al. 2006).

This idea of the predictive fiction film is highly relevant with regard to our food system. The overwhelming majority of fictional films that discuss food concerns are predictions of the future. In fact, I am aware of just a single fiction film set in the present day that considers our relationship to food and that is *Fast Food Nation* (2006). This is not surprising, as I have highlighted throughout this thesis that food concerns in the modern world are not immediately apparent to the uninitiated consumer. This also explains why the majority of films regarding the future of our food supply were produced in the 1970s, at a time when rising oil prices, population and a spate of bad weather had led to a food crisis (WFC 1974). One could claim that time has shown such predications to be false by the very fact that we in the developed world are still relatively well fed. However, it is also possible that fears of such an event have compelled us to work against it and that without doomsday predictions we would be in a much worse state than we are now (Kirby 2003a). Regardless of the truth, prediction is still a valuable tool in future planning and as one scholar put it "the business of science fiction is not to visualize *the* future but visualize *a* future one of many possible paths" (Parker 2007).

However, science fiction is not just about prediction, it can also be used to educate in other ways. The problem is distinguishing fiction from reality. Studies on the effectiveness of science fiction as an educational tool show that many students and the public in general often have difficulty in identifying which elements of the film are scientifically accurate and which are simply fictional ingredients included to enhance the story (Barnett 2006). What makes this even more problematic is the increasing degree to which movies transport audiences into the fictional world.

This could be solved by scientists taking an active role in the filmmaking process, something that appears to be already happening (Kirby 2003b). Over the last few decades, scientists and filmmakers have both discovered the power of including real science in fictional films. For filmmakers, accurate science adds an element of realism to the story, helping to further transport the audience, while accurately portraying the natural world (Kirby 2003b). Scientists on the other hand have begun to recognise the role that the movies can play in promoting science and scientific theories. This has led to the beginnings of collaboration between the two groups. A study investigating the use of science consultants in film, identified 101 different films that had employed a scientist from 1914 through to 2001 (Kirby 2003a). The researchers found that the number of science consultants employed on films jumped dramatically in the 1990s, with scientists becoming involved in 35% of films produced between 1990 and 2001, compared to just 10.9% between 1980 and 1989 (Kirby 2003a). In fact, the practice has become so valuable that a group called the Science and Education Exchange, run by the United States Academy of Sciences, now matches members of the entertainment industry with relevant scientists to further enhance the accuracy of science in fiction (Perreault 2009).

While this would seem to indicate an increase in the amount of "real science" in science fiction, as opposed to "movie science", it does not tell us whether viewers can recognise the difference. A study by Barriga et al, tested this very issue by examining three factors: how participants perceived science information and its relationship to the plot, the degree to which the participant was transported into the story and individual differences including prior knowledge and gender (Barriga 2010). They found that when science was present as peripheral to the story, male viewers were less likely to identify scientific inaccuracies, whereas females were more likely to, the opposite was true when science was presented as central to the plot (Barriga 2010). These results indicate that a viewer's

understanding and belief in movie science is largely determined by how they perceived its role in the plot, along with the viewer's gender. The researchers suggest that this may have something to do with the viewer's anticipated degree of interest in the story. Women tend to be less interested in action adventure than men, and would therefore be inclined to concentrate more on stories where interpersonal relationships are perceived central as opposed to those presented as science or action (Barriga 2010). If this is the case then science has a part to play in all genres of film, not just science fiction.

This is good news for the food problem, because food is not restricted to science fiction either. Indeed, while food is very rarely central to the plot, it usually plays a part, in most genres from romance to horror. Where futuristic films can be effective tools for discussing the potential outcomes of a situation, by utilising other film genres we maybe able to offer solutions on how to avoid reaching the predicted point in the first place.

When the University of Colorado's Joshua Cowell was asked why he wanted to be a comet advisor on the film *Deep Impact* (1998) he replied, "Many people's ideas about what is and what is not realistic or possible are formed almost exclusively by popular culture" (Kirby 2003a). This statement highlights the power of using popular culture as a tool for science communication. However, it is not the predictions, the accuracy of scientific facts or the presence of science advisors that make fiction so effective, it is the narrative.

Stories have been around much longer than the written word and, as such, they influence our lives in a multitude of ways, from everyday gossip to our own ethical and moral code. Stories tell us how the world works and they link us to others through empathy and experience (Dautenhahn 2003). The reality is that what we learn about the real world is not limited to the material we are exposed to in the classroom (Barriga 2010). Therefore, to effectively re-establish a connection with our food supply we must be willing to reach beyond traditional boundaries and include fictional entertainment of all types in the processes of science communication.

4:4 Narrative and Science Communication in *Three Little Pigs: A Curly Tale*

In May 2009, a segment about factory farming of pigs appeared on Television New Zealand's Sunday program. Featuring the well known comedian and ex-pork promoter Mike King, the show set out to highlight the appalling conditions in which pigs lived on these farms, particularly with the use of sow crates. The reaction was dramatic. Consumers across New Zealand were horrified and outraged. Pork sales plummeted as the industry struggled to justify their farming methods. Politicians and activists alike vowed to put all their efforts into outlawing the cruel practices. After a government initiated enquiry into the pork industry, a new code of practice was effected in December 2010, legislating the phasing out of sow crates, with a total ban in place by 2015 (NAWAC 2010). The issue with regard to sow crates seems to have been well wrapped up, but a larger question remains, how did it get to the point where people no longer knew how their food was produced? For years, consumers brought pork products unquestioningly, oblivious to the production method, which - as it turns out - they were morally against.

As a stark example of our continuing disconnect from food, Sam McIvor CEO of NZ Pork himself admitted in a report published the month after the Sunday program aired, that:

> " … Many consumers no longer have a strong connection to farming and knowledge of food production. With pork production this is understandable, we have around 230 commercial producers and 1.4 million households in New Zealand – in rough terms a pig farm for every 6100 households, the chances are most people will have no understanding of commercial pork production." (NZPork 2009)

When setting out to make our film *Three Little Pigs: A Curly Tale* (2010), this disconnection from food was the problem we most wanted to highlight. The question was how to best communicate both the issues and the realities, two elements that are not necessarily congruent. The general public and animal activists saw the issue as a question of animal welfare, whereas the Pork Board and a number of industrial pig farmers saw it as a lack of understanding on the part of the consumer. We wanted to investigate both sets of issues and produce a film that demonstrates the responsibilities of all involved.

The film aims to highlight the problems and processes within the pig farming industry in New Zealand through a combination of traditional current affairs methods and a semi-

fictional narrative based on the well-known tale of the Three Little Pigs. By semi-fictional I do not mean to imply that the farm stories are made up, but simply that the pigs Frank and Sol as individuals do not exist, they are simply examples of any pig found on a free range or industrial farm in New Zealand. While we realised that the facts and figures were vital elements of the debate, we also recognized that it is not statistics that connect people to their food, it is stories. It was for this reason that we decided to frame the farming information within the context of a fairytale.

By interspersing the lighter fairytale elements within the denser material of the ongoing debate, we were able to able to give the audience breathing space to process what had been said while still introducing new information. The stories of the three pigs allow an explanation of the science in pig farming filtered through the character's lives, thereby giving both an empathetic and informative overview of each pig farming process.

In addition, through both the fairytale narrative combined with the personal story of a 10-year old boy's relationship with his pig Chubby, the audience is able to connect on a more personal level with the three pigs, in a way that would not be possible through farmer interviews alone. This was further emphasized with the use of names, which allowed viewers to identify the pigs as personalities. Without implementing a narrative and naming the pigs, the story would have been more a story about the farmers and less about our connection to the pigs that would one day become our food. To truly bring about change in our food system, knowledge of agriculture, processing and diet must become imbedded in popular culture and for this storytelling and fiction is essential.

Conclusion

The modern food system is highly complex and as such, it is impossible to cover the complete scope of it here. However, it is clear that food connects us all, from the people who grow it, process it and sell it, to the people who eat it. Unfortunately, as our society becomes more complex and the global population increases, the processes that ultimately sustain us are becoming evermore distant. This disconnect is affecting the health of our entire society from our individual wellbeing to the health of our families and communities.

I have argued that three essential elements have lead to this disconnection. The first is the issue of food control. Because we no longer produce any of our own food, we are becoming increasingly dependent on an ever-shrinking number of corporations. Due to their incredible market power many of these corporations have the ability to dictate what we eat and how it is grown and as many New Zealanders discovered during the pig farming expose, this is not always to our liking. Nevertheless, as the control moves out of our hands, our ability to change it declines.

The second element is the issue of food content. The inclusion of artificial additives and the decrease in the number of crops give us a false impression of the number of foods available. By limiting the variety of our diet in such a way, we may be limiting our future options, not just in the number of product types we can consume, but also in our ability to grow them. The production of artificial foods especially those that require expensive equipment and specialist knowledge, is not a process that is open to everyone and it would be dangerous to rely too heavily on it as a means of sustenance.

Finally, the third element is food culture. As I discussed in Chapter Three, food has many different meanings to different people, but as we become increasingly disconnected from our food we are all losing the knowledge and respect we once had for it. We can see this loss of respect reflected in our lack of farming knowledge, the declining value placed on food and finally in our disregard for own health. The example of the New Zealand pork industry highlights this. In fact, the New Zealand public are as much to blame for the pig farming conditions as the industry itself; their continual consumer pressure on price, along

with a complete disinterest in how their pork is grown have both contributed to current situation.

While there is a move among some groups to counter the effects of the current food system, re-establishing a connection with food is going to require much more than this. We need to reincorporate the value of food and food production back into popular culture, a process that may well be achieved most effectively though the use of fiction, storytelling and science communication.

Bibliography

Academy. (2010). "Research and Preservation." Retrieved December 18, 2010, from http://www.oscars.org/research-preservation/index.html.

Allan, S. (2002). Media, risk and science. Buckingham, England, Open University Press.

Atwood, M. (2004). Oryx and crake. Port Moody, Canada, Anchor Publishing.

Avena, N. M., P. Rada, et al. (2008). "Evidence for sugar addiction: Behavioral and neurochemical effects of intermittent, excessive sugar intake." Neuroscience & Biobehavioral Reviews 32(1): 20-39.

Bailey, R. (2000). Earth day, then and now. Reason.com. N. Gillespie. Los Angeles, CA, Reason Magazine. May: 1-5.

Balick, M. J. (2007). Traditional knowledge: Lessons from the past, lessons for the future. Biodiversity & the law: intellectual property, biotechnology and traditional knowledge. C. R. McManis. London, Earthscan/James and James (Science Publishers) Ltd: 297.

Balme, I. (2010). Fonterra's approach tardy on dairy-farm pollution. NZ Herald. Auckland APN Holdings NZ Limited.

Barnes, E. (2007). Diseases and human evolution. Albuquerque, University of New Mexico Press.

Barnett, M. W., Heather; Gatling, Anne; Anderson, Janice; Houle, Meredith; Kafka, Alan (2006). "The impact of science fiction film on student understanding of science." Journal of Science Education & Technology 15(2): 179-191.

Barriga, C. A. S., Michael A.; Fernandez, Marissa L. (2010). "Science information in fictional movies: effects of context and gender." Science Communication 32(1): 3-24.

Bascand, G. (2010). Hot off the press: agricultural production statistics 2009. S. N. Zealand. Wellington, Statistic New Zealand, New Zealand Government: 1-17.

BBC (2004). Morrisons seals Safeway takeover. Business News. Bristol, British Broadcasting Corporation.

BBC (2008). Scientists unveil 'supercarrot'. BBC News Online. Bristol, British Broadcasting Corporation.

Beardsworth, A. and T. Keil (1997). Sociology on the menu: An invitation to the study of food and society. London, Routledge.

Belasco, W. J. (2006). Meals to come: a history of the future of food. Berkeley, University of California Press.

Berger, M. (2010). "GE Salmon an ambiguous milestone for aquaculture." Retrieved December 18, 2010, from http://ipsnews.net/news.asp?idnews=53037.

Blatt, H. (2008). America's food: what you don't know about what you eat. Cambridge, MA, Massachusetts Institute of Technology Press.

Bower, A. (2004). Watching food: the production of food, film and values. Reel food: essays on food and film. A. L. Bower. New York, Routledge/Taylor and Francis Group: 1-16.

Breslin, P. A. S. and A. C. Spector (2008). "Mammalian taste perception." Current Biology 18(4): 148.

Brodt, S. B. (2001). "A systems perspective on the conservation and erosion of indigenous agricultural knowledge in Central India." Human Ecology 29(1): 99-120.

Buhr, A. (2010). Seeds of rebellion. Times Live. Johannesburg, Avusa.

Burns, C., M. Jackson, et al. (2002). "Foods prepared outside the home: association with selected nutrients and body mass index in adult Australians." Public Health Nutrition 5(03): 441-448.

Bynum, C. W. (1997). Fast, Feast, and Flesh: the religious significance of food to medieval women. Food and culture: a reader. C. Counihan and P. V. Eskerik. New York, Routledge: 138-158.
Cameron, J. (2009). Avatar. USA, Twentieth Century Fox Film Corporation: 162mins.
Chandler, S. and J. M. Dunwell (2008). "Gene flow, risk assessment and the environmental release of transgenic plants." Critical Reviews in Plant Sciences 27(1): 25-49.
Chug, K. (2006). Fonterra seeks to dump for 22 years. Dominion Post. Wellington, Fairfax Media.
CIA. (2010). "The World FactBook." Retrieved 18 December 2010, 2010, from https://www.cia.gov/library/publications/the-world-factbook/geos/xx.html
https://www.cia.gov/library/publications/the-world-factbook/rankorder/2002rank.html.
Cohen, S. and G. Morgan (2008). "Monsanto Technology LLC v. Cargill: a matter of construction." Nature Biotechnology 26(3): 289-291.
Colla, E. and M. Dupuis (2002). "Research and managerial issues on global retail competition: Carrefour/Wal-Mart." International Journal of Retail & Distribution Management 30(2): 103-111.
Cottone, E. and C. Byrd-Bredbenner (2007). "Knowledge and psychosocial effects of the film *Super Size Me* on young adults." Journal of the American Dietetic Association 107(7): 1197-1203.
Counihan, C. (1997). Bread as world: food habits and social relations in modernizing Sardinia. Food and culture: a reader. C. Counihan and P. V. Esterik. New York, Routledge: 283-295.
CSPI. (2009). "Chemical cuisine: Learn about food additives." Retrieved 18 December 2010, from http://www.cspinet.org/reports/chemcuisine.htm.
Dana, L. P. and J. Schoeman (2010). "An entrepreneurial innovation: mega cooperatives." Asia Pacific Journal of Innovation and Entrepreneurship 4(1): 67-87.
Dautenhahn, K. (2003). Stories of lemurs and robots: The origin of story-telling. Narrative intelligence. M. Mateas and P. Sengers. Amsterdam, John Benjamins Publishing Company. 46.
Davis, D. R., M. D. Epp, et al. (2004). "Changes in USDA food composition data for 43 garden crops, 1950 to 1999." Journal of the American College of Nutrition 23(6): 669-682.
Deb, D. (2009). Valuing folk crop varieties for agroecology and food security. Fundamentals in Food and Agriculture. Ithaca, NY, Bioscience Resource Project.
Diamond, J. (1997). Guns, germs and steel: the fates of human societies. New York, W. W. Norton and Company Inc.
Drouard, A. (2009). Sugar production and consumption in France in the Twentieth Century. The Rise of obesity in Europe. D. J. Oddly, P. J. Atkins and V. Amilien. Surrey, England, Ashgate Publishing Ltd.
Edwards, L. (2009). Pork meat grown in the laboratory. PhysOrg.com, PhysOrg.com.
Eisenberg, M. E., R. E. Olson, et al. (2004). "Correlations between family meals and psychosocial well-being among adolescents." Archives of Pediatrics and Adolescent Medicine 158(8): 792-796.
Ettlinger, S. (2007). Twinkie, deconstructed: my journey to discover how the ingredients found in processed foods are grown, mined (yes, mined), and manipulated into what America eats. New York, Hudson Street Press.
Europa. (2010, September 8, 2010). "Seeds and Plant Propagating Material - Conservation varieties." Food safety: from farm to fork Retrieved 18 December 2010, from http://ec.europa.eu/food/plant/propagation/conservation_varieties/index_en.htm.

Evans, L. (2004). Structural reform: the dairy industry in New Zealand. APEC High Level Conference on Structural Reform Tokyo, Japan New Zealand Institute for the Study of Competition and Regulation Inc.

Fackler, M. (2009). Japan's Rice Farmers Fear Their Future Is Shrinking. New York Times. New York, The New York Times Company. March 29 2009.

Fairtrade. (2010). "What is Fair Trade." Retrieved December 18, 2010, from http://www.fairtrade.org.uk/what_is_fairtrade/default.aspx.

Fan, M.-S., F.-J. Zhao, et al. (2008). "Evidence of decreasing mineral density in wheat grain over the last 160 years." Journal of Trace Elements in Medicine and Biology 22: 315-324.

FAO. (2010a). "Biodiversity for a world without hunger: Plants." Biodiversity Retrieved 18 December 2010, from http://www.fao.org/biodiversity/components/plants/en/.

FAO (2010b). The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. Rome, Commission on Genetic Resources For Food and Agriculture Food and Agriculture Organisation of the United Nations.

FAOSTAT. (2010). "FAOSTAT production crops." Retrieved December 19, 2010, from http://faostat.fao.org/site/339/default.aspx.

Fernandez-Armesto, F. (2002). Near a thousand tables: a history of food. New York, Free Press.

FFNZ. (2010). "ETS costs demand an extra 88,000 + dairy cows." Media Releases 2010, 2010, from http://www.fedfarm.org.nz/88,000cows.

Fleischer, R. (1973). Soylent Green. USA, Metro-Goldwyn-Mayer: 97mins.

Fong, M. (2000). "Luck Talk in celebrating the Chinese New Year." Journal of pragmatics 32(2): 219-237.

Fonterra. (2009). "About us: our history." Retrieved 20 October 2010, 2010, from http://www.fonterra.com/wps/wcm/connect/fonterracom/fonterra.com/our+business/fonterra+at+a+glance/about+us/our+history.

Fonterra (2009). Moving Forward. Fonterra Annual Report. Auckland Fonterra Co-operative Group: 1-100.

Fonterra (2010). The natural source of dairy nutrition. Fonterra Annual Review. Auckland Fonterra Co-operative Group: 1-50.

Foodtown. (2010). "Foodtown NZ." Retrieved December 18, 2010, from http://www.foodtown.co.nz/.

Fraser, E. D. G. (2003). "Social vulnerability and ecological fragility: building bridges between social and natural sciences using the Irish Potato Famine as a case study." Conservation Ecology 7(2): 9.

Fraser, E. D. G. and A. Rimas (2010). Empires of Food: Feast, famine, and the rise and fall of civilizations. New York, Free Press.

Fryman, P. (2005). 4.2 The Best Burger in New York. How I Met Your Mother. USA, 20th Century Fox Television.

FSANZ. (2010). "Labelling genetically modified foods." Retrieved December 18, 2010, from http://www.foodstandards.gov.au/scienceandeducation/factsheets/factsheets2000/labellinggenetically29.cfm.

Fulkerson, J. A., M. Story, et al. (2006). "Family dinner meal frequency and adolescent development: Relationships with developmental assets and high-risk behaviors." Journal of Adolescent Health 39(3): 337-345.

Galvin, N. (2008). On the verge of a revolution. Sydney Morning Herald. Sydney, Fairfax Digital.

Garcia, M. A. and M. A. Altieri (2005). "Transgenic crops: implications for biodiversity and sustainable agriculture." Bulletin of Science, Technology & Society 25(4): 335 - 353.

Glover, D. (2007). "Monsanto and smallholder farmers: a case study in CSR." Third World Quarterly 28(4): 851-867.
GMO. (2010). "USA: Dispute over the approval of genetically modified salmon." Retrieved December 18, 2010, from http://www.gmo-compass.org/eng/news/540.usa_dispute_over_approval_genetically_modified_salmon.html.
Gray, B. (2010). "Box Office Mojo." Retrieved December 18, 2010, from http://www.boxofficemojo.com/.
Grindlinger, B. (2008). "Book Review: Twinkie, deconstructed: My journey to discover how the ingredients found in processed foods are grown, mined (yes, mined), and manipulated into what America eats." The Journal of Clinical Investigation 118(3): 827.
Guerrante, R. D. S., A. M. d. S. Antunes, et al. (2010). "An analysis of the growth trajectory of Monsanto." iBusiness 2(9): 223-231.
Guggenheim, D. (2006). An Inconvenient Truth. USA, Lawrence Bender Productions: 100mins.
Herrera-Estrella, L. R. (2000). "Genetically Modified Crops and Developing Countries." Plant Physiology 124(3): 923-925.
Hindo, B. (2008). "Monsanto on the Menu." Business Week(June 11): 1-2.
HNZ. (2009). "Best kept state house gardens revealed: marked increase in people growing their own vegetables." Retrieved December 18, 2010, from http://www.hnzc.co.nz/hnzc/web/home.htm.
Hodson, R. and T. A. Sullivan (2007). The social organization of work. Belmont, CA, Thomson Wadsworth Publication Company.
Holben, D. H. (2010). "Farmers' markets: fertile ground for optimizing health." Journal of the American Dietetic Association 110(3): 364-365.
Humphries, J. (2010). The impact of domestic food waste on climate change. Next Generation Food. Online, GDS Publishing Ltd.
Ifland, J. R., H. G. Preuss, et al. (2009). "Refined food addiction: a classic substance use disorder." Medical Hypotheses 72(5): 518-526.
IFOCE. (2010). "Major League Eating." Retrieved December 18, 2010, from http://www.ifoce.com/.
Inc., M.-W. (2011). "Merriam Webster Online Dictionary " Merriam Webster Retrieved 5 June 2011, 2011.
IYP. (2008). "The Potato." Retrieved December 19, 2010, from http://www.potato2008.org/en/potato/origins.html.
Jay, M. (2007). "The political economy of a productivist agriculture: New Zealand dairy discourses." Food Policy 32(2): 266-279.
Jiang, N., B. Sharp, et al. (2009). "New Zealand's emissions trading scheme." New Zealand Economic Papers 43(1): 69-79.
Johnson, A. W. and M. Gallagher (2010). Greater effort boosts the affective taste properties of food. Proceedings of the Royal Society B: Biological Sciences, The Royal Society. 1581: 1-7.
Johnston, K. (2010). New Zealand wins pavlova war. Stuff. Wellington, Fairfax Media.
Jones, R. A. C. (2009). "Plant virus emergence and evolution: Origins, new encounter scenarios, factors driving emergence, effects of changing world conditions, and prospects for control." Virus Research 141(2): 113-130.
Judge, M. (2006). Idiocracy. USA, Twentieth Century Fox Film Corporation: 84mins.
Kastler, G. (2005). "Europe's seed laws: locking out farmers." Seedling(July): 10 - 16.
Keijbets, M. J. H. (2008). "Potato processing for the consumer: developments and future challenges." Potato Research 51(3): 271-281.

Kirby, D. A. (2003a). "Science consultants, fictional films, and scientific practice." Social Studies of Science 33(2): 231-268.
Kirby, D. A. (2003b). "Scientists on the set: science consultants and the communication of science in visual fiction." Public Understanding of Science 12(3): 261-278.
Koons, D. (2004). The future of food. USA, Lily Films: 88mins.
Kumar, S. (2008). "A study of the supermarket industry and its growing logistics capabilities." International Journal of Retail & Distribution Management 36(3): 192-211.
Langreth, R. and M. Herper (2010). Company of the year: The planet versus Monsanto. Forbes Magazine. New York, Forbes.com LLC.
Lapoule, P. (2010). "Carrefour and its competitors in India." Management Decision 48(3): 396-402.
Lipschutz, R. D. (2006). "`Soylent Green ... is ... PEOPLE!': labour, bodies and capital in the global political economy." Millennium - Journal of International Studies 34(2): 4.
Lopez, M. A. A. and F. C. Martos (2004). "Iron availability: An updated review." International Journal of Food Science and Nutrition 55(8): 597-606.
Louwaars, N. P. (2005). "Seed laws: biases and bottlenecks." Seedling(July): 4-9.
Lowe, T., K. Brown, et al. (2006). "Does tomorrow ever come? Disaster narrative and public perceptions of climate change." Public Understanding of Science 15(4): 435-457.
MAF. (2010a, 23 September 2010). "Agriculture in the New Zealand Emissions Trading Scheme." Climate Change Retrieved 18 December 2010, 2010, from http://www.maf.govt.nz/climatechange/agriculture/.
MAF. (2010b). "Kiwifruit vine disease: *Pseudomonas syringae pv actinidiae* (Psa)." Biosecurity New Zealand Retrieved 18 December, 2010, from http://www.biosecurity.govt.nz/pests/kiwifruit-vine-disease.
Markovic, T. P. and S. J. Natoli (2009). "Paradoxical nutritional deficiency in overweight and obesity: the importance of nutrient density." The Medical Journal of Australia 190(3): 149-151.
Mayer, A.-M. (1997). "Historical changes in the mineral content of fruits and vegetables." British Food Journal 99(6): 207-211.
MfE (2007). Environment New Zealand. Wellington, Ministry for the Environment: 1-460.
Miller, S. (2008). Edible action: Food activism and alternative economics. Halifax, Fernwood Publishing Co. Ltd.
Mintz, S. (1997). Time, sugar, and sweetness. Food and culture: a reader. C. Counihan and P. V. Eskerik. New York, Routledge: 357-369.
Mintz, S. (2006). Food at moderate speeds. Fast food/slow food: the cultural economy of the global food system. R. Wilk. Plymouth, UK, Altamira Press: 3-11.
Monsanto. (2010). "Weed Management: Roundup Ready System." Our Commitments Retrieved 26 Oct 2010, 2010, from http://www.monsanto.com/weedmanagement/Pages/roundup-ready-system.aspx.
Monsanto. (2010). "Why does Monsanto sue farmers who save seeds." News and Views Retrieved 26 Oct 2010, 2010, from http://www.monsanto.com/newsviews/Pages/why-does-monsanto-sue-farmers-who-save-seeds.aspx.
Murphy, S. (2006). Concentrated market power and agricultural trade. Geneva, EcoFair Trade Dialogue Discussion Paper. 1: 1-41.
NAWAC (2010). Animal welfare (Pigs) code of welfare 2010. M. o. Agriculture. Wellington, MAF Biosecurity New Zealand
Nestle, M. and D. S. Ludwig (2010). "Front-of-Package food labels: public health or propaganda?" Journal of the American Medical Association 303(8): 771-772.
Neuman, W. (2009). Food Label Program to Suspend Operations. The New York Times. New York, The New York Times Company. October 24.

Newstalk ZB, NZPA, et al. (2007). Ribena-maker fined $217,500 for misleading vitamin C ads. NZ Herald. Auckland APN Holdings NZ Limited. Mar 27.
Nolan, J. M. (2010). "An Inconvenient Truth increases knowledge, concern, and willingness to reduce greenhouse gases." Environment and Behavior 42(5): 643-658.
NZFSA (2009). Identifying food additives. N. Z. F. S. Authority. Wellington, New Zealand Government: 1-16.
NZFSA. (2010). "Food additives and nutrition " What's in our food Retrieved 18 December 2010, from http://www.foodsmart.govt.nz/whats-in-our-food/chemicals-nutrients-additives-toxins/food-additives/.
NZPA (2006). Environmentalists to fight Fonterra wastewater dumping. NZ Herald. Auckland APN Holdings NZ limited.
NZPA (2010). Fonterra fined for acid in waterway. NZ Herald. Auckland, APN Holdings NZ Ltd.
NZPork (2009). Pork Outlook. S. Bowling-White. Wellington New Zealand Pork.
Parker, M. (2007). Sci-Fi in the Mind's Eye: Reading Science Through Science Fiction. Sci-Fi in the Mind's Eye: Reading Science Through Science Fiction. M. Grebowicz. Chicago, Open Court.
Pawlick, T. A. (2006). The end of food: How the food industry is destroying our food supply - and what you can do about It. Vancouver, Greystone Books.
Pérez, V. (2008). "Global Fairtrade sales increase by 47%." Retrieved December 18, 2010, from http://www.fairtrade.org.uk/press_office/default.aspx.
Perreault, M. (2009). "The science and entertainment exchange." Retrieved December 18, 2010, from http://www.scienceandentertainmentexchange.org/index.html.
Pilcher, J. M. (2002). Industrial tortillas and folkloric Pepsi: the nutritional consequences of hybrid cuisines in Mexico. The Cultural Politics of Food and Eating: A Reader. J. I. Watson and M. I. Caldwell. Malden, MA, Blackwell Publishing: 235 - 250.
Pilcher, J. M. (2006). Food in world history. New York, Routledge.
Pollan, M. (2010). The food movement, rising. The New York Review of Books. New York, NYREV: 1-13.
PRB. (2010). "Population data." Retrieved December 19, 2010, from http://www.prb.org/Topics/PopulationBasics.aspx.
Press, T. (2007). Benefits of growing own vegetables rediscovered. The Press. Christchurch, Fairfax Media.
PureNZ. (1999-2010). "To market, to market - NZ farmers markets." 100% Pure New Zealand.com Retrieved December 18, 2010, from http://www.newzealand.com/travel/media/tourism-media-homepage.cfm.
Ramey, E. A. (2010). "Seeds of change: hybrid corn, monopoly, and the hunt for superprofits." Review of Radical Political Economics 42(3): 381-386.
Randerson, J. (2002). Genetically-modified super-weeds "not uncommon". New Scientist. Boston, Reed Business Information.
Reynolds, R. (2004). "Guerrilla Gardening.org." Retrieved December 18, 2010, from http://www.guerrillagardening.org/ggcontact.html.
Rifkin, J. (1998). The biotech century: Harnessing the gene and remaking the world. New York, Jeremy P. Archer/Putnam.
Roberts, P. (2008). The end of food. Boston, Houghton Mifflin Company.
Robins, N. (2006). The corporation that changed the world: how the East India Company shaped the modern multinational. London, Pluto Press.
Saldivar-Tanaka, L. and M. E. Krasny (2004). "Culturing community development, neighborhood open space, and civic agriculture: The case of Latino community gardens in New York City." Agriculture and Human Values 21(4): 399-412.

Sciolino, E. (2008). A Portuguese Tradition Faces a Frozen Future. New York Times. New York, New York Times Company December 15.
Secretariat, F. I. (2008). "Cusco potato conference looks to "food of the future"." International Year of the Potato Retrieved 18 December 2010, from http://www.fao.org/newsroom/en/news/2008/1000816/index.html.
SFI. (2010). "Slow food: Our philosophy " Retrieved December 18, 2010, from http://www.slowfood.com/international/2/our-philosophy.
Shiva, V. (2004). The suicide economy of corporate globalization. ZCommunication. Online, Zspace, ZCom.
Silayoi, P. and M. Speece (2007). "The importance of packaging attributes: a conjoint analysis approach." European Journal of Marketing 41(11/12): 1495-1517.
Spiller, K. (2007). Farmers' markets: farmers' markets are a relative novelty in Britain, but what is their purpose? . Geography Review, General OneFile. 21: 40-41.
Spurlock, M. (2004). Super size me. USA, Kathbur Pictures: 100mins.
Standage, T. (2009). An edible history of humanity New York, Walker Publishing Company.
Stice, E., S. Yokum, et al. (2010). "Weight gain is associated with reduced striatal response to palatable food." Journal of Neuroscience 30(39): 13105-13109.
Stiegert, K. W., G. Shi, et al. (2010). Innovation, integration, and the biotechnology revolution in US seed markets. Choices: The Magazine of Food, Farm, and Resource Issues. Madison, Agricultural & Applied Economics Association 2nd Quarter: 1-12.
Stringer, C., C. Tamasy, et al. (2008). Growing a global resource-based company from New Zealand: The case of dairy giant Fonterra. Agri-food commodity chains and globalising networks. C. Stringer and R. Le Heron. Hampshire, England, Ashgate Publishing Ltd.
Swezey, B. (2008). "News Release: FDA Issues Documents on the Safety of Food from Animal Clones." Retrieved December 18, 2010, from http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2008/ucm116836.htm.
Taylor, D. (2010). "Laws, regulations, and policy: Genetically Engineered Salmon on the FDA's Table." Environmental Health Perspectives 118(9): A384.
Thomson, J. A. (2008). "The role of biotechnology for agricultural sustainability in Africa." Philosophical Transactions of the Royal Society B: Biological Sciences 363(1492): 905-913.
Time.com (2006). Local-Food Movement: The lure of the 100-Mile diet, Time Inc.
Tokar, B. (1998). "Monsanto: a checkered history." Ecologist 28(5): 254-261.
Trumbull, D. (1972). Silent Running USA, Universal Pictures: 89mins.
Twiss, J., J. Dickinson, et al. (2003). "Community gardens: lessons learned from California healthy cities and communities." American Journal of Public Health 93(9): 1435-1438.
UK, F. (2010). "Food Standards Agency." Retrieved December 18, 2010, from www.food.gov.uk/safereating/chemsafe/additivesbranch/enumberlist.
USCB. (2009). "Population Finder, New York City." American FactFinder Retrieved 19 December 2010, 2010, from http://factfinder.census.gov/servlet/SAFFPopulation.
USDA. (2010). "Meat and poultry labelling terms." Retrieved December 19, 2010, from http://www.fsis.usda.gov/factsheets/Meat_&_Poultry_Labeling_Terms/index.asp.
Vander Stichele, M. and S. van der Wal (2006b). The profit behind your plate: Critical issues in the processed food industry. J. Turner. Amsterdam, SOMO - Centre for Research on Multinational Corporations: 1-129.
Veltman, C. (2004). "Super Size Me." BMJ 328(7450): 1266.
Voicu, I. and V. Been (2008). "The effect of community gardens on neighboring property values." Real Estate Economics 36(2): 241-283.

Wachowski, A. and L. Wachowski (1999). The Matrix. USA, Warner Bros: 136mins.
Wadley, J. B. (1989). "Agricultural biotech research - Regulating agricultural biotech research: an introductory perspective." Hamline Law Review 12: 18.
Wagenhofer, E. (2005). *We Feed The World*. Austria, Delphi Filmverleih GmbH: 96min.
Weis, A. J. (2007). The global food economy: the battle for the future of farming. Black Point, NS, Canada, Fernwood Publishing
WFC (1974). Food: World food conference Science News. Rome, Society for Science & the Public. 106: 312.
Wilde, C. (1970). No Blade Of Grass. USA, Theodora Productions: 96mins.
Wilk, R. (2006). From wild weeds to artisanal cheese. Fast food/slow food: the cultural economy of the global food system. R. Wilk. Plymouth, UK, Altamira Press.
Willer, H. (2010). "New Zealand: Organic product sales rise." Organic-World. net Retrieved December 18, 2010, from http://www.organic-world.net/35.html?&no_cache=1&tx_ttnews%5Btt_news%5D=311.
Winston, E. I. (2008). "What if seeds were not patentable?" Michigan State Law Review(Spring): 321-344.
Yang, Q. (2010). "Gain weight by going diet? Artificial sweeteners and the neurobiology of sugar cravings: Neuroscience 2010." The Yale Journal of Biology and Medicine 83(2): 101.
Zimmerman, S. (2009). "Food in films: A star is born." Gastronomica: The Journal of Food and Culture 9(2): 25-34.