Investigating resilience of agriculture and food systems: Insights from two theories and two case studies

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ABSTRACT

There has been a growing concern described in the literature for the sustainability and resilience of agriculture and food (agrifood) sector towards local and global shocks. Resilience, defined in this context, is the ability of a system or society to recover from crisis while maintaining its function and identity. This thesis identifies two contrasting perspectives influencing contemporary resilience thinking and debated in the literature: one emphasises resilience as a system's emergent property, and the other emphasises the agency of the system's components to actively shape the system to be resilient.

In response to those perspectives and drawing their significance to the agrifood sector, this thesis seeks to clarify and understand *what 'resilience' means for agrifood systems in the context of local and global changes*. It does so by offering a novel theoretical framework in which resilience thinking is in dialogue with two social theoretical approaches that are commonly recognised (albeit usually as contradictory perspectives) in agrifood studies: food regime theory and actor-network theory (ANT). This framework facilitates the assessment of resilience in different agrifood systems by bridging the conflicting perspectives within resilience thinking by means of a theoretical pluralism. The application of this theoretical framework illustrates how resilience is influenced by both a global structure that rises and declines in response to social, economic and environmental drivers, as well as local actors (both humans and material objects) that, through their relational effects, perform agency to enhance the adaptive capacity of the society.

The theoretical framework is examined empirically through case studies of two agrifood systems: Indonesia's rice agriculture and the New Zealand kiwifruit industry. Data was collected from official documents, published reports and semi-structured interviews with 61 participants as representatives of various stakeholders of the two agrifood systems.

The findings of this thesis illustrate that both agrifood systems have demonstrated resilience towards various shocks, but in different ways in response to differing variables. Food regime analysis suggests both that resilience of the two agrifood systems is influenced by the expansions and contractions of the global food regimes over the course of their development and, to some extent, that each agrifood system shaped the trajectories of the food regimes in which they reside. However, food regime theory fails to address the idiosyncrasies that occur and the agency of local actors in shaping the resilience of the systems. Analysis through ANT enables a closer look at how networks of human and non-human actors adapt to the shocks at a particular time and in a particular space. Findings indicate that the multiplicity of rice creates a diversity of meanings and actions by which resilience is enacted in the broad context of Indonesia, while kiwifruit facilitates a process of transformative resilience within the industry in New Zealand as a means to adapt to changing circumstances and shocks.

This thesis finds that, firstly, resilience is a dynamic, multi-dimensional, context-dependent process; secondly, different contemporary theoretical models focus on different aspects while over-looking others; and thirdly, therefore, resilience cannot be accurately gauged through generic models and measures. It concludes that resilience needs to be assessed using multiple tools that take account of and accommodate the uniqueness of each agriculture and food system.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 2

CHAPTER 4

CHAPTER 5

CHAPTER 6

CHAPTER 7

CHAPTER 8

CHAPTER 9

PART I: INTRODUCTION

CHAPTER 1 NEW PERSPECTIVES: TOWARDS SUSTAINABLE FOOD SYSTEMS

1. 1. Setting the scene

This thesis explores two points of concern. The first aims to empirically assess whether and how agriculture and food activities (often referred to as agrifood, agro-food, or agri-food; see McMichael, 1994; Bonanno & Constance, 2008) can achieve a state of sustainability and resilience in the face of fast-changing global dynamics and the local perturbations that follow them. This analysis starts with a simple question: *what does a resilient agrifood system look like?* Even such a simple question, however, needs profound, systematic answers. What is resilience? And what is an agrifood system?

By contrast, the second point interrogates a set of theoretical questions. It recognizes a lack of satisfactory frameworks to address the first concern. In a sense, this thesis attempts to formulate a new way of understanding resilience and agrifood systems. In so doing, it deliberately challenges some of the recurring debates around three prominent dichotomies within social sciences that impede our current understanding of such a significant issue: structure-agency, global-local, and nature-society.

This thesis, therefore, serves as a discursive arena between different theories and, even further, paradigms. Drawing from a plethora of studies within a wide range of disciplines, this thesis takes the initial step to open a constructive dialogue between three emerging bodies of literature in the field of agrifood studies: resilience thinking, food regime analysis and actor-network theory (ANT). While this thesis demonstrates the value of theoretical pluralism in its analysis, my positionality as a researcher, shaped through my ontological journey and personal engagement with the issues, also influences the way in which the theoretical dialogue takes place. My academic background in two distinct disciplines (ecology and sociology) allows this thesis to pose such a complex and interdisciplinary research problem and penetrate into each theoretical realm through a constructive dialogue to address that problem. This chapter, in particular, provides a rationale for the study; and, in the following sections, I will show why it is important, if not essential, to break the boundaries of

paradigms so as to establish new and insightful ways of articulating agricultural sustainability.

1. 2. Resilience: an emerging concept

The study of agriculture and food has long addressed the potential capacity of systems to provide sufficient food with an earlier emphasis on sustainable development being superceded by a focus on resilience. Early discourse on sustainability, as stated in the Malthusian dilemma, was strongly related to agriculture and food and the ability of production to keep pace with the growth of population (Rosegrant et al., 2001). However, society began to take notice of a different issue after 1962 when Rachel Carson's book, *Silent Spring*, raised concerns on the environmental repercussions transmitted from the production of food which had started to boomerang back at people. Intensive agricultural practices (such as extensive pesticide use and large-scale application of chemical fertilizers) were, and still are, seen to be unsustainable for the health of the environment and society (Altieri, 2002).

In the agrifood sector, research on sustainability has advanced quite rapidly in the last four decades. The common definition of *sustainable development*, which is "… development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987), implies the need to measure the performance of the present growth and provide a projection for the future. Drawing from this definition, numerous studies on agricultural sustainability have focused on predicting the future of food production and consumption (Kindall & Pimentel, 1994) as well as developing indicators for sustainable agriculture (Zahm et al., 2008) and designing models of sustainable agrifood system, based in agroecology (Altieri, 2002), organic agriculture (Raynolds, 2004; Giovannucci, 2005) or alternative food networks (Allen et al., 2003; Holloway et al., 2006). However, achieving agricultural sustainability is also subject to the unpredictability of the future world. Folke et al. (2002) and many others suggest that, in an increasingly complex world, it is imperative to include contingency as part of the sustainability equation. Therefore, instead of predicting the future, the pursuit of sustainability needs to be oriented towards preparing for future uncertainties. Carl Folke and his colleagues (2002) offer another concept that may help us understand better how to prepare ourselves for these uncertainties in the discussion of sustainability. The concept is *resilience*.

Resilience as an academic concept emerged from two distinct disciplines. The first was introduced by Holling (1973) to explain the dynamics of populations within ecological systems. Resilience is defined as "… a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 1973:15). In this framework, the development of a system is characterized by (abrupt) change, unpredictability, and persistence, as it differs from the term 'stability' which connotes constancy and predictability (Holling, 1986). Holling thus suggests that resilience is not about maintaining the system in a stable state, but about understanding the boundaries within which a system can operate without shifting into different states. Here, resilience is seen as an emergent property of a well-functioning system. Studies from this perspective on resilience aim to develop ways to build a resilient system by understanding its structure and behaviour, as well as the nature of the driving forces and shocks (Walker et al., 2002; Walker et al., 2004; Allison & Hobbs, 2004).

The second concept of resilience originated in the discipline of social psychology as a term to describe groups of people that are able to rebound from adversity (Walsh, 1998). This perspective understands resilience as emerging from an active effort within individuals and society to self-organize and thrive amidst crises and disasters (Bohle et al., 2009; Coulthard, 2012). The value of this framework comes in the formulation of prescriptive ways of building resilience (Folke et al., 2003; Buikstra et al., 2010; Darnhofer et al., 2010), either through leadership, use of knowledge or enhancement of social capital.

As the two disciplinary approaches converged, resilience has become a widely-encompassing theoretical concept and policy framework for the pursuit of a sustainable future. The range of disciplines adopting the concept of resilience is remarkable, including ecology (Gunderson, 2000), economics (Brock et al., 2002), psychology (Buikstra et al., 2010), geography and cindynics (Adger, 2000), political sciences (Pritchard & Sanderson, 2002), urban planning (Gotham & Campanella, 2010), management (Moore & Westley, 2011), health sciences (Aranda et al., 2012) and, relevant to this thesis, studies of agriculture and food (Beilin, 2007; Darnhofer et al, 2010). In the academic world, research on resilience has increased exponentially over the past four decades, with more than 1,300 publications recorded from 1973 to 2007 (and over 200 publications in 2007 alone; Janssen, 2007). In addition, Almedom (2008) identifies at least 15 journals that published a special issue on the theme of

resilience between 1998 and 2008. This shows the enthusiasm of engaging with the issue of resilience amongst scholars and academics.

In the practical world, the concept of 'resilience' is used even more frequently, particularly in addressing complex issues such as climate change, peak oil and the global economic crisis (Leichenko et al., 2010). For example, the FAO includes resilience as a key step to achieving food security (see Pingali et al., 2005). Globally, more than 1,600 cities have adopted the concept to prepare themselves for the uncertainties of global crises (UNISDR, 2012). In terms of food, many practitioners (individuals and organizations alike) have attempted to define a resilient food system and to prescribe ways to achieve it (including in relation to concepts such as permaculture, community, diversity, natural, organic, or local[1]).

Notwithstanding the huge interest in, and a very wide applicability of, the term 'resilience', it also brings some confusion and different interpretations in its meaning (Reghezza-Zitt et al., 2010). Debates are occurring with regard to the characteristics and nature of a resilient community (Berkes, 2007; Buikstra et al., 2010), the relevance of resilience with regard to changes and continuity (Gotham & Campanella, 2010), and whether resilience is necessarily a good thing (Amundsen, 2012). The extent to which the concept of resilience has been applied also demonstrates that its meaning is very much dependent on the context in which it is used.

1. 3. The research questions: resilience of agrifood systems

So what does resilience mean in the context of agrifood studies? Answering this requires a deep exploration of the notion of resilience. The first thing to do is to look at the growing body of literature that encompasses the idea of resilience. The studies of resilience have found a convergence in what Carl Folke (2006) termed 'resilience thinking', as nurtured by a group of prominent, interdisciplinary scholars called the Resilience Alliance. The group has played a crucial role in formulating some of the key concepts within resilience thinking and disseminating these ideas, particularly through *Ecology and Society* (previously named *Conservation Ecology*), a highly regarded journal specifically focused on this widely used theme. Since its inception in 1997, the journal has published more than 200 articles, many of

[1] The list is non-exhaustive. A websearch through Google using keywords "resilient food system" generates 97,400 results, ranging from websites belonging to cities, organizations and community groups to private corporations.

which are included in 78 special features that discuss particular topics around resilience from a wide range of issues. The journal also encourages theoretical merging and transdisciplinary approaches within resilience thinking (e.g. Smith & Stirling, 2010; Pelling & Manuel-Navarrete, 2010; Atwell, 2009). Of course, resilience is also discussed extensively in a wide range of other journals, books and reports (Janssen, 2007), thus adding to the rich repositories of resilience research.

Despite the extent of studies within resilience thinking, including many on the topic of agriculture, I find a lack of sufficient study into the meaning of resilience for agrifood systems. Much of the literature focuses either on resilience at the farm (e.g. Darnhofer et al., 2010; Keil et al., 2008), regional (Allison & Hobbs, 2004) or societal level (Milestad et al., 2010), or on a particular environmental shock such as climate change (Challinor et al., 2007), agricultural policy (Happe et al., 2006), or globalization (Armitage & Johnson, 2007). Although these studies are insightful, they do not fully capture the complexity of the kind of agrifood system that this thesis will go on to examine. Furthermore, I find these studies generally lack the perspective of the social sciences and, thus, often fail to recognise that an agrifood system is also about social (and material) relationships (Jarosz, 2000). This indeed has been one of the drawbacks of resilience thinking so far; that although it is well-advanced in its exploration of ecological dynamics, resilience thinking is still underdeveloped when engaging with social theory (Davidson, 2010, 2013), even more so with social studies of agriculture. As I will argue, such a limitation of resilience thinking lies in its apparent lack of concern for addressing some of the things that are extensively discussed in agrifood studies. For example, issues like the relevance of global food relations in shaping resilience at the local level, the extent to which local actors can change the trajectories of the global system, and the importance of food in influencing the way in which humans 'perform' resilience have not been extensively discussed in resilience thinking. Chapter 2 in this thesis will elaborate further the development of resilience thinking and identify some of its limitations as it engages with the social dimensions of agrifood systems.

Following these issues and their implications, I argue that for scholars of resilience thinking to get a better grasp of the social dynamics of agrifood systems, they need to more deeply explore the advances in theoretical discourse made within agrifood studies and rooted in the disciplines of sociology (Buttel, 2001) and human geography (Morgan et al., 2006). In comprehending what an agrifood system is, the discourses within these disciplines have long

gone past the study of agriculture at the farm level. A modern agrifood system should in fact be seen as a complex social system (Jarosz, 2000; Buttel, 2001) – encompassing not only farmers and farm activities, but also, and most importantly, global political, economic, and cultural praxes of food that are manifested through long commodity chains stretching from one end of the globe to the other.

It follows that the theoretical framework of this thesis is derived from two major schools of thought within the social studies of agriculture and food. Food regime theory (Friedmann & McMichael, 1989) is a structuralist approach that looks at agrifood systems as being shaped in history by political, social, economic and ecological relationships between regions/countries/commodities on a global level. The theory provides a global framework for assessing both the behaviour of particular agrifood systems in many parts of the world, as they struggle to maintain their existence in the global arena, as well as the periods of global stability and crisis that drive this behaviour. Actor-network theory (Law, 1992; Latour, 2005), on the other hand, is a post-structuralist (or post-human) approach that offers a more detailed understanding of the micro-processes occurring at the local level in which components of the system/network, or actors, interact with each other in their efforts to remain resilient. Chapter 3 will explore the evolution of agrifood studies, focusing on these two prominent theories in particular, in greater depth as a response to the call for the theoretical merging which resilience thinking has long awaited.

The challenge in bringing resilience thinking, food regime theory and actor-network theory together, I would argue, is that they stand on different paradigms. A never-ending debate between structuralism (food regime theory) and post-structuralism (actor-network theory) comes from the very nature of the two approaches – each is seen to contest the other. Given such circumstances, there has never been any significant attempt to bring the two into constructive dialogue. However, from the lens of scholars of resilience thinking, there is in fact huge potential for the two approaches to complement each other. This thesis thus argues that if we can shift our attention to the similarities shared by the theories, we can develop a powerful analytical framework to investigate the resilience of agrifood systems. To do so, we first must embrace what is called theoretical pluralism (e.g. Popper; Feyerabend, in Midgley, 2011) – that is, to bridge several theories and see them side by side without determining which one is better. Resolving this will be the main theoretical contribution of this thesis. In linking social theory to resilience thinking (based on the positionality of the researcher),

Chapter 4 also raises concerns regarding whether this grandiose theoretical framework actually provides any practical understanding of resilience when grounded within specific empirical cases.

This thesis will elaborate two case studies: Indonesia's rice agriculture and the New Zealand kiwifruit industry. There is, of course, a rationale behind the choice of the case studies. A comparative assessment of the two contrasting agrifood systems (which also are representative of other food systems worldwide) facilitates insight into understanding various different ways in which resilience is perceived, valued and enacted in its local, social, ecological and political contexts.

Indonesia's rice agriculture is an inward looking agricultural sector in a very populous, developing nation. Rice is the staple food for the majority of the population (Arifin, 2007), and thus plays a crucial role in shaping the social and political stability of the country. Most of the farmers practicing rice agriculture are peasants, owning or leasing a very small plot of land (White & Wiradi, 1989). The commodity is subject to international price fluctuations (Dawe, 2002). Climate change is one of the biggest threats to the continued viability of production and that of the communities living from it (Keil et al., 2008). Nevertheless, rice agriculture has been practiced for millennia in the region and experienced many crises through which it proved its capacity to survive and thrive. This first case represents many other peasant farming systems all around the world that are struggling to remain viable amidst global challenges, but with their crops entangled with the life of the society in many different ways. The resilience of this type of agrifood system will be of significance to the majority of the world's population as their means of survival.

The New Zealand kiwifruit industry, on the other hand, is an export-oriented horticultural industry within a neoliberalised agricultural country (Bonanno, 2009). Kiwifruit is a high-value product, filling shelfs of large supermarkets all around the world with a strategic positioning as a healthy fruit (Beverland, 2001). The production end is technology-intensive based on large capital investment (Kilgour et al., 2008). The marketing channel shows a robust network at a global scale, with support from international audit schemes rendering the industry able to withstand price fluctuations and various economic shocks. Indeed, the structure of the industry as it is today is shaped by many shocks and crises that formed an ever stronger industry (Campbell & Fairweather, 1998). This second case represents what

Bonanno et al. (1994:10) called "a true globalization"; an agrifood system that is fitted to the global configurations of the capitalist system. Achieving sustainability, thus, relates closely to the industry's ability to respond to global demand and increase its economic efficiency and business growth. In this thesis, I try to understand what that means for the resilience of this type of agrifood system.

In both cases, actors (the government, farmers, and the industry) have endeavoured to enhance the sustainability of their agrifood systems, although for different reasons: for Indonesia, it is because rice is an essential crop for the society (Arifin, 2007); for New Zealand, kiwifruit is the largest horticultural industry in terms of export values (Kilgour et al., 2008). Furthermore, both of the agrifood systems face uncertainties associated with climatic change and globalization, with pest and disease outbreaks occurring in combination with financial crises. In this context, resilience has become a catchphrase to justify the actions intended for the continuance of both systems. As more policies and strategies are being formulated on the basis of system resilience, there is an urgent need to first resolve the problematic issue of defining resilience in the context of both agrifood systems. Accordingly, Chapter 5, 6 and 7 offer an analysis of their resilience through different approaches. Chapter 5 is an interpretation of the case studies from a food regime perspective. This chapter discusses the historical development of Indonesia's rice agriculture and the New Zealand kiwifruit industry as they are entangled with global food relations, and also examines the way in which the global relations shaped the resilience of the systems. Chapter 6 and 7 will use actor-network theory to explore Indonesia's rice agriculture and the New Zealand kiwifruit industry, respectively, through a closer look at actors, agency and locality. Here, the question brought forth is how resilience is enacted differently in each locality.

1. 4. Re-statement of the thesis purpose

To close this chapter, I would like to re-state the research questions explored in this thesis. First, I ask *what resilience is in the context of agrifood studies*. In answering this, I investigate in great depth the theoretical framework within resilience thinking and two prominent social theories in agrifood studies that provide a novel insight to the understanding of agrifood resilience. The second question is, *how can we build a joint theoretical framework from a constructive dialogue between the three approaches?* The case studies will test whether this framework does indeed establish a significant contribution to theoretical

understandings of resilience. At the same time, the cases are representative of two existing agrifood systems in the modern setting. Thus, the third question, "*what would a resilient agrifood system look like*?" will also be of significance to the practical understanding of resilience. In Chapter 8 and Chapter 9, these three research questions will be addressed intensively, in the specific empirical contexts and within broader agrifood discussions, respectively.

This thesis is, thus, intended as an exploration of the concept of resilience, in the context of agrifood systems, in its theoretical and empirical senses. Accordingly, the thesis will pursue two outcomes. On a theoretical basis, it offers an alternative lens for and complementary insight to understanding resilience and sustainability from the perspective of agrifood studies. It seeks to identify emergent properties and social-material relationships that shape the dynamics of agrifood systems, showing how different systems can have different or similar responses to a combination of environmental and socio-economic drivers. In an empirical sense, the thesis will identify some of the points of concern that decision-makers need to take into considerations in building resilience at different and changing (spatial and temporal) contexts of the agrifood system.

PART II: INSIGHTS FROM TWO THEORIES

CHAPTER 2 THE EVOLUTION OF RESILIENCE THINKING

2. 1. Introduction

The arguments throughout this thesis are based on one particular question: are agrifood systems, as exemplified by various commodity chains stretching from local to global levels, resilient in the face of disturbance? In order to answer this question, a theoretical framework should first be constructed to illuminate the two basic ideas found within it—'resilience' and 'agrifood system'.

'Resilience' as a concept has its roots in many disciplines, among others in structural and material engineering (Gordon, 1978), natural hazards and cindynics (Klein et al., 2003; Adger, 2000) and social psychology (Walsh, 1998; Buikstra et al., 2010). However, resilience thinking as it is now commonly known evolved mainly from within the discipline of system ecology (Holling, 1973; Gunderson, 2000). This chapter focuses primarily on the development of resilience thinking from this latter root, while acknowledging other interpretations of resilience where relevant. As the genealogy of resilience theory has been well documented by Folke (2006), it is not my intention to repeat a thorough summary in this chapter. This review instead focuses on several analytical concepts that serve as basic propositions for this thesis, and are consequently used as a framework to understand the complexity of agrifood systems. This chapter ends by highlighting some of the limitations of resilience thinking in understanding agrifood systems as complex adaptive systems, and providing a rationale for the incorporation of social approaches and analyses to get a better grasp of resilience in the agrifood context.

Resilience thinking has come a long way since its inception in 1970s. It first started as a theoretical approach to understand ecological phenomena. In his seminal paper in the *Annual Review of Ecology and Systematics* (1973), Holling introduced the term 'resilience' to explain the dynamics of populations within an ecological system. At that time, research in applied ecology was focused on the attempt to find equilibrium in an ecosystem. Accordingly, stability was the main notion in ecosystem management. In simplified models of ecosystem dynamics, such as that shown in the familiar Lotka–Volterra's model of predator and prey (May, 1972), the concept of stability is plainly portrayed. Rise and decline in the population of prey is balanced by the dynamic population of the predator, which

eventually leads both predator and prey populations to a stable equilibrium. In the complexity of a real world ecosystem, however, this is not always the case.

Through empirical evidence, Holling (1973) showed that an ecosystem does not necessarily constitute a single stable state. Ecosystems can shift from one state to another in the face of disturbance. The population of prey, for instance, could considerably decrease due to multiple stressors to a level where a return to the previous equilibrium is unattainable, and the ecosystem would then reconfigure to a seemingly different system. Consequently, Holling suggests that research should be focused less on the measurement of the time needed for a system to return to its equilibrium (stability), and more on the amount of disturbance a system can absorb before it shifts into an alternate stable state. Resilience was thus defined as "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 1973: 14).

In the next two decades, as environmental concern began to take a more defined shape, more practical research on ecosystem management was needed (Holling, 1986). Since then, the resilience framework has been evolving in order to accommodate growing concerns over global environmental changes, societal wellbeing and sustainability that were not addressed in the early development of resilience thinking. Researchers seek to adopt resilience thinking into studies of other complex systems, which include economic (Brock et al., 2002), political (Pritchard & Sanderson, 2002), institutional (Moore & Westley, 2011), as well as agriculture and food systems (Ericksen, 2007; Darnhofer et al., 2010). The basis for such wide application of resilience theory is that, like an ecosystem, these various systems are assumed to display attributes of complex adaptive systems (Levin, 1999), with characteristics such as feedback mechanisms, emergent properties, and adaptive changes.

However, as this framework began to incorporate the social dimension, many scholars argue that it failed to address issues within this dimension satisfactorily. Over the next decade, many scholars have proposed a new approach to understanding resilience through agent-based thinking. This approach has proven to be a meaningful theoretical and political framework, particularly to address the role of human agents in tackling problems around sensitive regions, vulnerable societies and communities (Adger, 2000; Bohle et al., 2009, Berkes & Ross, 2013).

Reghezza-Zitt et al. (2012) thus interrogate the polysemic nature of resilience. Is resilience a system property (as advocated by Holling, 1973), a potential (Adger, 2000), or an active process (Walsh, 1998)? As they argue, this polysemy is not necessarily bad; in fact, it enriches the discourse and methodological framework within resilience thinking. The authors' only concern is that this might create "theoretical and operational dead ends" and "end up being 'inoperative'" (Reghezza-Zitt et al., 2012: 2). In this thesis, I argue that resilience must instead be seen complementarily through both perspectives, particularly in investigating a complex system such as agriculture and food. In order to offer a conciliatory conception of resilience, the subsequent part of this chapter is divided into two sections. The first section (Section 2.2) examines resilience as a system property and some of the key concepts within it. By contrast, the second section (Section 2.4) interrogates resilience as agency, as I review the extent to which social dimensions have been incorporated into resilience thinking. In both sections, I highlight the significance of the perspectives (and the key concepts) in better understanding the resilience of agrifood systems.

2. 2. Resilience as a system property

2. 2. 1. Understanding systems of agriculture and food relations

To see resilience as a system property, we need to start by defining what a system is. A system, in general, consists of and is defined by its interacting components which form an integrated whole (Cumming & Collier, 2005; Pidwirny, 2006). Interactions between these components set forth emerging properties of the system not present in each component when seen separately (Levin, 1999; Capra, 1996). Hence, a system is a single unit of analysis in and of itself. A system's components, as well as the relationships between these components, define the structure and function of a system (Pidwirny, 2006). An ecosystem, for instance, has functions of nutrient cycling and energy flow through the interaction between its biotic and abiotic components (Likens, 1992). In a similar manner, Buckley (1967) argues that a social system functions through information flow between its social components.

The problem with such views is that it subtly assumes that a system is a naturally occurring entity; that a system exists in reality and, consequently, can be observed in an isolated manner. In fact, it is not. Humans, as observers, often simplify and make sense of complex phenomena and relationships by representing reality as 'system' (Kwa, 2002). In other words,

a system, instead of being an inherent part of reality, is subjectively constructed and arbitrarily defined for the purpose of analysis. But how can we then define a system that is agreeable within academic consensus? Cumming and Collier (2005: 3-4) propose four aspects that are most often used to help setting the definition: (1) its structure and key components; (2) its functions and the relationships among the components; (3) the spatial scale at which a system is defined and considered to be of importance; and (4) the temporal scale at which the structure and function are still sustained.

In the context of agriculture and food, one question remains: what unit of analysis should one use so as to understand the system's resilience? Is an agrifood system defined as agricultural activities at the farm level? Or does it include whole commodity chains, from production to consumption? An agrifood system encompasses a wide range of food-related activities, which may include production, distribution, and consumption (Ericksen, 2007). This covers agriculture, but not in its strict sense. I suggest that agriculture is a complex activity consisting not only of farming, but also activities that support farming (from agricultural supply, infrastructure preparation, to regional policy-making). This increases the complexity of an agrifood system because it then incorporates economic, political, financial, and ecological systems, to name a few. Furthermore, an agrifood system can stretch from the farm to the global scale.

In my review of the literature presenting studies relating to resilience, three generic models of an agrifood system often used as conceptual frameworks were compared (see Figure 2.1). To illustrate these three models, I primarily compare the works of Ika Darnhofer et al. (2010), Evan Fraser and his colleagues (2005) and Polly Ericksen (2007) as examples. The first (Darnhofer et al., 2010, as Figure 2.1a) is what I have called a region-based model of an agrifood system. This model centres on a farming system in a particular geographic area, stretching from a small plot to a whole catchment region. The second is a society-based model, which focuses on food-related activities (from production to consumption) in a particular society (Fraser et al., 2005, as Figure 2.1b). The third is a food-based model, where the system is represented by a commodity or value chain linking different food-related activities in various geographic areas and groups of people (Erickson, 2007, as Figure 2.1c). As I will show, the models that they represent in their works resonate with many other studies of agrifood system's resilience.

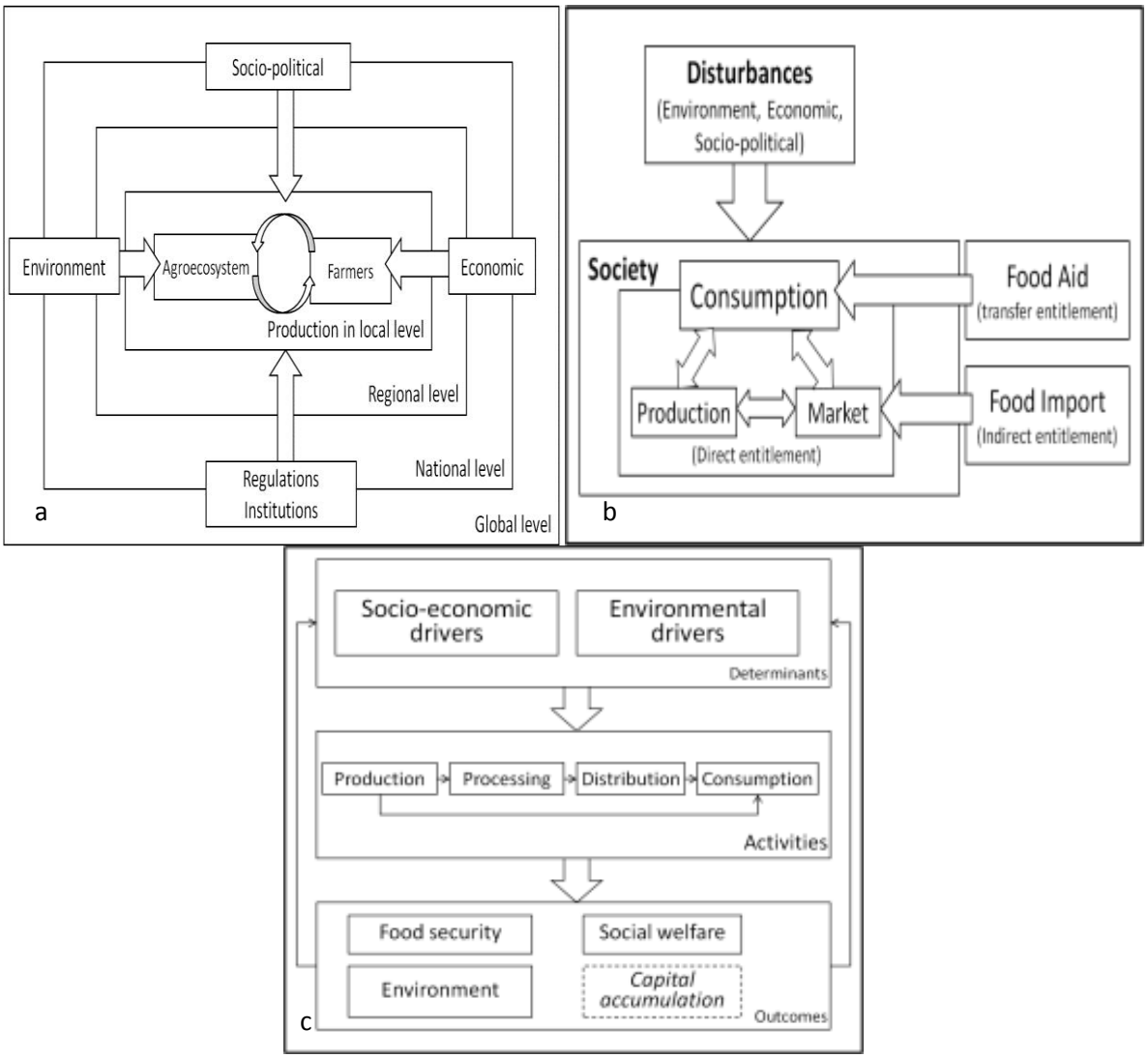

Figure 2.1. Conceptual models used in the study of agrifood system's resilience; (a) Darnhofer et al. (2010)'s multi-level drivers to farm level; (b) Fraser et al. (2005)'s 'Panarchy framework'; (c) Ericksen (2007, 2008)'s 'Food systems framework'. Box implies a single functional group, process, or level in food system.

As shown in Darnhofer et al. (2010; Figure 2.1a), the region-based model is practical in addressing resilience because it highlights the idea of system identity in a particular locale, in combination with disturbances that occur across multiple scales. Darnhofer et al. (2010) show a variety of factors originating at different scales that can be seen as disturbances to the focal system (the region or farm level). Many studies on agriculture resilience have used a similar model (e.g. Keil et al., 2008; Milestad & Hadatsch, 2003; Challinor et al., 2007; van Appledorn et al., 2011), mainly because it can depict an obvious connection between humans and nature, as well as emphasize resilience in the face of external disturbances more clearly.

The main problem of this model is that it fails to address the multiple scales of a food system. By definition, such systems stretch beyond the farm level and encompass processing, distribution and consumption activities that may reside in different locations (Anderson, 2007). This model, therefore, although partly useful in analysing resilience at the farm level, does not provide a comprehensive understanding of the system.

The society-based model (as exemplified by Fraser et al., 2005; Figure 2.1b) provides a more detailed representation of food systems in a particular society, which emphasizes consumption, with other activities in a lesser degree. In their study, Fraser and his colleagues propose a framework in which the vulnerability of a food system is seen in relation to the system's wealth (potential), connectedness, and diversity. The wealth of a food system refers to the ways in which the society or consumers obtain food, and it is best described through an entitlement framework (Sen, 1988), i.e. that food is attained either through direct (societies produce the food themselves), indirect (people purchase food from producers through money they earned from work), or transfer entitlement (food is given as aid). The connectedness of the food system is defined by the length and complexity of the 'chains' that link the producers and consumers. The diversity conveys the various means by which the society attains its food. In *Ecology and Society*, studies that align with this model (v.d.Veen & Gebrehiwot, 2011; Aggarwal et al., 2004; Reidsma & Ewert, 2008) generally focus on regional food security policies and strategies. This conception of an agrifood system is useful for understanding the resilience or vulnerability in a society where food is a part of its dynamic; but is still not sufficiently complete to comprehend the full complexity of agriculture-related activities and production-consumption relationships.

The food-based model represents an agrifood system centred on food and agricultural products that are transferred from one activity (production) to another (processing, distribution, consumption, etc.). One study that partly resonates with this model is such by Ericksen (2007; Figure 2.1c). She describes a food system as consisting of three main compartments: activities, determinants, and outcomes. The determinants affect the activities of the food system, which then result in outcomes that may or may not return as feedback to the determinants. The first outcome (social welfare) involves the function of the agrifood system in providing income, employment, and capital for the actors involved. The second outcome (food security) consists of the availability of food supplied by producers, the accessibility of food for consumers, and the utilization of food in terms of health, culture, and

social values. The third outcome (environment) concerns the impact of production, processing, distribution, and consumption activities on the ecosystem. The framework also demonstrates a feedback mechanism where outcomes can affect the activities in a positive (e.g. food is accessible, thus providing a good social environment for production) or negative way (e.g. environmental impact deteriorates land for production). Ericksen's model is by far the most comprehensive. However, as it covers broad structures of an agrifood system, the interaction between the components lacks detail (e.g. what would a global economic driver look like? How can dynamics at the production level be connected to other activities?), and it becomes less applicable to a resilience framework.

These three models clearly demonstrate the complexity of agrifood systems. I suggest that an ideal and thorough analysis of an agrifood system's resilience needs to incorporate the three approaches; i.e. it must address the linkages between different food-related activities/subsystems (Ericksen, 2007), position societies within the complex system (Fraser et al., 2005), and recognise disturbances in cross-scale dynamics (Darnhofer et al., 2010). However, these conceptions of an agrifood system fail to account for another difficulty associated with a system perspective of resilience: that as a dynamic and open entity, a system changes throughout time and space (Cumming & Collier, 2005).

2. 2. 2. Stability, threshold and uncertainty: the concept of domains of attraction

Both system identity and disturbances are critical in highlighting the continuous changes implied in a system resilience framework. Holling's (1973) conception of system and resilience was controversial at that time because it denies the premise that a system self-regulates within a single equilibrium state. At the heart of Holling's conception of resilience is precariousness; that in the presence of disturbances, natural (and social) systems undergo change, along with the possible states in which each system may reside. The concept of 'multiple stable states' is proposed to address that argument (see also Ludwig et al., 1997 for a handful of mathematical models of multistable states). The concept of multiple stable states implies that a system, in the absence of perpetual stress or disturbance, is attracted to a 'domain of attraction' (Holling, 1973) or 'stability domain' (Gunderson, 2000). In the case of the predator-prey relationship, this domain of attraction would be the equilibrium around which the population numbers oscillate. At the same time, disturbances might force the system to move away from the domain until it reaches a threshold at which even a small

amount of disturbance might distinctly alter the configuration of the system. In other words, it shifts into an alternate stable state.

Walker et al. (2004) give a more elaborate explanation of the concept of 'domain of attraction' in order to grasp the fundamental nature of resilience, using a metaphor of a basin to illustrate a stable state into which a system is attracted (see Figure 2.2). A 'domain of attraction' can be seen as a regime - a set of possible relationships and combination of variables in which a system may reside (Figure 2.2). As resilience is defined as the amount of disturbance a system can absorb before it shifts into another domain/basin of attraction, three properties of the basin which contribute to the system's resilience should be considered: Resistance (R), that is, how easily a system changes; Latitude (L), the amount of change necessary to draw the system to its threshold; and Precariousness (Pr), the proximity of a system to its threshold. The state of a system within the stability domain at a specific time and space is driven by the dynamic between the attractor and disturbances that move the system towards and away from the centre of the domain (Walker et al., 2004). But what does this metaphor inform us about the continuous changes that Holling (1973) so strongly advocates? And what does this imply to the understanding of resilience?

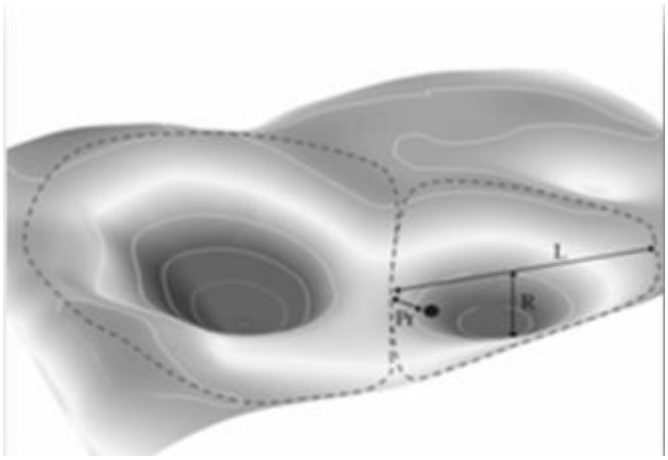

Figure 2.2. Multiple basins of attraction; the system is represented as a small dot; R=Resistance, L=Latitude Pr=Precariousness, (Source: Walker et al, 2004:4)

In their article, Holling et al. (2002a) assert that the concept of multiple stable states is not sufficient to capture the idea behind resilience thinking. In an ideal static world, there would only be one state of resilience for each specific system within its stability domain. If the basin was so deep, any system within would be very resilient; i.e. it would take a huge amount of

shock to pull the system towards the threshold. In a situation where the system was undesirable, the society within would be trapped in a 'maladaptive' system (Holling et al., 2002b). Fortunately, however, the world does indeed change. Holling (et al., 2002a) propose the idea of 'nature evolving', suggesting that the configuration of the stability domain within which the system resides is not fixed throughout time. A stability domain can expand and contract, depending on its relations to other domains and its evolution over time. Accordingly, as the domain evolves, the system resilience also increases or decreases relative to the three properties of the domain as mentioned above (R, L, and Pr). This is of particular importance in resilience analysis, as it is essential to maintaining a system within a desirable state, or shifting from an undesirable one. The question now is not merely "is a given system resilient?", but "when and in what condition is a system resilient?"

In agrifood studies, the idea of change and resilience in multiple stable states is well illustrated by Molly Anderson's (2007) assertion of four possible agrifood stability domains. In her study, Anderson maps different types of agrifood systems, based on a two-dimensional matrix, with one axis indicating the scales of the food systems (from localized/fragmented to global system) and another axis showing its determining factors (from specifically economic to multifunctional signals). Agrifood systems, with regard to the four compartments formed by the matrix, could reside within: (1) a global conventional food order with vertically integrated supermarkets, (2) local agriculture with localized markets and independent grocers, (3) local alternative food relationships, and (4) a global alternative order that is exemplified by the global organic or fair trade network. Each compartment acts as a domain of attraction that contracts and expands based on the influence of other domains. For instance, the domain of attraction of a local food system is presently seen to be contracted and 'consumed' by the global conventional domain. Anderson's (2007) matrix is, of course, only a simplification of the existing food orders. Nevertheless, the conception is useful in illustrating the alternate stable states in which any local system might reside.

The idea of stability domain alone, I argue, is not adequate in addressing system resilience for at least two reasons. First, it suggests that resilience of a particular system is solely dependent on the dynamics of the larger state-space in which the system resides. In this view, the system is seen to only passively progress based on its position relative to the width and depth of the basin, instead of 'moving' across basins. Second, the concept also suggests a static condition where the basin changes only in response to the growth of other basins. Implied in this

argument is that the system, or the society within it, has very little capacity to modify (constrict or enlarge) the stability domain into a desirable state. Several scholars of resilience thinking (Holling, 1992; Gibson et al., 2000; Cumming & Collier, 2005) offer a way to overcome the limitations by proposing that, first, a system can actively shift its position within the state-space over time in accordance with the system's development and, second, a system can also alter the configuration of the state-space through cross-scale relationships. The subsequent sections discuss two notions within system resilience framework that are pertinent in our understanding of such propositions: adaptive cycle and panarchy, respectively.

2. 2. 3. Temporal Scale in Resilience: Adaptive Cycles

Inspired by theory of succession from plant ecology (Clements, 1916), the metaphor of the adaptive cycle (Gunderson, 2000; Holling and Gunderson, 2002) proposes that every system develops in a 'life cycle' along which the system grows, accumulates wealth, collapses, and reorganizes, enabling it to grow either in the same or a different configuration. Each phase is symbolized as r, K, Ω, and α respectively (see Figure 2.3).

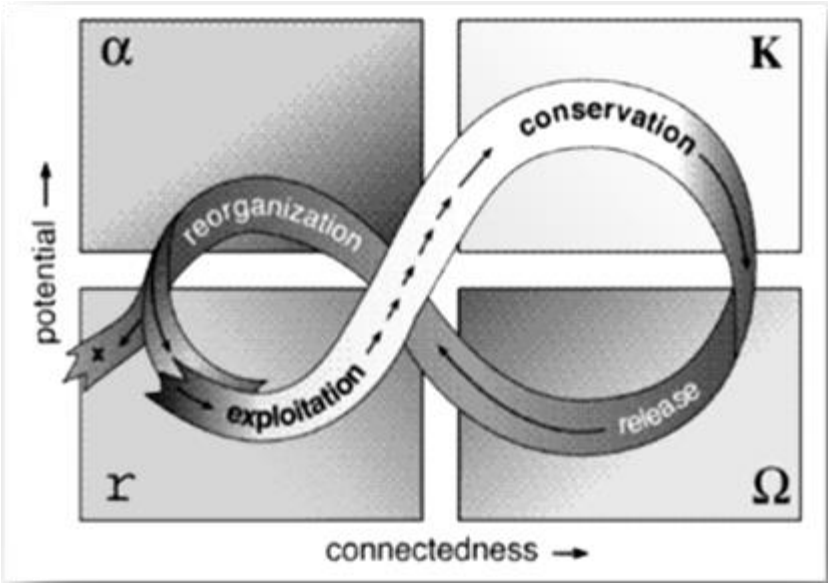

Figure 2.3. Adaptive renewal cycle. Phases in the cycle are symbolized with r (exploitation), K (conservation), Ω (release), and α (reorganization). The cycle reflects change in two properties, connectedness and potential (Source: Holling & Gunderson, 2002: 34)

A system exhibits different speeds of change in each development phase. Between the exploitation (r) and conservation (K) phases, the system grows relatively slowly in complexity and connectedness, while also accumulating resources. As the amount of resources increases, it enriches the potential available for change. While this occurs, the connectedness of the system also increases its rigidity, making it more vulnerable to disturbances. If there is sufficient disturbance during that period, the system will eventually collapse (Ω-phase), releasing a high level of potential in a very rapid sequence. The system will then enter a reorganization (α) phase during which it recollects resources in order to grow as essentially the same system once again. However, there is a possibility that a system reconfigures into a distinctly different system (be it less or more desirable from an observer's point of view) or even ceases to enter the exploitation phase (Walker et al., 2006; the 'x' sign in Figure 2.3).

A system development does not necessarily occur strictly according to these sequences (Cumming & Collier, 2005; Walker et al., 2006). Walker et al. (2006) propose three further trajectories that might transpire in specific circumstances. The first is a trajectory without any conservation phase (r-Ω-α), as happens in a system with little structure and high disturbance. Another trajectory comprises r, K, and α phases without a period of release. This is exemplified by an ecosystem that changes from grassland to forest due to high potential. The last possible trajectory is the inexistence of structure, where the reorganization phase does occur, but is directly followed by collapse due to lack of organization (as mentioned in the preceding paragraph). Nevertheless, the complete trajectory of four adaptive phases is the most common pattern (Holling & Gunderson, 2002), and allows for a greater understanding of the continuity of the system as well as its alternate stable states (Cumming & Collier, 2005).

Another interesting aspect of the adaptive cycle relevant to this thesis is its association with resilience. A system in its conservation phase experiences high rigidity due to its connectedness, thus making it highly vulnerable to disturbances. On the contrary, a system in the exploitation phase seems to be very resilient to shocks. The way in which resilience correlates to system development is shown in the third dimension of the Adaptive Cycle model (Figure 2.4). In this three-dimensional model, resilience is seen to reach its highest level during the exploitation and reorganization phases, and is lowest in the conservation and collapse phases. Although Holling and Gunderson (2002) hint that these former two phases

entail a high degree of resilience, they do not fully explain why this happens and what differences these two phases have in terms of their resilience.

In relation to this, Darnhofer et al. (2010) propose that there are two types of resilience, depending on the behaviour of the system in response to disturbances. A system can absorb these disturbances without any changes in its structure, or it can reconfigure its structure so as to adapt to the disturbances while still maintaining its function. Both are definitions of resilience, albeit manifested in different ways. The former can be seen as 'shock resilience', whereas the latter is 'transformative resilience'. Given their characteristics, I argue that the two types of resilience proposed by Darnhofer and her colleagues conform to the conception of resilience as depicted in the three-dimensional adaptive cycle (Figure 2.3). If 'shock resilience' is illustrated by a high degree of resilience in the growth phase (in which the system absorbs the shocks while continues to grow), the resilience in the reorganization phase illustrates 'transformative resilience'.

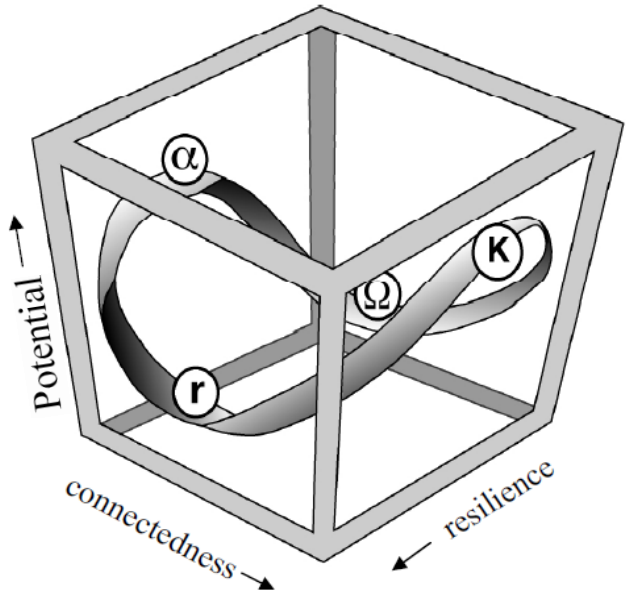

Figure 2.4. The Adaptive cycle as illustrated in three-dimensional heuristic model; the third dimension is Resilience, where it is high in r and α-phases, but low in K and Ω-phases (Source: Allison & Hobbs, 2004: 4)

This understanding is important because it allows us to assess in more detail the way in which resilience is manifested in a specific phase of the system development and to subsequently formulate a resilience management plan (Walker et al., 2002) for that particular phase.

Transformative resilience is a particular interest within the study of urban planning (Gotham & Campanella, 2010) and other discourses on crisis and transformation within social science, because this concept allows for an insight to possibilities of constructing a more tenable system that still provides the same function for the society (e.g. agricultural system, financial and economic systems, etc.). On the other hand, shock resilience helps us to identify the extent to which a system is able to grow without being too rigid and vulnerable to shocks, and the level of disturbances a system can absorb before it collapses.

Several studies have sought to identify these types of resilience through historical profiling of a particular system over a long period of time (Walker et al., 2002; Allison & Hobbs, 2004; Darnhofer et al., 2010). Each of these studies describes the long historical development of a system according to the adaptive cycle and identifies one to five full cycles throughout the time period under investigation, depending on the time span of the analysis. A particular insight to every phase in the trajectories effectively determines which periods during the system's history were highly resilient and which periods were not. However, so far, there has been no significant study that analyses resilience at the global level on the basis of this historical narrative. Holling's (2004) initial attempt to examine global capitalism has proven ineffective (Gotts, 2007) as it fails to recognise the global pattern and trajectories of capitalism. The difficulty in performing a historical profiling of global food systems is that it becomes contingent on the social-political framework used. Clearly, resilience analysis using the adaptive cycle model can benefit from an incorporation of a social theory that focuses specifically on the historical constructions of global orders (as Chapter 3 will elaborate further).

2. 2. 4. Spatial Scale in Resilience: Hierarchy and Panarchy

The preceding discussion has placed resilience theory within its temporal context, yet this discussion is still unable to completely describe system resilience. This is because, in a complex system, the dimension of spatial scale is also relevant. This aspect of scale has always been a major issue in geography as well as ecology (Meentemeyer, 1989; Holling, 1992). Of particular interest is the interaction between systems at different levels (Meyer et al., 1992; Holling et al., 2002b). Most of an ecosystem's components reside within a definite spatial and temporal scale (Holling, 1992), and therefore can be easily studied through a single scale approach. To study a population of insects, for example, one might use a time

scale of months within a spatial scale of a few meters. Studying a tree population, on the other hand, needs both a larger spatial (up to kilometres) and temporal scale (decades).

A problem, however, arises if one is to study interacting components within an ecosystem, components which operate at different scales. In such a case, a multi-level analysis in the form of a *hierarchy*, i.e. a causally or conceptually linked system along an analytical scale, is particularly useful to tackle the problem (Allen & Starr, 1982; O'Neill et al., 1989). This hierarchy might come in the form of an exclusive hierarchy, as exemplified by food chains in ecosystems or commodity chains in social systems; or a constitutive/nested hierarchy (Gibson et al., 2000) where a level is encapsulated by the larger level of analysis. The study of resilience mainly uses the latter type of hierarchy (see Figure 2.5).

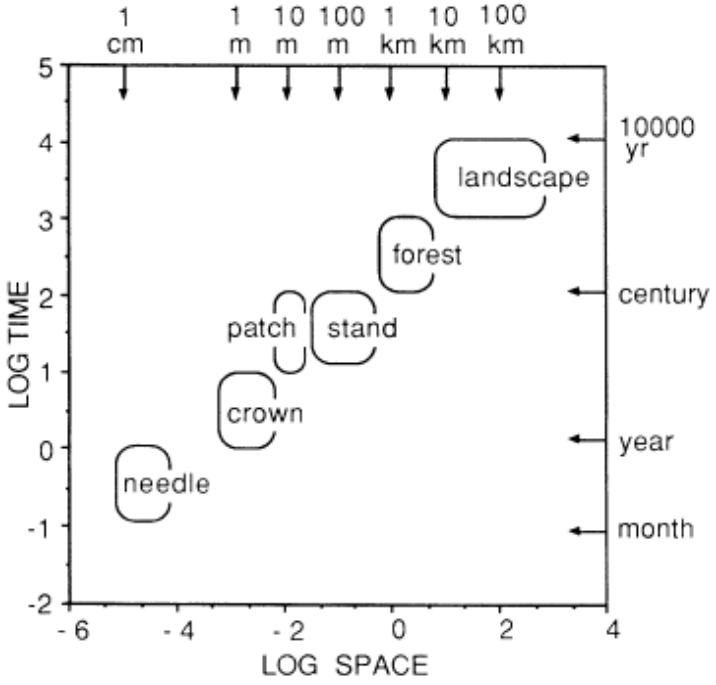

Figure 2.5. Example of nested hierarchy in an ecosystem, showing logarithmic time and space scales of boreal forest (Source: Holling, 1992: 452)

In relation to what hierarchy theory proposes, Holling et al. (2002b) suggest an approach according to which both upper as well as lower levels affect the focal system, and there is a reciprocal cause-and-effect relationship between the global and the local. Holling and others label such cross-scale dynamics *Panarchy*, a term derived from the Greek God 'Pan' depicting the creative and destructive nature of cross-scale self-organizations. They

distinguish this concept from the earlier concept of hierarchy which is known for its rigidity and top-down nature, so as to also emphasize the dynamism of systems in contrast with a hierarchy's static nature.

Panarchy differs from the traditional hierarchy concept in two distinctive ways (Holling et al., 2002b). The first way is the incorporation of the adaptive cycle into each level of system. In panarchy, every level constitutes its own adaptive cycle; each operates at different speeds and with shared key variables. Using the spruce forest as an example, the dynamic of a tree is characterized by tree growth, reproduction, and senescence. At a higher system level, spruce forest advances in a series of successive phases, from juvenile to mature old forest. This feature reveals that different levels might have different dynamics. Furthermore, each level connects with other levels to form cross-scale dynamics. This is the second feature of panarchy.

In the context of agrifood studies, whether it is local farming or a multinational agro-industry, an agrifood system tends to present cross-scale dynamics, most importantly from the interaction between an exclusive institutional hierarchy (production – distribution – consumption) and a nested spatial hierarchy (local – regional – global). Darnhofer et al. (2010) illustrate these dynamics in a broad sense by giving examples of major drivers in an agrifood system that operate at various spatial and temporal scales, from pest infestation, land use change, consumer preferences, to world food crises and global climatic change. Each driver has its own dynamic and operates at a different speed. Global financial crises or climate change, for example, evolves over a period of decades. In contrast, local fluctuations in rainfall or temperature occur over a short period (days to weeks). These various disturbances are the results of adaptive cycles at every level of the system, and the combination of these disturbances demonstrates panarchy in the agrifood system.

There are various possible connections between levels in panarchy, but Holling and his colleagues (2002b) emphasize two types. The connection between lower levels and the system of interest is typified by rapid and destructive changes. The lower system in its release (Ω) phase forces the upper system to enter the same phase, and thus acts as a sort of disturbance to systems above its own level. A forest fire in a local patch may cascade up to the larger region of forest, if the higher level is situated in a conservation phase with low resilience. This first type of connection is named 'Revolt' (Figure 2.5). In spite of this, a fire

may also be restricted to a local area if the region has a high resilience to fire (for instance, consists of patchy vegetation). Another connection comes from the effect of an upper system transmitted to the focal level in the form of 'remembrance'. This usually occurs when the focal system faces a period of reorganization, and the larger system supplies the focal system with a 'memory' with which to reorganize itself into the same configuration. This memory can appear as seed banks in an ecosystem, or as institutional memory and local knowledge in a social system (Berkes & Folke, 2002).

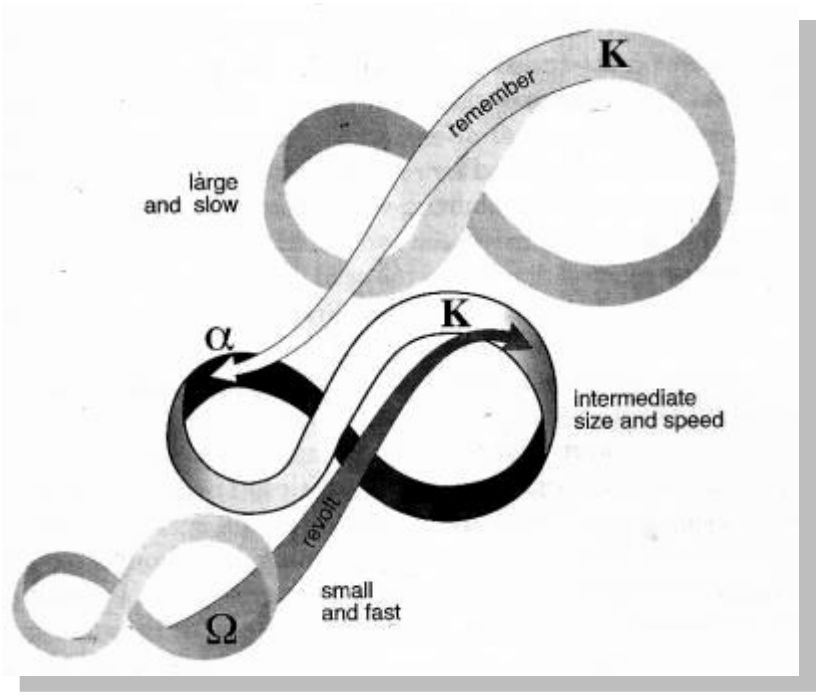

Figure 2.6. Cross-scale dynamics in Panarchy. The smaller level influences the system of interest through revolution, and the upper level through remembrance (Source: Holling et al., 2002b: 75)

In panarchy, cross-scale relationships can stretch so widely that they eventually connect global phenomena (such as globalization and environmental changes) to the smallest unit of analysis at an individual level. In their study of globalization, Armitage and Johnson (2006) found an interesting phenomenon concerning the way in which globalization changes the construct of local systems and, *vice versa*, the way individuals and local community resist or adapt to such changes. In their argument, the cross-scale relationships do not necessarily occur in the manner that Holling et al. (2002b) propose (as shown in Figure 2.5). Revolution, often correlated to the smaller and faster-developing level, can also move downward from global to local. Global dynamics are seen as fast and destructive, while the local system

(institutional value, local wisdom) develops slower. The relationships depicted in panarchy thus are not strictly defined and open to possibilities.

As originally applied to ecosystems, the concept of panarchy, I argue, is still relatively underdeveloped for addressing cross-scale relationships in a social system. Armitage and Johnson's (2006)study on globalization shows that relationships occurring between levels of the system cannot be reduced into merely 'bottom-up' revolution and 'top-down' institutional memory. From a social science perspective, the dynamics of globalization can be driven by a wide range of factors, including power relations, class structures, and ideology (Bottomore & Nisbet, 1978). This is particularly the case with the global agrifood system that, as argued by Friedman and McMichael (1989), influences transformations at the national and local levels (an argument I will elaborate in Chapter 3). The point is that panarchy, and other key concepts within system-oriented resilience thinking, does not fully address how social-ecological relationships take place in agrifood systems at the local level (especially when emphasis is put on the social). However, before I argue the need to further incorporate more social theory into the study of agrifood system's resilience, I will first highlight the extent to which the social aspect has been embedded into resilience thinking.

2. 3. Understanding the social in resilience thinking

2. 3. 1. Resilience and human-nature relationships

Within the resilience theoretical framework, resilience is often defined as the ability of a system to absorb changes while still maintaining its structure, function, and identity (Walker et al., 2004). The definition implies that resilience leans more towards sustaining a given system's attributes than to an adaptive response of the system's components. Although this is practically true to ecological systems (Holling, 1973; Gunderson, 2000), more scrutiny has been directed to the applicability of the framework in social systems (Davidson-Hunt & Berkes, 2003; Davidson, 2010), pushing scholars to explore deeper into the realm of the social sciences (e.g. Westley et al., 2002; Pelling & Manuel-Navarrete, 2011; Cote & Nightingale, 2011; Coulthard, 2012).

The integration of a social dimension to resilience thinking has been advanced through numerous efforts resulting in much debate in the literature with roots in the ongoing theorization of nature-society relationships. As summarised by Davidson-Hunt and Berkes

(2003), the early Cartesian paradigm of nature-society that saw humanity as the centre of attention was challenged by an environmentalist perspective that positioned humans within, and as part of, the ecosystem. This other end of the anthropocentric pole emerged from environmental determinism, a perspective that perceived culture to be the product of the environment. These two perspectives have always contradicted each other when it comes to addressing environmental-related problems. For instance, pre-1980s thinking continued to put more emphasis on the environment's influences on society (van der Leeuw & Aschan-Leygonie, 2000), partly because early capitalism saw nature and its repercussions on society as "something to be overcome" (Marsden et al., 1996: 367). Only after the impacts of global development began to take prominence in the 1980s did thinking about nature and society shift into a different perspective, giving greater emphasis to the influence of society. As van der Leeuw and Aschan-Leygonie (2000: 5) describe it, the paradigm shifted from 'culture is natural' to 'nature is cultural', in which much of the environmental dynamics observed were the result of human activities. The ongoing debates have opened a door for resilience thinking, whose theorists seek to resolve the nature-society dichotomy through an all-encompassing framework. Study of resilience in a coupled human-natural system was first initiated by Holling (1986) in showing how societies have taken part in disturbed and managed ecosystems. From that point on, many related studies have played a role in shaping the course of a new idea in resilience thinking, namely Social-Ecological Systems (SESs) (e.g. Carpenter et al., 1999; Walker & Abel, 2002; Olsson et al., 2004; Allison & Hobbs, 2004). The SES forms a single unit of analysis as it is seen to unveil new emergent properties which remained unobserved in studies of social or ecological systems alone (Westley et al., 2002).

The concept of SES, however, as this thesis argues, also comes with at least two limitations. The first relates to a rigid understanding of human-nature relationships. The social-ecological resilience framework is limited by the continued assumption of a barrier between social and ecological systems. This implies that any effort to integrate these two entities should first see both as separate subsystems, i.e. each subsystem influences the other in different ways (Westley et al., 2002; Kinzig, 2012). This view, of course, is still relevant to address cases of local natural resource management (Berkes & Folke, 2002) or ecologically vulnerable societies (Adger, 2000). But what if the complexity of the social system goes beyond its geographic attachment? As Berkes and Ross (2013) have noted, the problem of such an

assumption is that it constrains one to only see a particular situation where a community is attached to its geography, whereas in reality, "most communities are too diffuse, boundaries are much too porous, and many people make their livelihoods outside the immediate geographic area" (Berkes & Ross, 2013: 10).

Nonetheless, studies in environmental sociology have found that, in practice, the two can not necessarily be separated (FitzSimmons & Goodman, 1998). Particularly in agrifood studies, there is always a component of nature that is linked to society, even at the global scale, in various manifestations – crop, food, fibers, climate or environmental issues. Implied in this conceptualization is the interconnectedness of human and nature, both from human-in-nature (Davidson-Hunt & Berkes, 2003) as well as nature-in-society paradigms; i.e. humanity is attached to and constrained by nature, yet the conception of nature is also constructed within a society. There are interrelationships between individual, social and nature through the mutual co-creation between humans and their socio-ecological surroundings (Manuel-Navarrete & Buzinde, 2010). As an illustration, Soemarwoto (2007) observes that the centuries-long interaction between rice and local community has resulted in cultural resilience to external shocks, regardless of the way in which the idea of nature (in this case, rice) is separated from the physicality of rice itself, as a plant, and its attachment to the ecosystem. In short, I argue that there is a way to provide a complementary perspective to a social-ecological resilience framework by looking deeper into social theory that seeks to dissolve the society-nature divide, which is the objective of Chapter 3.

2. 3. 2. Resilience and structure-agency dichotomy

The second limitation of the concept of SES lies in its inability to fully address the active choices of humans, as individuals or a collective, within the bigger picture of a self-regulating system. Several scholars (e.g. Westley et al., 2002; Davidson, 2010; Cote & Nightingale, 2011) argue that there is something more in the social system that cannot be found in the natural system; in other words, that a structuralist perspective of self-organizing systems is not adequate to comprehend the complexity beneath the social. Social-ecological resilience as a system property is often criticized within the study of social wellbeing, lending to a sense that resilience is sometimes negative and, even worse, abusive. Bohle et al. (2009) illustrate this through their case study of the urban food system in a megacity of Dhaka, Bangladesh. While the food system appears to be resilient (and helps to legitimise government policies),

the resilience (and vulnerability) of the urban poor is often undermined. Similar cases are also found in Amundsen (2012) and Coulthard (2012). As an alternative, these authors propose that resilience ought to be seen as an active process of the society to survive and adapt to shocks. This challenges resilience thinkers to employ a different view of resilience as advocated in other disciplines, such as the study of social psychology (Walsh, 1998) and natural hazards research (Adger, 2000), and incorporate the notion of human agency as a new research agenda (Bohle et al., 2009; Coulthard, 2012; Berkes & Ross, 2013). These scholars frequently offer novel conceptions of resilience, which are to some extent contradictory to the ecosystem-oriented definition of the concept. From a social vulnerability research perspective, Neil Adger (2000) argues that a society has its own resilience, which he defines as "the ability of groups or communities to cope with external stress and disturbances as a result of social, political, and environmental changes" (Adger, 2000: 347). Similarly, from the social psychology discipline, resilience is defined as "… an active process of endurance, self-righting, and growth in response to crisis and challenge" (Walsh, 1998:4). Both definitions of resilience imply an active role of individuals to act beyond the given social structure.

The new wave resilience thinking thus adopts the view that humans have agency; they behave independently outside the entrapment of the social system, while also influencing how the system adapts to shocks (Folke et al., 2003; Berkes & Ross, 2013). Within resilience thinking, the predominant idea of agency refers to human intentionality and reflexivity (Westley et al., 2002; Berkes & Ross. 2013). As humans have the capacity to learn from and reflect on experiences and, to some extent, forecast the trajectories of future development, they are able to adapt to disturbances and, by doing so, increase the resilience of their livelihood. In other circumstances, for example, when the environment is untenable, humans can also transform their milieu into a construct which may sustain life.

Earlier studies on social resilience, particularly from cindynics and vulnerability study (e.g. Adger, 2000; Fraser et al., 2005), relate resilience to the capacity of communities to adapt and cope with disturbances, although they do not explicitly address this as a form of agency. In contrast, Bohle et al. (2009) and Coulthard (2012) clearly assign agency as an important aspect of resilience, with influences mainly from welfare studies (Lister, 2004). Here, agency is used "…to characterize individuals as autonomous, purposive and creative actors, capable of a degree of choice" (Lister, 2004: 125). Intentionality gives humans an active role in their

process of adapting to changes and being resilient, instead of being a passive recipient of shocks (Coulthard, 2012).

What seems to be lacking from the adoption of agency in resilience thinking is recognition that the structure-agency debate has always been a central issue in the sociological study. A classic structuralist approach, for instance, often undermines the notion of agency and puts the cause of social phenomena mainly on the social, political and economic institutions that encompass individuals and society. Recent development of sociological analysis shifts this debate into an integration of the two poles including, for example, through what Giddens (1984), in his theory of structuration, calls the duality of structure. In his argument, there is a reciprocal relationship between structure and agents, i.e. agents are constrained by, and at the same time reproduce, the structure to which they are bound. The structure itself is not a robust entity, but a fluid set of material (resources) and immaterial (rules) relationships. One notable attempt to link structure-agency duality with resilience thinking, and consequently power relations, can be found in Pelling and Manuel-Navarrete (2010), in which they address a rigidity trap in a social-ecological system in Mexico as a result of structure-agency dynamics.

A special issue of *Society and Natural Resources* journal included an intense debate around the extent to which the notion of agency has been, and can be, incorporated into resilience thinking (Davidson, 2010; Magis, 2011; Berkes & Ross, 2013; Davidson, 2013; Ross & Berkes, 2013). Ross and Berkes (2013) argue that agency needs to be brought to its broadest understanding that is not confined only to individual actions, but also, and referring to Bandura (2001), to a form of collective agency that emerges from "… interactive, co-ordinative and synergistic dynamics of their transactions" (Bandura, 2001: 26). Bandura (2001) further asserts that individual agency can be enhanced or constrained by others. Collective agency is thus an emergent group-property that comes from interrelationships between its members. From Giddens's theory of structuration, there seems to be a continuum of intentionality that stretches between individual and collective, although in the end, the humans are still assigned the sole source of agency. However, if collective agency can be manifest within the social, does the same hold true to human-nature relationships? In other words, can the relationality between humans and their nonhuman surroundings, which to some extent also limit and enhance human's decision making capacity, also produce a sense of heterogeneous collective agency?

The problem with the current view of agency is that it still fails to comprehensively address the factors that drive a society or a system to be adaptive and resilient. One of the questions that this thesis raises is whether the emphasis of agency should be put on a network of social relations rather than on intentionality. If the intentionality itself is undermined and seen only as a result of these complex relations, can (non-human) material also have agency? There are many instances where humans are trapped in a particular structure and unable to fully manifest their adaptive capacity because of their dependency on the very environment or natural resources they are exploiting (Adger, 2000; Neilson & Arifin, 2012; Rosin et al., 2012). Particularly in the context of agrifood studies, this question becomes relevant due to the centrality of agricultural crops within SESs – as a food, commodity and political tool. This thesis argues that the factors that contribute to system resilience are the product not only of humans, but also of the relationships between humans and nature (including crops) (Whatmore & Thorne, 1997; Busch & Juska, 1997; Goodman, 1999). It is apparent that resilience thinking does not accommodate this view of agency, a scientific gap that I seek to address in this thesis.

2. 4. Concluding remarks: limitations of resilience thinking

This chapter has given a critical review of two emerging perspectives within the evolution of resilience thinking over the past 40 years. I argue that using a single perspective will give limited insight to the resilience of the system in question. Indeed, several studies focus on a partial aspect of resilience when assessing a narrowly and strictly defined matter of concern – such as a coastal region, urban society or farming system. However, if we are to delve into a complex set of relationships within a multi-level, dynamic system, such as the case of an agrifood system, there is a critical need to employ a broader resilience framework that fits into that level of complexity.

Summarizing the key concepts within resilience thinking described in the previous sections, I argue that a resilience framework for assessing an agrifood system must consist of the following basic analytical components. First, it must examine a complete commodity chain (from producers to consumers) as a single unit of analysis (*System Identity*, section 2.2.1) that it is formed by links of processes across every functional group. Second, it needs to link the agrifood systems with a global set of relationships by which it is influenced, in order to assess the system's resilience in the face of global changes (*Domains of attraction*, section 2.2.2).

Third, it needs to address the historical development of both the local and the global systems to identify the characteristics of *adaptive cycles* (section 2.2.3) in each, but also to connect their patterns of development as a form of cross-scale dynamics (*Panarchy*, section 2.2.4). Lastly, it needs to explore the social-ecological relationships at the local level that are overlooked by a system perspective, particularly those that reveal the *agency* of actors in building resilience within the agrifood system (section 2.3). Such a framework would substantially expand the scope of analysis commonly found in literature on the resilience of agrifood systems.

Debra Davidson (2013) suggests that much remains to be done to fully incorporate the social into resilience thinking. I fully agree with her assertion, and find that this is particularly true for the understanding of agrifood system's resilience. The limitations of resilience thinking in attempting to assess complex agrifood systems are due to an as yet fully developed engagement with the social aspects of agriculture and food. The critiques that this chapter has continuously addressed reflect three important dualisms, which have also opened a discursive arena in sociology and human geography: global-local, nature-society and structure-agency. Although some of the key concepts within resilience thinking (in both perspectives identified in this chapter) address these dualisms to a certain degree, it is still unable to provide a satisfactory answer to the questions that follow. For example, how does the metaphor of a domain of attraction envisage and define a 'set of relationships' when it addresses the global food order? How does the adaptive cycle model historicize the development of agrifood systems in relation to the global capitalism? How do cross-scale dynamics in panarchy address globalization, power relations, class structure and ideology? What is the importance of food crops (and nature more generally) to the agency of humans in building resilience, if any?

By contrast, in the social studies of agriculture and food, one can find a plethora of studies that addresses the various qualities of the agrifood system (Niles & Roff, 2008), in which social dynamics, such as the global development of food regimes, commodity chain integration, and the agency–structure relationships, are readily apparent. Campbell (2009) has given a preliminary review on ways to integrate resilience thinking into the growing literature of the Sociology of Agriculture and Food (SAF), particularly by considering the long chains of commodities as embedded to localities, and through which mechanisms such as feedback loops, adaptations, and response to shocks take place. In its core discipline, resilience

thinking is bound to physical relationships between social and ecological systems in a specific geographical area. Through the incorporation of sociology, resilience thinking can be expanded to a wider coverage of commodity chains and, consequently, the global system. Thus, in the next chapter, I elaborate such notions through a deeper study of the sociology of agriculture and food.

CHAPTER 3 EMBRACING THE SOCIAL OF AGRICULTURE AND FOOD

3.1. Introduction

This chapter situates the agrifood system in the social context, using notable theories and approaches as ways to explicate the structures and processes within the system. It highlights significant discourses in agrifood study in the late twentieth and early twenty-first centuries. In this chapter, I seek to understand the sociological analysis of agrifood systems by reviewing key issues in the historical development of the sociology of agriculture and food (SAF)[2]. I start this chapter with a narrative of the theoretical development of the sociology of agriculture in the twentieth century noting, in particular, the emerging social dynamics that contributed to changes in the discipline over the past 80 years. Throughout this chapter, where appropriate, I comment on how thinking and theories in the SAF resonate with, complement or contradict studies within the resilience framework, particularly in regard to the three dualisms mentioned at the end of the preceding chapter (global-local, nature-society and structure-agency).

The second part of this chaper is primarily concerned with several major foci of research and approaches that have shaped the trajectories of SAF. Among those approaches, food regime theory (Friedmann & McMichael, 1989) and actor-network theory (Callon, 1986; Latour, 1987; Law, 1992) are those which emerge as relevant to the analysis in this thesis. Food regime theory examines the development of the global agrifood system, laying particular emphasis on the rise and decline of different food regimes through the course of history. Actor-network theory, in comparison, enables a more detailed analysis of the system by exploring the interactions between its human and non-human entities. In a nutshell, these approaches demonstrate gradual changes in the analytical focus from the macro- to micro-scale. Each approach has its place in accentuating different facets of agrifood systems, and I will conclude with some of the advantages and limitations of the two approaches and the

[2] [2] The term 'Sociology of Agriculture and Food' (SAF) was popularized by, among others, Bonanno & Constance (2008) and Bonanno (2009). It is also the name of the 40th Research Committee (RC-40) under the auspice of the International Sociological Association (ISA). The acronym SAF will be used from this point to refer to this field of study.

potential to bridge the two approaches in order to fit into the narrative of the complexity of agrifood relations, as necessitated within resilience thinking.

3.2. Genealogy of sociology of agriculture and food

Historical overviews of SAF have been presented by many scholars (for example, Buttel, 2001; Constance, 2008; Bonanno, 2009); each scholar places emphasis on particular concerns that reveal different facets of SAF. Frederick Buttel (2001) focuses his review on the way in which the articulation of social studies shifted from the so-called 'new rural sociology' of the 1970s to the late twentieth century sociology, and highlights the incorporation of new theoretical and methodological approaches such as world system, regulation studies, actor-network, and commodity system analyses. Douglas Constance (2008) enquires into the shifting overarching questions on agrifood studies, from questions concerning the 'agrarian' and the 'emancipatory' to those concerning 'environment' and 'food'. These shifts are the result of the dynamics of the agrifood system that transcend the boundaries of rural and farm; while the agrarian question relates mostly to issues at the farm level, questions of food and environment stretch to include consumers' concerns over agricultural activities at a distance. In the end, Buttel argues that the food system, as it started from rural societies, has to be returned to its localities by creating alternative spaces in which consumers and producers are embedded (see also Morgan et al., 2008). In the conclusion of his review, Alessandro Bonanno (2009) stresses the importance of scholars' participation in building a sustainable food system. The common issue that these scholars raise is the need to understand the relative ease or difficulty of transforming the conventional and arguably unjust agrifood system in the context of globalization into a more just alternative system.

With respect to comprehensiveness, Frederick Buttel's (et al., 1990; 2001) examinations of the genealogy of the sociology of agriculture are highly regarded in the field. In his attempt to distinguish SAF from the whole body of rural sociology, Buttel starts his overview by describing the nature of rural sociology in the early 1990s. The first studies in rural sociology were concerned mostly with the sociology of rural communities. These studies can be divided into two eras. The earlier era, from 1900–1950s, was focused on initial attempts to understand different types of agricultural systems and to identify the structure of agriculture. In the later era (1950s–1970s), researchers shifted their focus to behaviourism and the social

psychology of agricultural activities, mainly in relation to the diffusion of innovation, technological change, and the value orientations of farmers, as well as educational and occupational aspirations and achievements among 'farm-reared' people. This, in turn, was a response to the early adoption of agricultural modernization in the event of the green revolution.

Recent studies of agrifood system's resilience are mostly related to issues discussed in the first wave rural sociology. For instances, Atwell et al. (2009), in their study of the U.S corn belt, seek to integrate resilience thinking with diffusion of innovation theory (Rodgers, 2003). In their article, Atwell et al. reveal factors influencing the effectiveness of the diffusion of innovation in a cross-scale relationship between social and ecological systems. Several other resilience studies also emphasize social capital and adaptation at the rural and farm level (Keil et al., 2008; Sallu et al., 2010), as well as exploring various types of agricultural system that enhance and nurture social–ecological resilience (Milestad & Hadatsch, 2003; King, 2008). These studies of resilience maintain a focus on the basic understanding of rural sociology that, although still relevant, is no longer of major importance in the study of the sociology of agriculture. This is partly because SAF, even in the mid-1970s, has gone beyond, and could no longer be confined to, the boundaries of rural regions (Bonanno, 2009). As noted by Bonanno (2009: 31),

> "... by the 1970s, most food items could not be identified with the commodities produced within the 'farm gate'. Even 'fresh' products were now parts of complex commodity chains transcending the farm".

Long after the green revolution, the study of rural sociology began to expand toward the equity impact of agricultural capitalism. As social movements concerned with the repercussions of the green revolution garnered greater attention in the early 1970s, a new wave of rural sociology study was born as a result of theoretical thinking previously absent in rural sociology; this came from the fields of the sociology of development, peasant studies, the re-emergence of classical political economy, and, most importantly, neo-Marxism (Buttel, 2001). This second wave of rural sociology was also known as the 'new rural sociology' or 'new sociology of agriculture' (Buttel, 2001). The important text for this shift was Kautsky's *Die Agrarfrage*, or 'the agrarian question', which relates to the political economy of agriculture (Constance, 2008; Niles & Roff, 2008). In parallel, research was also undertaken

into issues surrounding industrial agriculture, agricultural wage labour force, petty commodity production, and the differentiation of social classes (Buttel et al., 1990).

The new rural sociology was characterized by discourses on structure–agency relationships within the agriculture and food complex. On one side, the structural analysis of agriculture was a major issue, given the strong influence of the neo-Marxist perspective at that time (Hopkins & Wallerstein, 1982; Lawrence, 1987). During this period, the focus of agricultural activities shifted from the rural to national level as a result of existing political developments (protectionism, post-World War II commodity programs, etc.). As described by Buttel (2001: 170), "the new rural sociology approached agriculture largely by the assumption that the nation-state was the self-evident unit of analysis". In contrast, several scholars under the constructionist perspective (Newby, 1980; Long & van der Ploeg, 1989) argue that actors or agents, whether they be individual or collective, play an important role in shaping the agricultural structures, and that "contemporary farming cannot be correctly understood without considering culture and social agency" (Bonanno, 2009: 35). Up to a certain point, the structure-agency debate resonates well with the ongoing discourse within resilience thinking on system and agent-based approaches (Bohle et al., 2009; Berkes & Ross, 2013; see Section 2.3.2). From the perspective of the new rural sociology, resilience might be translated as the agency of humans to restructure the existing food system.

Another interesting point in the development of SAF, in relation to resilience thinking, is the attempt to bring 'nature' back into its study. Rachel Carson's *Silent Spring* (1962) was pivotal to agrifood discourses, and in the following decades environmental issues were increasingly considered an important issue by scholars as well as by societies in general. The sociological issue shifted from an agrarian to an 'environment question' (Buttel, 1996; Constance, 2008). Agricultural research and practice were oriented towards more environmental-friendly farming, and the term 'sustainable agriculture' was introduced. In the subsequent years, consumers' awareness of healthy food was also taken into account (Buttel, 1986; Marsden et al., 1996), and thus expanded the scope of study to encapsulate the whole definition of a food system, i.e. 'from land to mouth' (Kneen, 1995). Yet, one question was left unanswered: how and to what extent should one incorporate nature in the study of sociology (Marsden et al., 1996; Marsden, 2000)? In the early development of capitalism, nature was, although not entirely ignored, seen only as a hindrance that need to be

surmounted (Marsden et al., 1996). In the more recent debates, the urge to see 'nature' as a central issue was becoming more important. Several approaches such as actor-network theory (Latour, 1987; FitzSimmons & Goodman, 1998) and commodity system analysis (Friedland, 1984; 2001) gained in significance, while the functionalist perspective within Marxism that placed humans at the center of attention was almost entirely left behind (Buttel, 2001). This is not to say that neo-Marxist scholars have not addressed such problems. As summarized by Castree (2002), there are numerous scholars who see nature as an important feature of capitalism (among others, see John Bellamy Foster's (2000) review of Marx's 'metabolic rift). However, the way they position nature as "stocks and flows of potential use values" or "conditions of production" is being criticized by non-functionalist thinkers (FitzSimmons & Goodman, 1998: 201). We can find a parallel of this ongoing debate to that emerges in the development of resilience theory – that is, the question of how to incorporate 'social' into ecological system (see Section 2.3.1).

The study of SAF encountered another shift in the mid-1980s as it came across new challenges, such as the elongation of the commodity chain, agro-industrialization, and globalization. In response to these transformations, SAF scholars attempted to encompass a wider standpoint, giving rise to the new wave of sociology of agriculture and bringing with them the label 'political economy and sociology of global agrifood systems' (Buttel, 2001: 171). The influence of globalization is the final aspect of Buttel's historical overview. He finishes by summarizing four major foci which emerged at the end of the twentieth century and remained relevant to the study of SAF in the early twenty-first century.

1. World historical and world systemic analyses of the agrifood system, as influenced by Hopkins and Wallerstein's (1982) world system theory and Aglietta's (1979) regulation theory, emerged through the seminal work of Friedmann & McMichael's (1989) food regime theory. The focus of this approach is to understand the economic forces that regulate a system of global production and trade, as well as the rise and decline of global food regimes during capitalist development.
2. Agrifood commodity system analysis uses the commodity chain as single unit of analysis that, as controlled by Trans-National Corporations (TNCs), transcends the boundary of the nation-state (Friedland, 1984; Bonanno et al., 1994; Hendrickson & Heffernan, 2002).

3. Agrifood political-sociological studies focus mostly on the global restructuring of agrifood systems (Bonanno & Constance, 1996; Marsden, 2000). It puts emphasis mainly on the dynamics between structure and agency in the global agrifood system, as well as issues related to the re-localization of food system (Marsden et al., 1996; Kuhnlein & Receveur, 1996; Feenstra, 1997).
4. Actor network analysis of agrifood systems is a way to bridge the divide between the global and the local (Whatmore & Thorne, 1997; Busch & Juska, 1997; Murdoch, 1997, 1998). Through actor-network theory (Latour, 1987; Law, 1992), the agriculture and food complex is seen as a network of heterogeneous materials (human and non-human) that generates modes of social ordering, comparable to the social structure according to the structuralist perspective.

Studies originating in each focus might, and often do, intersect with other foci, demonstrating the intertwined issues within the study of SAF (Buttel, 2001). For instances, McMichael (1994) and Bonanno et al. (1994) explore the food regimes theory to explicate how TNCs restructured the global food system. Friedland (1994), on the other hand, addresses the issue of global restructuring using a different approach, the commodity system analysis. Furthermore, Hopkins and Wallerstein (1986) also use the commodity system approach to understand the dynamics of world systems. In a different manner, Busch and Juska (1997) incorporate actor-network theory with the commodity chain approach to describe the globalization of rapeseed. As can be seen, all of these approaches seek to unravel the same issue that was most significant to the agrifood studies of the late 1990s, the global restructuring of the agrifood system.

The study of SAF in the new millennium is showing a continuation of late twentieth century study. As predicted by Buttel (2001: 177), "there will be greater continuity in agrarian studies from the 1990s to the 2000s than there was from the 1980s to the 1990s". Previous issues studied in the new rural sociology are now re-emerging in a different context. These issues are, among others, the global–local interplay (Marsden & Murdoch, 2006; Sonnino & Marsden, 2006), the emergence of alternative food systems (Jaffee et al, 2004) as well as their 'conventionalization' (Campbell & Liepins, 2001; Raynolds, 2004; Niles & Roff, 2008), re-embedding 'nature' into agrifood study (Friedmann, 2005; Campbell, 2009), and on-going

social resistances against the dominant food systems (Patel, 2007; Wright & Middendorf, 2008).

To summarize, I find at least three main issues in the development of SAF that are relevant to the study of systems' resilience. The first issue is the structure–agency relationship that also resonates with the debates around system and agency in resilience thinking. The second issue is the incorporation of 'nature' in the study of SAF, which can be seen to parallel the incorporation of 'society' in Social–Ecological Systems (SESs). The third issue is the global development and re-localization of agrifood systems that represents cross-scale dynamics depicted in the notions of adaptive cycle and Panarchy of resilience theory. In the next part of this chapter, I will elaborate two major theories and approaches used by scholars of SAF (namely food regime theory and actor-network theory) to situate these issues.

3.3. Food regime theory

The seminal work of Friedmann and McMichael (1989) gave rise to a new perspective of 'food regime', which stretched the scope of SAF to situate the food system in the historical political context. This theory is mostly influenced by Hopkins and Wallerstein's (1982) world system theory and Aglietta (1979) and Lipietz's (1986) regulation theory. The study mainly stresses the periodic rise and decline of agrifood systems, during which the growth and (in)stabilities resulted from the dynamics of global food regimes. A food regime is understood as a set of relationships of "rule-governed structure of production and consumption of food on a world scale" (Friedmann, 1993: 30-31). Although at first food regime theory focused on the stability of a system's growth, in subsequent studies, Friedmann (2005) and McMichael (2009) pay more attention to the transition period between regimes during which the system undergoes several momentous crises.

Harriet Friedmann and Philip McMichael introduced the concept of the food regime in order to historicize world food production and trade within the context of global capitalism. Food regime theory explains the history and development of modern agriculture in the world based on their relations to capital accumulation and the centre of regulation (Lipietz, 1986). It sees patterns of development in individual modern agrifood systems as they conform to the trajectories and properties of the global food order. This theory circulates around the existence of a centre of capital accumulation and the way this centre changes along the course

of history through periods of crises and transitions. Friedmann and McMichael thus identify three food regimes that have reigned in the history of modern civilization; the last regime is arguably within its early stage of development (McMichael, 2009).

The relationship between countries with regard to the centre of accumulation prepares the stage for the concept of the global division of labour, addressing countries that act as cores and peripheries (Hopkins & Wallerstein, 1982). Peripheral countries supply the cores with agricultural commodities, while core countries, aside from providing manufactured goods, also strengthen the peripheries with financial support. This in turn introduces another significant feature of the food regime theory– the emergence of a financial regime that influences the way the food regime operates. The relationship between the cores and the peripheries then enmeshes circuits of food and capital mobilization. As the centre shifts from one regime to another and the circuits are connected and reconnected, the food regime experiences periods of global restructuring, in which core–periphery relationships evolve over time (McMichael, 1994).

Food regime theory has several advantages in addressing agriculture and food relations. First, as a theory of a global order, it has become a relevant framework to analyse the interrelationships between national and local level agrifood systems and the world-scale regulation and capital accumulation processes. In particular, it does a good job in explaining how the global dynamics influence countries' agricultural and food policies (Le Heron, 1993). Second, it retains agriculture and food as central to its theorisation. By focusing on this sector, food regime theory helps to delineate the social boundaries of a global food system, for the purpose of other types of global-level analyses. Third, the theory puts the current global challenges in the historical context of capitalism since its infancy. It does explain clearly why the global food system appears as it is today. Due to this, it has also become a significant framework for a wider discourse on capitalism and globalization. Lastly, and in relation to the third point, food regime theory focuses on periods of crises and transitions rather than a linear historical narrative and projection of global food orders. The focus helps to give a better grasp on some of the factors that drove particular regimes to a collapse and rise (and reflect on some that might work for the current regime).

Friedmann and McMichael (1989) state that throughout the history of modern Europe and the U.S (and the world in general), agrifood systems have passed several periods of restructuring.

The first food regime was settled during the period of colonization (1870–1914), where the regime of accumulation centered in Britain and other European countries, with commodities such as tropical produce, grain and livestock from colonies being massively imported to Europe. This period is also known as the 'settler-colonial food regime'. During the second food regime (1950s–1970s), the center of accumulation shifted to the U.S where its expanding economies (particularly through the Food Aid and 'development project') increased the dependencies of the U.S informal colonies (McMichael, 2009). Although the U.S's hegemony grew enormously during this period, the nation-states were the main driving forces of the food system. The first green revolution within the newly developed Third World countries was one of the major events that situated this period as the 'mercantile-industrialist food regime'.

Despite its usefulness, food regime theory also comes with limitations, which happen to correspond to the advantages mentioned earlier. Firstly, in terms of historical narrative, food regime theory, although clearly identifying the rise and fall of global regimes in retrospective, fails to provide a clear projection of how a future (or even the current regime) would or should look like. McMichael (1992) and Friedmann (1993) each predicted that the global food relations in the 21st century were developing into a corporate- and environment-food regime, respectively, as marked by the rise of TNCs on the one hand and ecological awareness on the other. However, after more than a decade, this regime has yet to take its stable state. Friedmann (2005) observes a middle ground between corporate dominance and ecological awareness over what she calls the corporate-environment food regime – a move toward more sustainable practice at the trans*national* level. Meanwhile, McMichael (2009) still considers the TNCs to be a dominating structure that now encompasses even larger issues beyond food (such as biofuel), while also acknowledging an emerging global resistance through movements such as *La Via Campesina*. Thus, the question remains as to whether these different structures are still at their infancy, which then explains an ongoing fight over the throne of the third food regime, or whether each has become well-advanced in its structure and relationships, thus demonstrating that there can be multiple centres co-existing at the same period in time.

In a special issue of *Agriculture and Human Values* journal in 2009, several scholars provided insights to what the structure of the third food regime (if any) might be. Among

others, Hugh Campbell (2009), in his attempt to push for 'an ecological turn' within the body of knowledge, argues that the global food structure displays a feedback mechanism that translates environmental repercussion and societal concerns into shocks that reshape the configuration of the food regimes as a whole. As such, environment is not merely a by-product of the food regime, but also, and most importantly, a pillar that structures the configuration of agricultural activities within the global food regime. He proposes a food-from-somewhere regime (in reply to McMichael's food from nowhere regime) as a characteristic of the current regime. He does mention, however, that its existence lacks a strong hegemonic power compared to the previous two regimes.

Secondly, as a global framework, food regime theory is claimed to have a narrow structuralist determinism that overlooks local contingency and agency. Criticism of food regime theory is directed to the fate of local and national level food systems within the global food regimes (Moran et al., 1996). The question is whether any particular food system in the world would truly be encapsulated by the global food regimes or, as an antithesis, whether the food regimes merely represent the existing dominant food circuits along which idiosyncratic food systems might simply co-exist. Proponents of food regime theory stand for the former. Richard Le Heron (1993: 76), for instance, stresses the need to understand any development of national level food systems within the global context, stating that most agricultural systems in a particular nation-state will be at least partly influenced by the prevailing food regime.

Yet, critics (Moran et al., 1996; Atkins & Bowler, 2001) question the ontological consequences of such an argument: do the local food systems still have the flexibility and sovereignty to determine their own fate (hence act as an agent) within the strong influence of the global structure, or are they only pawns of the global politics? In either case, to what extent does the global food regime have control over local food systems? Opponents of the theory express their concern that "... there is no place in the food regimes theory for endogenous development as an organizing vehicle for capital in food sectors at the national, regional, local or farm levels" (Pritchard, cited in Atkins & Bowler, 2001: 33).

In summary, the criticisms challenge food regimes theorists on the basis of the three dualisms. First of all, food regime theory fails to translate local dynamics into the global level. This has been underlined, for instance, by Busch and Juska (1997) in seeing the irrelevancy of local activities in the face of globalization. Secondly, in a similar sense, as it is

based on a structuralist view of societies, food regime theory has been confronted with the need to explain how actors perform agency to resist and transform the structure from within (Wright & Middendorf, 2008; although Friedmann, 2005 and Campbell, 2009 have a say on this as they talk about the 'food from somewhere' regime). Thirdly, food regime scholars are also left with a question of how, in a practical sense, to incorporate nature in the global structure of an agrifood system. For a theory about food and agriculture, it focuses too much on the economic system that underlies the agrifood-related activities, rather than the materiality of the food (and nature) itself that shapes the relationships. Without a proper understanding of such issues, food regime theory cannot be used to satisfactorily address the complex challenges faced by agrifood systems – not only in the form of political economic manouvres, but also in a combination of social, ecological, economic and political crises (Rosin et al., 2012), similar to the idea of multiple shocks in resilience thinking.

3.4. Actor network theory

Another theory that forms the basis of analysis of food globalization is actor-network theory (ANT) (Latour, 1987, 2005; Law, 1992), which emphasizes the roles of actors (human as well as non-human) within social systems. The basic idea of this theory is that any entity that exists within the society is meaningful not merely because of its existence, but also, and most importantly, because of its relationship to others. A human is established as a consumer, for instance, by his/her connection to retailers and farmers, to foods he/she eats, and even to the technologies he/she uses to process his/her food. Without the other actors, the meaning of the human as consumer dissolves. This is also true of non-human actors such as nature, commodity, technology, or even ideas and knowledge. In ANT, an actor is thus defined as "an effect generated by a network of heterogeneous, interacting, materials" (Law, 1992: 383). In certain circumstances, an actor can be seen as a single entity, as in the case of a healthy human body or a functional machine. In other circumstances, such as during sickness or when the machine is broken, this actor might represent a bundle of networks, and one should take note of the bits and pieces in order to be able to analyse it.

In an ANT perspective on society, human and non-human actors develop a social ordering similar to the structure found in other social theories. These modes of social ordering are not constant but changing in time and space. ANT, in this sense, is a study of social

transformations through a heterogeneous network. A network exists only to the extent that the actors are willing to hold themselves together and relate with each other, hence the network being precarious and constantly negotiated. Michael Callon (1986), in his social study of scientific research on scallops, describes the way in which a network is being formed by various actors (scientists, fishermen, scallops, etc.) through a series of negotiations. Throughout this process, however, a process of betrayal [3] from one or more actors (exemplified by larvae of the scallops and impatient fishermen) could also dissociate the existing network. In discussing about betrayal, John Law (2009:145) asserts that an actor-network "is a web of relations that makes and remakes its components", and "all it takes is for one translation to fail and the whole web of reality unravels."

Actors form different networks all the time, and by so doing position themselves in different and changing roles. Depending on various ways and practices through which an actor engages with others, there can be multiple meanings within the material-semiotic realities. This leads Annemarie Mol (2002) to address a research object (in her case, a disease) as being single, but also multiple – of a chronic multiplicity. In her account, multiplicity is never a matter of different perspectives. Multiple realities are produced by particular practices or actor-networks that relate to each other.

Thus far, multiplicity as a concept is somewhat under-studied (cf. Kjellberg & Helgesson, 2006; Elliott, 2009; van der Duim et al., 2013), let alone within a specific topic such as agriculture and food. However, the extent to which discourses within agrifood studies have come close to the idea of multiple meanings of food is worth noting. Philip McMichael (2000), for instance, describes contemporary ways in which food products have become perceived beyond what it was normal in the past, as biofuel, feedstuff, security, or even a political instrument. ANT approach has the potential to further this discussion by addressing the implications of the multiplicity of food on the resilience and transformation of agrifood systems.

However, what is unique about ANT analysis of food, or any non-human actor in this matter, is the idea that the non-humans have an equal role as humans in shaping the trajectories of a system. In order to make sense of this argument, Michel Callon (1986) proposes three

[3] The notion of betrayal will be frequently used in the discussion of the case studies in Chapter 6 and 7.

principles from which ANT is drawn: *agnosticism*, *generalised symmetry* and *free association*. The first principle, agnosticism, relates to how the researcher needs to avoid any sentiment and value towards or against one actor. The second principle is generalised symmetry – to address all actors, both humans and non-humans, in an equal and unbiased analysis. The third principle relates to the way ANT sees relationality. With free association, the researcher needs to put actors plainly on the landscape, thus eliminating any assumption about patterns, relationships and scales. Using these three principles, Callon (1986) is able to describe how scientific research and innovation do not always progress as planned, as other actors that are often not taken into account (particularly non-humans) play a role in the innovation process. I will discuss the latter two principles as they are strongly linked to the two prominent tensions that actor-network theorists have been trying to resolve: structure-agency and global-local dichotomies.

The principle of generalized symmetry (and to some extent agnosticism) opens a new understanding of agency that is different from the one commonly used in other social theory (See Section 2.3.2). This form of agency takes into account the relational effect between human and the material objects surrounding it. Latour (2005: 71) argues that an agent is "*any thing* that does modify a state of affairs by making a difference" (emphasis in original). In a post-human perspective of the social, this means that non-humans can also have agency; they are not seen as passive resources at the disposal of humans, but active, vibrant agents that also exert power.

For many scholars, the argument of material agency is seen to be too extreme. Friedland (2008: 46), for instance, rejects the idea of nature's (or nonhuman) agency as he claims that "there is a difference between nature being an actor in human affairs ... but this hardly gives agency to nature." In his view, "agency is a human attribute, the product of reflexive consciousness and having some counterhegemonic content". Of course, relational agency does not imply that there is intentionality within these material objects. Instead, ANT asserts that agency is no longer seen to come solely from intentionality, but from the way in which intentionality is shaped (allowed, encouraged, blocked, rendered possible) by an extension of causal relations between the humans and non-humans. Jane Bennett (2007: 134) argues that this form of agency needs to be seen as "… a force distributed across multiple, overlapping

bodies, disseminated in degrees—rather than the capacity of a unitary subject of consciousness."

The implications of this shift in the understanding of agency from human intentionality to heterogeneous association have been addressed by several authors. For instances, Bennett (2007) illustrates how foodstuff such as dietary fat, vegetables and alcohol act as quasi-agents that affect not only human body (which is often taken for granted as a form of agency), but also moods and cognitive processes. Even more so, they also take part in the emergence of civic movements like Slow Food. Law (1986) conducts a historical analysis of the extension of Portugal's power over 150 years of naval exploration in which he assigns equal importance to the agency of ships, spices and documents as to that of humans. These materials attracted, elongated, mobilized and rendered durable to an exercise of power from the Portuguese to others. They too, are agents without which the agency of humans is meaningless.

The latter example from John Law (1986) also shows that ANT seeks to address not only the structure-agency dualism, but also, to a lesser degree, the global-local tensions. The third principle, *free association*, eliminates the idea of scale and multi-level system. Law's (1986) study on Portugal's 'power at a distance' implies that all actors within global relations are visible; thus, there is no reason to assign power to an abstract concept of capitalism or globalization. Because of this simplicity of seeing global-local relationships, ANT has been widely used, particularly in the study of the agrifood system, as a means to bridge the gap between macro- and micro-level analyses (Busch & Juska, 1997; Tan, 2000).

Through ANT, local actors are seen to vigorously negotiate for positions within a wider network. In the case of coffee in Vietnam for instance, Tan (2000) shows how the peasant farmers self-enrol themselves to the coffee network so as to gain significance in the global commodity market. Using ANT, Tan acknowledges how the local peripheral level can become relevant to the bigger picture of global coffee commodity chains. In a different case, Busch and Juska (1997) explore the interaction between humans (farmers) and non-humans (plants) in the Canadian rapeseed subsector. The result of networks formed between local scientists, technologies, rapeseed, its chemical compounds, and even mice (!) that span time and space, is the global commodity system of canola oil, one of the most important commodities in modern consumption.

Busch and Juska (1997) demonstrate that the level of network can expand to the global level, as 'action at a distance'. The spatial and temporal scales that an ANT-based analysis delves into thus depend on the stretch of the networks, their *durability* through time, and their *mobility* across space (Law, 1992). However, critiques of ANT from agrifood scholars also focus on the global-local dichotomy that ANT tries to dissolve. Analyzing Busch and Juska's (1997) global rapeseed study, Friedland (2001:91) criticizes ANT as being more appropriate for micro- rather than macro-level analysis, regarding the macro-level as 'more amorphous'. The challenge for ANT in bridging the global and the local is such that by the time ANT seeks to encompass the long commodity chain and wide spectrum of actors, the analysis becomes vague, or at the very least renders one part irrelevant. In regard to this, Marsden (2000) stresses that in an analysis of agrifood systems, weight should be placed more on humans and institutions than on nature, particularly in a condition where the global market discards nature and local actors as being irrelevant.

To summarize, although arguments brought by actor-network theorists are appealing, ANT approach is often still seen as lacking the practical and theoretical value in addressing current issues in agrifood studies. Both Marsden (2000) and Friedland (2001) consider ANT more as a methodology rather than theory, as its agnosticism does not contribute to a meaningful understanding of the food system – highlighting how ANT prefers to 'describe' rather than 'explain' (Latour, 2005). However, I see such characteristics of ANT not as a limitation, but as an opportunity to enrich theoretical discussions. Through its revolutionary way of thinking, ANT offers a fresh look at social (and ecological) phenomena that have been intensely discussed for decades within agrifood studies. It reveals some of the things that are often overlooked, but in fact play a crucial role in shaping agrifood systems; e.g. food, crops, pests or diseases. Nevertheless, I also argue that ANT will have less theoretical value if it stands alone as an analytical tool. In the subsequent chapters, I will propose the need to incorporate ANT with different approaches in helping to address the central point of analysis in this thesis: resilience.

3.5. Concluding remark: towards a dialogue between theories

In this chapter, I have discussed the evolution of the sociology of agriculture and food. In regard to issues like the elongation of value chains due to globalization, social resistance

against neoliberalism, and environmental degradation, I highlighted the three underpinning dualisms that have invited serious debates within the literature: global-local, nature-society and structure-agency. I have also critically reviewed two main social theories in detail and showed that, although both theories are useful in investigating a commodity-based agrifood system, each puts a different emphasis in its exploration. Food regime theory tends to take a broader view of a system, so broad that it employs a global scale analysis. By contrast, actor-network theory sees a system (or network) in more detail, even to the tiniest of bacteria, to an extent that these tiny entities can be assigned agency. Each theory has its way of addressing the three tensions mentioned above, which serve as both an advantage as well as a limitation to the understanding of agrifood systems.

What is often overlooked from the two approaches is a vast potential for a discursive dialogue between the two to compensate for the limitations of each. There has tended to be more tensions and contestation between proponents of each theory than attempts to merge them. This thesis thus offers to take this initial step for a theoretical conjunction. For one thing, the myopic view of agrifood systems employed in the food regime theory can be compensated by ANT's assertion of 'action at a distance' (Law, 1986), offering a more detailed articulation of global-local interactions. Likewise, ANT could benefit from food regime theory by rendering the 'amorphous' macro-level analysis (Friedland, 2001) more apparent. In terms of nature-society relationships, an 'ecological turn' in food regime theory as proposed by Campbell (2009) necessitates an acknowledgement of the materiality of food and nature – thus opening another point to which ANT can link. The potential for such a linkage has been shown in a wider discourse of political economy (particularly those of neo-Marxism) through the works of Noel Castree (2002) and Bruce Braun (2005). Through the relationality between humans and non-humans, and the agency that emerges, ANT might offer an alternate explanation for the ongoing crises and transitions that occurred in each regime.

One significant hindrance to this theoretical dialogue is the fact that each theory emphasises different matters of concerns. While food regime theory underpins patterns of rise and decline (and hegemonic power) of global capitalism or neoliberalism, ANT (particularly the post-1998 discourse, see Law & Hassard, 1998; Latour, 2005) delves into contingency, material agency and re-assembling of the social system. Regardless, in an increasingly complex world

that combines the uncertainty of environmental changes and the volatility of the capitalist systems, I argue that there is an opportunity for the merger. This thesis suggests that by shifting away from the dissonances toward broad, all encompassing, issues such as uncertainty, contingency and sustainability (those that are addressed in resilience thinking), we will have an insightful approach to the current issues in agrifood studies.

However, bringing two very contrasting approaches to the table is clearly not an easy task, especially because the two theories are rooted in distinct (if not contradictory) paradigms – one in historical constructivism and structuralist approaches and the other in relational constructivism and post-structuralism (and even post-humanism). It is not surprising then that, over the past 30 years, discourses have been focused too much on criticizing each other's paradigm rather than creating a constructive dialogue. One question, accordingly, remains: How can food regime and actor-network theories conform to a resilience framework when they take contrasting standpoints in seeing systems and relationships? The next chapter will look deeper into the root of each theory as I investigate the epistemological side of this thesis.

CHAPTER 4 AN ONTOLOGICAL JOURNEY TOWARDS A MULTIPLE-PARADIGM RESEARCH

"It is now largely accepted as uncontroversial amongst systemic action researchers that there is practical value in theoretical pluralism: seeing through multiple theoretical 'lenses' that bring different (sometimes contradictory) assumptions into play." (Midgley, G., 2011: 3)

4.1. Introduction

The two preceding chapters, while elaborating the theoretical roots of the thesis, raise several pertinent critiques and questions regarding the applicability of selected theoretical approaches to the analysis of real world food systems. Resilience thinking, despite offering a universal model of system resilience, fails to satisfactorily address some underlying tensions within social sciences in relation to global-local, nature-society and structure-agency dualisms. Consequently, its capacity to critically and comprehensively engage with a social system is often questioned (Davidson, 2010). Food regime and actor-network theories touch on these tensions in more depth and thus provide a tool to complement some of the social aspects that resilience thinking fails to address. In the end of Chapter 3, I assert the value of incorporating the two approaches within resilience thinking for a better understanding of agrifood resilience. The issue left unanswered is how this theoretical merging can be accomplished.

In addressing that issue, I argue (following Lincoln et al., 2011) that we need to pay attention to three important principles in employing a social scientific inquiry. First, opening a dialogue between the three different approaches requires the identification of the theoretical 'paradigm' of each approach. 'Paradigm' (Kuhn, 1962) here refers to a particular set of basic values and rules by which a scholar poses specific research questions, seeks answers and perceives reality. Acknowledging and bridging the different paradigms helps to determine the way in which the research methodology is to be taken. Second, although the joint theoretical framework enables us to pose certain research questions, answering them necessitates reflection on valid empirical data. Case studies in a real-world context help to elucidate questions, substantiate or falsify an argument, and identify potentials and limitations of a particular approach. Third, in social research, the problems and solutions are never free from the subjectivity and interpretation of the researcher (Minichiello & Kottler, 2010a). I thus construct this thesis not only on the basis of the theories and case studies, but also on what I refer to as my ontological journey (see Campbell & Rosin, 2011); i.e. the motives, values, and perspectives that have evolved over the last nine years of my academic experiences. In

the end, the three points become a justification for this chapter; its purpose is to inform the reader regarding the way in which I make sense of the theoretical framework, to apply the framework to an empirical context, and to build arguments and narratives on the basis of such a framework.

Accordingly, the structure of this chapter is as follows. Firstly, I will explore the paradigms and conceptions of reality to which resilience thinking, food regime theory and actor-network theory are inclined. In doing so, I refer to the work of Karl Popper and his pupils on theoretical pluralism (Midgley, 2011) as a means to engage with and compare theories and, subsequently, build a synthesis from them. Secondly, I will disclose my ontological journey as a justification for the particular emphases on, and nuances to, the different facets of each of the three approaches by which the research question and theoretical framework is posed. Thirdly, I will provide a rationale for the use of case studies and the choice of methods, along with a detailed discussion of the real-world context on which the thesis is based. I conclude this chapter by offering my positionality and the way this acts to both strengthen and limit the understanding of the main topic of this thesis: the resilience of agrifood systems.

4.2. Engaging with paradigms

I begin by exploring what a paradigm is and what it has become. A paradigm is commonly known as a set of linked assumptions, concepts and languages about the way reality works. The term gained prominence in the scientific world with Kuhn's seminal book, the *Structure of Scientific Revolutions* (1962; 1996). In the book, Kuhn defines scientific paradigms as "universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners" (Kuhn, 1996:x). The main characteristic of a scientific paradigm is thus its unquestionable, dogmatic rules that every scholar ought to follow within the scientific community. A paradigm need not be explicit in its form, and some scholars may not realize that such thing even exists. Yet, it does determine the way in which scientists pose a specific set of questions and arrive at answers.

The nineteenth century scientific paradigms are categorized into what Kuhn called 'normal science', referring to a normal way of practicing scientific research. However, the normal way of thinking was challenged by 'anomalies' in scientific findings, forcing the community to question their existing paradigms. This process often occurred abruptly through a rough 'scientific revolution', or 'paradigm shift'. A revolutionary change from Newtonian to

Einsteinian physics is one example of such a shift. Similarly, the existence of 'normal science' was a result of a paradigm shift from the previously dogmatic, Church-driven, sciences (e.g. from geocentric to heliocentric paradigms in astronomy).

Since the publication of Kuhn's book, the terms 'paradigm' and 'paradigm shift' have become extensively used in a very wide range of literature, often with a deviation from its original meaning (Hoyningen-Huene, 1993). Among others, Tapscott and Caston (1992) use paradigm shift to describe a revolutionary change in the way in which marketing and management was commonly practiced. In psychology, Candy (1982) applies 'paradigm shift' to a shift in an individual's way of perceiving reality, to which he refers as a 'personal paradigm'. Capra (1996:5-6) proposes what he calls a 'social paradigm', i.e. "a constellation of concepts, values, perceptions, and practices shared by a community, which forms a particular vision of reality that is the basis of the way the community organizes itself". He argues that the twentieth century was characterized by a social paradigm shift from anthropocentric to ecocentric perspectives. I will refer to these different definitions later in this chapter when I explain about my ontological journey (Section 4.2.3).

Although the increasing use of 'paradigm' has been remarkable elsewhere, within the philosophy of science the term has been fiercely criticized. One important critique of Kuhn's paradigm was documented in an edited book by Lakatos and Musgrave (1970), also known as the 'Kuhn-Popper debate' (Hassard, 1993). In this book, Popper (1970) challenges Kuhn's paradigm on the key premise of the latter's analysis. Popper argues that although many students and scientists are 'trapped' in the so-called paradigm while conducting scientific research, it is not how science is ideally performed. To the contrary, scientific inquiry should start with a critical view of the theoretical framework in use. Consequently, scientific revolution is always in the making within every critical scholar rather than the result of an abrupt process triggered by anomalies.

The second point of Popper's critique addresses the idea of a single dominant paradigm in each discipline that determines the course of scientific research within it. He argues:

> "Although I find Kuhn's discovery of what he calls 'normal' science most important, I do not agree that the history of science supports his doctrine ... that 'normally' we have *one* dominant theory —a 'paradigm'—in each scientific domain, and that the history of a science consists in a sequence of dominant theories, with intervening revolutionary periods of 'extraordinary' science" (Popper, 1970:55; emphasis in original)

What exists in science, in his view, is a "constant and fruitful discussion between the competing dominant theories" (Popper, 1970:55), a dynamic that Kuhn identifies exclusively with the social sciences. Kuhn argues that within the social sciences, there is no paradigm. Instead, "it is the tradition of claims, counterclaims, and debates over fundamentals which ... have characterized philosophy and much of social science ever since" (Kuhn, 1970:6). But do the social sciences really lack paradigms?

Hassard (1993) argues that the social sciences are in fact characterized by many paradigms that are, to some extent, communicating with each other in competing or constructing ways. There is no dominant paradigm, but there are multiple paradigms in research. Social theory is constructed on the basis of these multiple paradigms. Although one social research approach can be very different from and seemingly incommensurable with another, I argue that, in order to build an effective dialogue between these approaches, one should first find the resonance between the roots of each theory and mediate the approaches on the basis of these roots/paradigms.

Having said this, this chapter will use the concept of paradigm as a metaphor only to the extent that it enables a constructive dialogue between the theories that this thesis seeks to explore. Consequently, paradigm shift is referred to not as the revolution within a scientific community, but as an internal shift in my way of thinking and perceiving reality (referring to Candy's (1982) personal paradigm). However, Kuhn's paradigm shift is to some extent relevant because the way in which I perform research is primarily influenced by the scientific community that nurtures my ontological journey (which Section 4.2.3 will discuss in great length). In reaching this section, I would like to first explore some of the existing inquiry paradigms in social sciences, from which I reflect my own engagement and inclination to a particular way of doing research.

4.2.1. Towards encompassing inquiry paradigms

In line with Kuhn's assessment of scientific revolutions within the hard sciences, social scientists have seen the emergence of new perspectives (Hassard, 1993). In order to understand this, I start by describing the 'normal', or orthodox, social science. Some of the notable sociologists, including Auguste Comte, John Stuart Mill and Herbert Spencer, have argued that, like other scientific disciplines, social sciences need to be built upon a positivist paradigm and empirical certainty. This means that social research must align with the

scientific method, and true knowledge only comes from observed, explicit phenomena. Referred to as positivism, this paradigm is thus characterized by a strong inclination to the measurability and quantification of social data (Lincoln et al., 2011).

In Hassard's assertion, the development of positivism in sociology had reached a point of hegemony by 1960 as the perspective became a dominant paradigm for performing social research. After the 1960s, the social scientific paradigm was challenged by other theories and ways of thinking. Lincoln et al. (2011) explain that such a revolution stemmed from critiques of positivism both internally (from the proponents of the paradigm) and externally (from those offering alternative paradigms). Among these critiques, positivism was challenged for stripping the contexts from which the data is taken, excluding values and meanings that shape human behaviours and assuming a general theory from locally specific cases (see Lincoln et al., 2011 for a more elaborate discussion). These challenges led to what Hassard termed the social paradigm shift (inspired by Kuhn's paradigm shift). However, unlike Kuhn's argument, the social scientific revolution did not result in a single, new paradigm. Instead, it resulted in competing (and converging) paradigms that offered alternatives to positivism[4]. Whereas Popper (1970) argues that paradigms are commensurable (although difficult), Hassard contends that the dialogue between paradigms has become characteristic of social science, lending to multiple paradigms in the research agenda.

In relevance to this thesis, I refer to the work of Guba and Lincoln (1994; 2005; Lincoln et al., 2011) in recognizing at least four alternative inquiry paradigms in quantitative and qualitative social research: positivism, post-positivism, critical theory and constructivism (Table 4.1). I will briefly discuss the latter three in the following section.

Table 4.1. Basic beliefs of alternative inquiry paradigms†

Issue	Positivism	Post-positivism	Critical theory	Constructivism
Ontology	Naïve realism	Critical realism	Historical realism	Relativism
Epistemology	Objectivist	Modified objectivist	Subjectivist; value-mediated findings	Subjectivist; co-created findings
Methodology	Experimental; mainly quantitative	Modified experimental; May include qualitative	Dialogic /dialectical	Hermeneutical /dialectical

†Source: Lincoln, Lynham & Guba (2011)

[4] Effrat (1973; as cited in Hassard, 1993:59-60) identifies at least eight major competing paradigms for academic sociology, which include: "... Marxists; exchange theorists and utilitarians; culture and personality school; Freudians; Durkheimians or French collectivists; symbolic interactionist and activity theorists; Weberians and German idealists, Parsonians, cyberneticists; and phenomenologists and ethnomethodologists".

As a response to critiques of positivism, a post-positivist paradigm sees reality in a more critical sense, albeit still arguing that there is a single reality. The way we understand reality is often constrained by our own limitation (Guba & Lincoln, 2005), hence we can only apprehend reality imperfectly. The post-positivists assert that although we may not know the truth, we can establish false belief through the method of falsification. What distinguishes post-positivism from positivism is that the latter drives towards prediction and control of natural phenomena. As nature cannot be fully understood, post-positivists only seek to make an approximation of how it works. Furthermore, in contrast to positivism, it suggests that science cannot be neutral recognising that the research results are value driven. In terms of methodology, post-positivism is opened to qualitative methods because of its inclination to 'discovery' as an element in inquiry, by which quantitative methods cannot seem to address (Lincoln et al., 2011).

Towards the other end of the spectrum, critical theory and constructivism perceive reality as being relativistic and socially constructed. Critical theory originated with Frankfurt school theorists such as Herbert Marcuse, Max Hokheimer and Jürgen Habermas (Bohman, 2012). Critical theory conceives reality from a historical insight, in a sense that social, political, cultural, and economic values virtually shape the perceived reality (Lincoln et al., 2011). It is founded on the argument that "human nature operates in a world that is based on a struggle for power" (Lincoln et al., 2011:103). Thus, research within this paradigm focuses on social structures, power and control. It positions itself to be subjective, recognising that the people being researched influence the value and validity of the research. *Vice versa*, the value of the research resides not in its method, but in its capacity to transform the society.

Constructivism, by comparison, perceives reality as locally and specifically constructed (Lincoln et al., 2011). In this sense, reality is the result of interaction between the researcher and the people being researched. A qualitative research method is considered more suitable for this paradigm because it provides flexibility in opening a dialogue between the the research participants so as to construct meaningful knowledge. Like critical theory, constructivism accommodates action research as part of the values and validity of the research results. However, constructivism is involved less with the struggle for social justice, and more with understanding the localities and adding knowledge to society.

Up to this point, I have discussed that Lincoln et al.'s inquiry paradigms can only bring us to a certain point in understanding the roots of the three approaches in this thesis. The paradigms do enable us to ask particular research questions and set specific research methods. However, their categorization of paradigms fails to address how a researcher can perceive complex social relations (as exemplified by agrifood systems) differently, as described in Chapter 2. I argue that the crucial standpoint here is not so much on how we see reality as it is how we see the complexity of reality. In addition to the inquiry paradigms, the next section will explore the notion of *complexity*.

4.2.2. The conception of complexities: between system and association

In order to understand the complexity of reality, we need to revisit the underlying concepts of system and complexities in more detail, as suggested by John Law and Annemarie Mol in their edited book, *Complexities* (2002). Relevant to my discussion, the observation of these concepts requires a new realm of paradigms: system and association (Kwa, 2002). Firstly, the book suggests that complexity can be understood "... if things relate but don't add up, if events occur but not within the processes of linear time, and if phenomena share a space but cannot be mapped in terms of a single set of three-dimensional coordinates." (Mol & Law, 2002:1). Complexity is a way (or ways) to see reality without simplification and was the common way to understand society and nature before the scientific paradigm, as Kuhn explained, was put forward during the nineteenth century. In normal science, sense is made of reality through scientific experiments, and this often (although not necessarily) requires reductions of the variables. The scientists, to paraphrase Mol and Law, need to tame the parameters so as to separate the object of the research from its distorting environment.

In the late twentieth and early twenty-first century, this way of performing scientific research (and seeing reality) was fiercely challenged by a new wave of discourses that brought complexity back to the stage, particularly from authors such as physicist Fritjof Capra (1996; 2002) and ecologist Simon Levin (1999). Capra (1996), for instance, considers this era to be a form of paradigm shift within both the scientific and social worlds. He proposes what is known as systems thinking, arguing that there are emergent properties not present in each component of a system when seen separately. In his way of embracing complexity, Capra conceptualises society and nature interactions as systems. This emergence of systems thinking is known as *holism*. However, it is not the only representation of complexity. Chunglin Kwa (2002) distinguishes two conceptions of complexity based on ways of seeing

society and nature: "*romantic complexity* [that sees] a society as an organism and the *baroque* conception of an organism as a society" (Kwa, 2002:26; emphases added).

Romantic complexity, as exemplified by *holism*, integrates individuals within a single entity with self-regulating properties. The conception uses metaphors like system and organism. It recognizes that a group of individuals creates a unity at a higher level of organization. The self-regulating mechanism implies that any system seeks for equilibrium and develops towards maturity or climax, just as a true organism. In the field of natural science, Frederic Clements, a renowned ecologist, proposes the metaphor of "superorganism" (Clements, 1916) to explain a complex ecological system through the theory of successions. Furthermore, the notion of equilibrium, or a stable state, implies that a system is attracted to a particular domain regardless its initial state. Odum's (1983) conception of system ecology is also representative of romantic complexity given its strong assertion of stability.

Although Kwa's analysis is intended for the interpretation of nature, several tenets in social theory also seek to adopt the conception of romantic holism. Among others, Buckley's (1967) and Luhmann's (1995) theories of a social system view society as a self-regulating system, both being inspired by von Bertalanffy's (1968) general system theory, although with different emphases. While Buckley's social system theory mostly links the behaviour of society to a general law of nature (focusing on energy flow and entropy, see Odum, 1983), Luhmann's leans more toward a constructivist approach that emphasises the cognitive aspect of a system. In an entirely different way, some critical social theory incorporates romantic complexity. For example, Wallerstein's world system-theory (Hopkins & Wallerstein, 1982) asserts that in political and economic power struggles, a large global-level structure encompasses the smaller nation-states and determines the behaviour of these components.

A baroque conception of complexity is different from romantic. It does not see a system as a unity, but as a collection of structures (for example, a group of individuals cooperating as table companions). Unlike a romantic conception of system, no stable pattern emerges from the connection between individuals. Consequently, the baroque conception does not recognize boundaries between the internal and external. The materials comprising a larger association take free and random combinations with others and fluidly flow across all directions. Leibniz's monads (Kwa, 2002) and Deleuze-Guattari's rhizomes (Deleuze & Guattari, 1987) are examples of units of analysis in baroque complexity. In nature, this

conception can be observed in the critique of Clements' superorganism raised by ecologists like Henry Gleason (1926) and Paul Colinvaux (1973). In reference to plant populations, Gleason argues that "… an association is not an organism, scarcely even a vegetational unit, but merely a coincidence" (Gleason, 1926:16). Likewise, Colinvaux writes that there are no self-organizing properties, only consequences of the various adaptive strategies of individual organisms.

In summary, the combination of inquiry paradigms and conceptions of complexity as discussed in this section provides a rich repository for setting the research questions. In Section 4.3, I will revisit those perspectives that are aligned with the theories this thesis seeks to explore. However, theoretical pluralism and the subjectivity of social sciences implies that there is no one right paradigm. The choice of paradigm depends on the individual researcher's values and goals, which are often shaped by his/her academic experiences within the scientific community. In the case of this thesis, the rationale for my inclination to a particular paradigm(s) reflects my journey through different scientific communities and ontological engagements.

4.2.3. The ontological journey

I started my ontological journey in 2004 while working on my undergraduate thesis. As a biology student, I took a standpoint that the positivist paradigm was good, that the scientific method was the only way of conducting research, that reality needed to be measured, and that we ought to distance ourselves from our research object so as to guarantee objectivity (those qualities of quantitative research as listed by Minichiello and Kottler, 2010b). As I will show in the following narrative, my academic journey led me to a 'personal paradigm shift'.

My major was in Botany and Plant Ecology; yet I was intrigued by a unique aspect of botany, ethno-botany, that was not commonly examined at the time and which seeks to understand the ways in which people perceive, and interact with, the plants around them (Martin, 1995). This interest widened my academic experience from botany to include anthropology. My research examined how a community gives meaning to the plants it uses and with which it interacts, both as commodities and as a part of their wider values. Rice, for instance, is commonly used as a staple food for many Indonesians, and also embodies deeper meaning as their cultural heritage (also documented by Soemarwoto, 2007). To see it retrospectively, I find the root of my study, in part, in *symbolic interactionism*, particularly due to the

understanding of nature (and reality) as being socially constructed (see Chapter 2, Section 2.3.1).

Another trajectory in my ontological journey focused on human-nature relationships. As a plant ecologist, one of the key points of my study was to understand the plant population dynamics and interactions within a plant community and their importance for humans in providing ecosystem services (biomass, water, carbon cycle, etc.). In understanding the relationships between an ecosystem and a social system, I largely adopted the approach of Howard T. Odum (1983) on *System Ecology*, in which he states that a social-ecological system is a large entity consisting of compartments (e.g. agricultural system, social system, economic system, and ecosystem) that operate as a whole in transferring energy and circulating materials. Thus, relationships between society and nature were represented through the use of ecosystem modelling and energy measurement. This was an overly-simplified understanding of the social. Despite the simplification, the ecosystem modelling was useful in identifying whether an ecosystem is degraded due to human activities and in designing sustainable ecosystems to integrate a society and its natural environment for the benefit of both (Mitsch & Jørgensen, 2004, through their concept of *ecological engineering*).

At this point, I began to engage with issues of sustainable development (Rogers et al., 2006). By aspiring to integrate ecological with social and economic approaches, in accordance with the triple bottom line of sustainable development, I sought to investigate cases of unsustainable natural resource management as examples of a failure to connect the social and economic systems with the ecological system – and to identify the pitfalls that led to this failure in management. One of the keys to comprehending the concept of sustainability, as I understood it then, was to use scenario building, prediction and model simulation (Odum, 1983; Rogers et al., 2006). My master's thesis (Dwiartama, 2008) focused on formulating a strategy for more sustainable smallholder plantation management of nutmeg in Aceh, the westernmost part of Indonesia. I combined a Present Value analysis for a 10-year projection of the nutmeg plantation (from an *ecological economics* perspective, Schultze et al., 1994) with an analysis of the agro-forest ecosystem biodiversity (Barbour et al., 1999) and minimal social description, to measure the sustainability indicators of the plantation. Despite being the least analysed, I found that the dynamics of the society determined the sustainability of the plantation for the most part.

McCarthy's (1999) previous engagement with the community in Aceh has unravelled the social conflicts and disparities that hinder progress towards sustainable management. I came to a conclusion that, within the case study, sustainability could not be measured solely on the basis of ecological and economic performances. It was also contingent on the dynamics and relationships within the society which were founded on their social, economic, political, and cultural values – phenomena which were much more difficult to quantify. I also realised that the relationship between humans and nature should not be seen as a mere connection between subsystems within a larger social-ecological system (through which the crop channels the energy and material flows; Odum, 1983), but instead as a borderless interaction through which society gives meaning to nature and its components (Vayda & McCay, 1975). As a result, I began to reconsider the lens through which I could best understand sustainability and social-ecological relationships.

To summarize, in the course of the past nine years of my ontological journey, I have used different perspectives for conducting research. With regard to the research question I am employing, in particular, I find that positivism is no longer suitable as a paradigm to perceive social constructs and human-nature relationships. My ontological journey has influenced the way I am attracted to, and engage with, the theories in this thesis. As an ecologist, the value of resilience thinking, in particular, draws my attention as it offers a different perspective on ecosystems – shifting from that of stability to contingency and resilience (Holling, 1973). The further development of the theory also encompasses social studies as part of the analysis of social-ecological systems (Gunderson & Holling, 2002). Using resilience thinking, I was able to bridge Odum's system ecology with a more fluid understanding of system dynamics and human-nature relationships. Here, critical social theory, such as world system analysis (Hopkins & Wallerstein, 1982), regulation theory (Lipietz, 1986) or food regime theory (Friedmann & McMichael, 1989), might provide a valuable insight into a deeper understanding of social dimensions within resilience thinking.

Such insights notwithstanding, my pursuit of deeper inquiry to human-nature relationships could not be satisfied by the current discourse in resilience thinking. Does nature and its components (plant, animal, crop, etc.), with its society-given meaning, influence the resilience of the society? The connections and relationships that render resilience visible can only be comprehended if we look beyond the usual framework of social-ecological systems into constructed realities within the realm of the social, as partly shown by Beilin (2007) or

Buikstra et al. (2010). In both studies, resilience is understood as a social construct and an ideal state towards which the society progresses. Having been engaged with a similar type of question in the past (through ethno-botany and symbolic interactionism), I am inclined to actor-network theory as a complementary framework for resilience thinking[5].

The challenge then is to combine the theories in order to offer a novel and satisfactory understanding of resilience, if at all possible. The first thing to acknowledge here is that each theory stands on different inquiry paradigms and conceptions of complexity, and the interpretation of the theories depends on which paradigm we choose to use.

4.3. Finding a common ground

In combining the different standpoints for this research, I start by mapping the paradigms onto the theories I am using (namely, resilience, food regime, and actor-network theories). Table 4.2 illustrates a matrix between inquiry (Lincoln et al., 2011) and complexity (Kwa, 2002) paradigms including my mapping of the theories. The core objective of this thesis is to go beyond paradigm shifts in order to practice a theoretical pluralism that seeks to understand the resilience of agrifood through different perspectives. While 'paradigm shift' indicates that theories are incommensurable (Kuhn, 1996), theoretical pluralism (Midgley, 2011) allows for a juxtaposition of theories for the purpose of gaining greater flexibility in seeing the phenomenon of concern.

The benefit of theoretical pluralism in this thesis is that it allows a wider set of questions to be brought to the table. What is resilience if we see agrifood as a system (*sensu stricto*), a self-regulating integrated whole made of smaller components? And what is resilience if we see it as a network, an association between actors without pre-determined patterns and trajectories? How do power relations influence agrifood system resilience? How is the meaning of resilience constructed in society? The following is my exploration in finding a common ground between the three theories based on the above questions.

[5] Blok & Jensen (2011) provide a review of Bruno Latour's engagement with symbolic interactionism within ANT.

Table 4.2. Matrix of complexity and inquiry paradigms

Complexity conceptions† / Inquiry paradigms‡	Romantic complexity	Neo-baroque complexity
Positivism	Theory of successions (Clements, 1916); System ecology (Odum, 1983)	Plant association (Gleason, 1926); Ecology (Colinvaux, 1973)
Post-positivism	Late development of *resilience thinking* (Gunderson & Holling, 2002; Walker et al., 2004)	Early development of *resilience thinking* (Holling, 1973)
Critical theory	World-system theory (Hopkins & Wallerstein, 1982), *Food regime theory* (Friedmann & McMichael, 1989)	Late development of food regime theory (Campbell & Dixon, 2009)
Constructivism / Interpretivism	Theory of autopoietic social system (Luhmann, 1995)	*Actor-network theory* (Law, 1992; Latour, 1987; 1988; 2004)

† Kwa (2002); ‡ Lincoln et al. (2011); Guba & Lincoln (1994)

4.3.1. Resilience thinking

Most of the research conducted within resilience thinking arguably fits into the post-positivist paradigm. Although still loyal to a scientific approach, research in resilience thinking appears as a mixture between qualitative and quantitative research methods (e.g. Olsson et al., 2004; Allison & Hobbs, 2004; Jannsen et al., 2006). Resilience theorists seek to shift from the view of controlling the environment to that of adapting to the environment (Holling, 1986; Walker et al., 2004). They embrace complexities and uncertainties as part of nature, hence positing no strict definition of reality (Holling, 1973).

In terms of complexity, resilience thinking incorporates aspects of both romantic and baroque conceptions. A romantic conception is reflected, to some extent, in metaphors such as domain of attraction, system and panarchy (Gunderson & Holling, 2002). However, early resilience thinking (and the subsequent evolution of the theory) does not necessarily fit the paradigm; instead, it aligns more with a baroque conception of complexity. In the early development of resilience thinking, Holling (1973), in his work on population dynamics, rejects the idea of a single equilibrium state and patterned trajectories of a system. He puts more emphasis on uncertainties, multiple equilibria, discontinuity and fragments, such characteristics of complexity as are seen from the baroque conception. Although the later development of resilience thinking has deviated towards romantic conceptions, recent discussions have

returned to a baroque standpoint, particularly in understanding the social (Buikstra et al., 2010; Davidson, 2010).

Therefore, I argue that resilience thinking, as constructed through interdisciplinary discourses, to be malleable to different inquiry paradigms and conceptions of complexity. Although mostly residing within post-positivism, research conducted from resilience thinking can also cross the borders of paradigms. Dialogues have connected resilience thinking with critical as well as constructivist theories including, for instance, Gotts's (2007) dialogue with world system theory, Armitage and Johnson's (2006) with globalisation, Atwell's (et al., 2009) with diffusion of innovations, Smith and Stirling's (2010) with transition theory, and Michon's (2011) with political ecology. In this thesis, I seek to build dialogue between resilience thinking and two distinct approaches in agrifood studies, namely food regime and actor-network theories.

4.3.2. Food regime theory

I begin by highlighting some of the contradictions and complementarity between food regime theory and resilience thinking. In its earlier development, food regime theory offered a perspective that was completely different from resilience thinking. Much of this difference can be attributed to the emphasis placed by food regime analysis, as a critical theory, on power relations and the global development of capitalism, rather than the integrity of the food system. In so doing, food regime theory tends to undermine the nature-society and agency-structure interactions that shape the system dynamics in the first place. Only after environmental issues appeared as an important feature of global food relations did food regime theory move to new theoretical ground that could incorporate social legitimacy as well as ecological dynamics (Campbell, 2009).

The incorporation of an ecological perspective in the latest development of food regime theory creates an entry point for other theories that link social and ecological issues. In his article, Campbell (2009:316) asserts that there is a "need for 'an ecological turn' in food regime theory". Largely inspired by world-system analysis (McMichael, 2009), the theory positions itself in the romantic paradigm. This explains the resonance of the theory with resilience thinking as the latter emphasises system development, panarchy and global domains of attraction. In this case, resilience thinking can be seen to align with food regime theory for at least two reasons.

Firstly, both food regime and resilience theories address a similar concept with the metaphors of regime and stability domain, i.e. a set of possible states and relationships that in combination determines the trajectory of systems residing within it. The two theories view domains of attraction (Walker et al., 2004) or food regimes (Friedmann & McMichael, 1989) as an inescapable space within which agrifood systems reside. They are also founded in the assumptions that a regime contracts and expands within periods of its development and is characterised by certain key variables (Carpenter & Turner, 2001). However, different from a food regime that encompasses a set of relationships at a global scale, a regime in resilience thinking is often set in more specific, and often smaller, temporal and spatial scales, such as a lake (Carpenter et al., 1999), a rangelands (Walker & Abel, 2002) or a forest ecosystem (Holling & Gunderson, 2002). Although Holling (2004) does speculate on the existence of a global regime, his conception is very premature and subject to criticism (Gotts, 2007), particularly because the global system proposed by resilience thinking lacks (as yet) a clear construct and, thus, remains very vague in its manifestation.

Secondly, as noted by Allison and Hobbs (2004), the rise and decline of the global food regimes (inspired by a similar pattern of boom-bust cycles in capitalistic systems such as explicated by Kondratieff's 'cyclical rhythms' in the world system theory, Hopkins & Wallerstein, 1982) resembles the metaphor of adaptive cycle in resilience. This comparison is, however, challenged by Gotts (2007) specifically in regard to Hopkins and Wallerstein's (1982) world-system theory as the foundation of food regime theory. Gotts argues that despite several comparable and complementary aspects of world-system theory and resilience thinking, each theory is liable to a point of weakness that is not addressed by the other—for instance the existence of semi-peripheral countries in world system theory.

In summary, I see huge potential for the two theories to complement each other in compensating for their limitations. For resilience thinking, questions regarding the kind of relationships that appears in a global regime, the way to provide a historic profile of agrifood systems, and linking power structure to panarchy (Chapter 2) may be addressed by food regime analysis. For food regime theory, understanding the nature behind the regimes' rise and collapse, linking nation-states and local farms to global food regimes, and looking at the possibilities of a future food regime (Chapter 3) are some of the issues that potentially become an entry point for resilience thinking. Nevertheless, food regime theory does not satisfactorily address the relationships between actors at a micro-level that shape the

resilience of an agrifood system. As a result, I am inclined to actor-network theory to further investigate this aspect of resilience thinking.

4.3.3. Actor-network theory

As distinct from food regime theory, ANT[6] argues that power, domination, and structure are processes resulting from actor-network relationships, rather than given systems attributes (Law, 1992). Following the same logic, system identity and resilience are also considered processes from an actor-network perspective. As Latour (2005) argues, there is no such thing as a social system, in the sense that social relationships are made of expanding networks rather than closed bordered systems. This, in particular, contrasts with food regime theory, which strictly defines the boundary of the agrifood system (i.e. commodity chains from from production to consumption) and identifies scales within the system. In an actor-network perspective, global dynamics are simply elongated networks of local relationships. Thus, rather than the strictly defined multilevel interaction of resilience thinking, ANT conceives panarchy as a form of 'actions at a distance' (Busch & Juska, 1997). The rigidity or fluidity of the structure within these networks depends on the way in which actors continuously form networks among themselves (Murdoch, 1998). Because there are no boundaries between 'internal' and 'external' components, disturbance and stress, regardless their origins, are interpreted as merely features of actors' dynamics to enroll others to the network, as well as to negotiate with, and betray, other actors (Law, 1992). Put simply, actor-network theory contradicts resilience as well as food regime theories in a way that nullifies the existence of a system and all its attributes (feedback mechanism, self-regulating, resilience).

That being said, the potential for resonance between ANT and resilience thinking remains. I posit that any complementarity between and new insight from ANT and resilience thinking requires a shift from a system to a network/association perspective. Such a shift necessarily considers the arbitrarily defined system as no more than networks being woven by actors. ANT finds greater commonality with resilience thinking through the notions of contingency and agency (Latour, 2005); those notions that help to better understand how resilience is performed in different localities. I seek to mediate the notion of network in ANT and system in resilience thinking by referring to Noe and Alroe (2005), who describe a system as a

[6] Latour (2005) actually argues that ANT does not necessarily align with social constructivist paradigm, because reality is constructed by a relational effect of both the society and the materials. Kjellberg and Helgesson (2006) describe ANT as relational constructivism. For reasons of simplicity, I put ANT into the constructivist category.

stabilised network. This implies that a system needs to be seen in a performative state, which is fluid and open to ongoing contestation and negotiation between actors, rather than as a self-regulating entity. A network is by its nature precarious, and it is only through the process of negotiation that a network achieves stability.

The fact that ANT is inclined to a methodology rather than a theory provides another entrance for resilience thinking to better grasp the agrifood realms. It is interesting to note that ANT's approach to the nature-society linkage is slightly different from, and yet complementary with, that of resilience thinking. Research in social-ecological resilience is limited to the assumption that there is still a boundary between social and ecological systems, and that to integrate these two entities, one should first see both as separate, although interacting, subsystems (Westley et al, 2002). Nonetheless, studies of culture dynamics show that components of nature, such as wild foods (Johns & Sthapit, 2004) or domesticated rice (Soemarwoto, 2004), can be intertwined with society regardless of the physical boundaries. Put simply, a human-in-ecosystem perspective in resilience thinking (Davidson-Hunt & Berkes, 2003; see Chapter 2) is complemented by a nature-in-social system perspective in ANT.

In addition, ANT offers insight to the recent discourse on agency within resilience thinking. Agency, from an ANT perspective, appears as a relational effect resulting from interactions between actors (Law, 1992; Latour, 2004). To some extent, this resonates with the idea of socio-ecological agency as proposed by Manuel-Navarrete and Buzinde (2010; in fact, their conception was partly inspired by Latour's). Through negotiation processes, actors influence others to the extent that they change the way other actors relate with each other—a process known as *translation* (Callon, 1986). Resilience, adaptability and transformability are rendered visible through the same relationality. To summarize, ANT provides resilience thinking with tools to investigate the three dichotomies (global/local, structure/agency, nature/society) in a novel, post-structuralist manner.

4.3.4. Bridging the theories

The two social theories used in this thesis are equally important and complement each other in providing insights to agrifood system resilience. In food regime theory, uncertainty has been the main concern in addressing the future of the global food system in the face of the world food crisis and the growing influence of social movements (Rosin et al., 2011).

Resilience thinking relates to this by addressing the precariousness of the system within domains of attraction, a situation in which a regime shift is an expected eventuality. In the metaphor of the adaptive cycle, transformative resilience during the reorganization phase is the key to understanding this uncertainty. Transformative resilience also implies that the system's future trajectories are contingent on the processes occurring both at the global and local levels – which in turn introduces the concept of panarchy. This provides a space for ANT to provide explanations of the precariousness and uncertainty of the system (or network), which are seen as ongoing performative action. Panarchy, in turn, can link the three theories (resilience, food regime and actor-network) in an encompassing framework by what I propose as a dual approach to resilience (Figure 4.1). Resilience of agrifood systems is, thus, a *result of the dynamics of the global food relations that are reaching down to nation-states and, at the same time, agency (of both society and material objects) at the local level that drives the adaptive capacity of the system.*

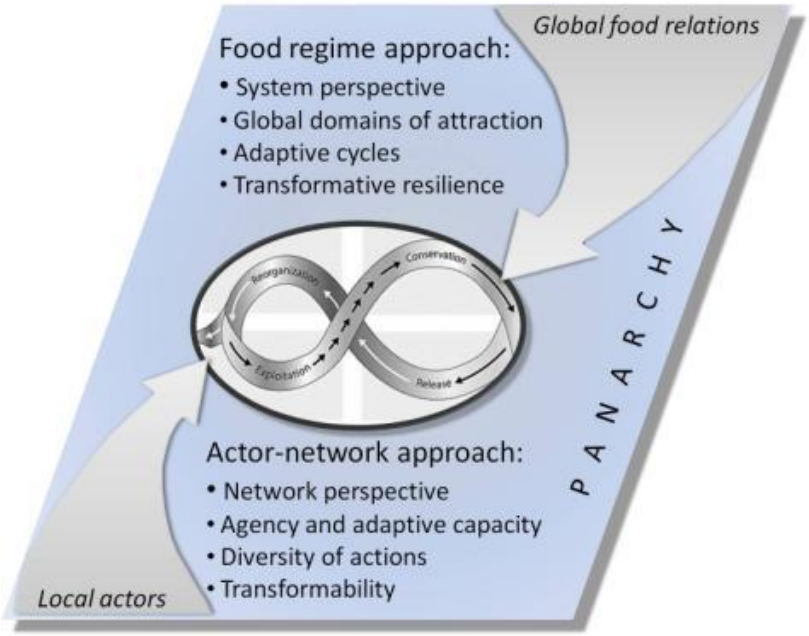

Figure 4.1. A two-way approach in assessing the resilience of agrifood systems

4.4. Setting the context for the case studies

Notwithstanding the potential in bringing the three theories to a constructive dialogue, the conflicting paradigms that each employs can also act as a hindrance. As implied in the quote at the beginning of this chapter, the practical value of theoretical pluralism can only be achieved if the multiple lenses can provide a novel understanding of the phenomenon in

question without generating too much tension within the conflicting stances. In other words, the benefit of the theoretical merging must surpass the value of resilience thinking alone in assessing agrifood systems. The first part of this chapter ends with an assumption that there is a huge potential for theoretical conjunction between resilience thinking, food regime theory and actor-network theory to provide novel insight into agrifood studies. However, it also ends with at least two open-ended theoretical questions: (1) what would a resilient food system look like if seen from this joint framework? And (2) what is the benefit of employing this framework to a practical understanding of agrifood systems that cannot be gained by a more simple applicaton of resilience thinking?

The questions raise the issue that the joint resilience framework for agrifood systems still seems abstract and will need to be substantiated through empirical analysis. As the selected theories stand on subjectivist paradigms (critical theory and constructivism), I argue that qualitative research is a highly suitable research methodology (Minichiello & Kottler, 2010b; Lincoln et al., 2011). However, neither food regime theory nor ANT explicitly suggests a specific method be employed. Although it is apparent that food regime analysis is based on historical interpretation of realities and dialectic (McMichael, 2009), in which document and archival analysis is appropriate (Yin, 1994), ANT is somewhat more obscure. Several scholars from outside science and technology studies (from which the theory originated) contend that ANT is in itself a methodology, hence the term actor-network methodology (Friedland, 2001). Yet, there is no strict sense of method. The researcher needs only to follow one particular actor within the actor-networks "... all the way along their length; there is no need to step outside the networks for all the qualities of spatial construction and configuration of interest will be found therein" (Murdoch, 1997:332). This methodology has previously been used to demonstrate the way a new commodity or technology successfully merges into a system—for example, as in the introduction of the Zimbabwe bush-pump (de Laet & Mol, 2000), the domestication of scallops in France (Callon, 1986), and the canola oil industry in Canada (Busch & Juska, 1997).

The thesis research was based on a multiple case study research design using exploratory and explanatory ways to understand and compare the 'what' and 'how' of agrifood systems (Bailey, 1987; Yin, 1994). A case study method is particularly useful as it allows an in-depth analysis of, what George and Bennett (2004:17-18) termed, 'a class of events', i.e. "a phenomenon of scientific interest, such as revolutions, types of governmental regimes, kinds

of economic systems, personality types that the investigator chooses to study with the aim of developing theory (or "generic knowledge") regarding the causes of similarities or differences among instances (cases) of that class of events". As a methodological instrument with wide applicability, a case study method aligns with different epistemological stances (e.g. rational choice theorists, structuralists, historical institutionalists, social constructivists) (George & Bennett, 2004), and thus fits well with the research questions that this thesis seeks to address.

Two case studies have been selected in order to provide such a relevant test of the framework's value: Indonesia's rice agriculture and the New Zealand kiwifruit industry. For the purpose of this research, these two agrifood systems enable the application of the framework across distinctive contexts, involving a perfect example of polarization within the global food systems as described by Marsden and Murdoch (2006). The former is an example of subsistence agriculture and is characterized by inward-oriented policies and culture-based management (Gerard et al, 2001). The latter, by contrast, is a technology-intensive industry with globalized production and marketing (Beverland, 2001). Interestingly, despite their differences, both of the systems experience similar global driving forces, namely environmental (climate, pest and disease), economic (world price, supply and demand), and social-political (consumers' awareness, social movement) forces. Given these driving forces and their contrasting properties, the case studie will allow an analysis of how each agrifood system adapts to, transforms, and is resilient in the face of the existing and potential shocks. Will resilience be manifested in a similar mechanism and practice across the two cases?

Rice agriculture in Indonesia reveals a particularly interesting illustration of a resilient food system. Its long history, its attachment to the society's culture and tradition, and the many crises the food system has experienced provide rich material for the discussion of food system resilience. The New Zealand kiwifruit industry, on the other hand, was in its adolescence when a series of economic and political crises altered the world in the late twentieth and early twenty-first centuries. The dynamics of the kiwifruit industry were assumed to behave in a manner corresponding with the global processes. Yet, the industry underwent a series of transformations, demonstrating its resilience through its adaptability in surviving the crises and emerging in a strong and secure state. Each case offers a different way of understanding resilience of agrifood systems, as I will show in the subsequent chapters.

The case study method used in this research is different from a comparative method; the latter aims to compare small number of cases, whilst the former involves an internal examination of single cases and an extention towards cross-case comparisons within a single study (George & Bennett, 2004). Within this study, the cases were not compared using a strict one-to-one framework; instead, both of the cases were used to answer an argument based on the theoretical framework, i.e. that different trajectories of agrifood systems will result in similar/different resilience. Accordingly, I conducted the research in two steps: document and archival analysis (Yin, 1994) and in-depth semi-structured interviews (Flick, 2006) with participants from two study sites that represented the human actors within both the rice agriculture (West Java province, Indonesia) and kiwifruit (Bay of Plenty region, New Zealand) industries.

4.4.1. Study sites

Indonesia

Rice agriculture in Indonesia is concentrated on the island of Java with about six million hectares under cultivation, or 47% of the total rice field area in Indonesia (BPS, 2011). Java has the biggest population concentration compared to any other islands in the archipelago, and is the centre for economic and political activities. Rice agriculture in Java can be categorized into several areas based on the island's geographical properties. The most productive area is located in the northern region, with fertile soils from volcanic sediments (Christie, 2007) and advanced irrigation facilities (Hardjono & Hill, 1989). Another productive area lies in the middle to southern part of the island, with fertile soils but only a simple traditional irrigation system. Rice agriculture is also practiced in several hilly and dry areas, but in such places it is usually in the form of dry-land farming or rain-fed wetland farming, with lower productivity. Due to their isolation and distance from the administration of government agricultural policies, these areas still maintain their traditional agricultural practices (Soemarwoto, 2007).

The fieldwork focused on three locations representing different rice growing practices (Figure 4.2), all of which are located in West Java province (apart from the farmers, most of the participants were easily accessed in large cities such as Jakarta and Bandung, while ICRR is located in Subang regency in West Java province). The three rice producing centers are:

1. The northern coastal region of West Java (*pantura*) that represents intensive rice agriculture. This regency is known as Java's 'silo' for rice production (Irhamni & Nuryakin, 2009);

2. Subang and Garut Regency in the central and southern region that represent semi-intensive rice agriculture. Due to limited access to the main irrigation facilities, farmers in this region have the flexibility to convert their farming practices to organic agriculture;

3. Sukabumi Regency in the hilly area of West Java that represents traditional rice agriculture. Research conducted by Soemarwoto (2007) on traditional communities is based in this region, and shows that it is maintained as one of the in-situ conservation areas for rice varieties in Java.

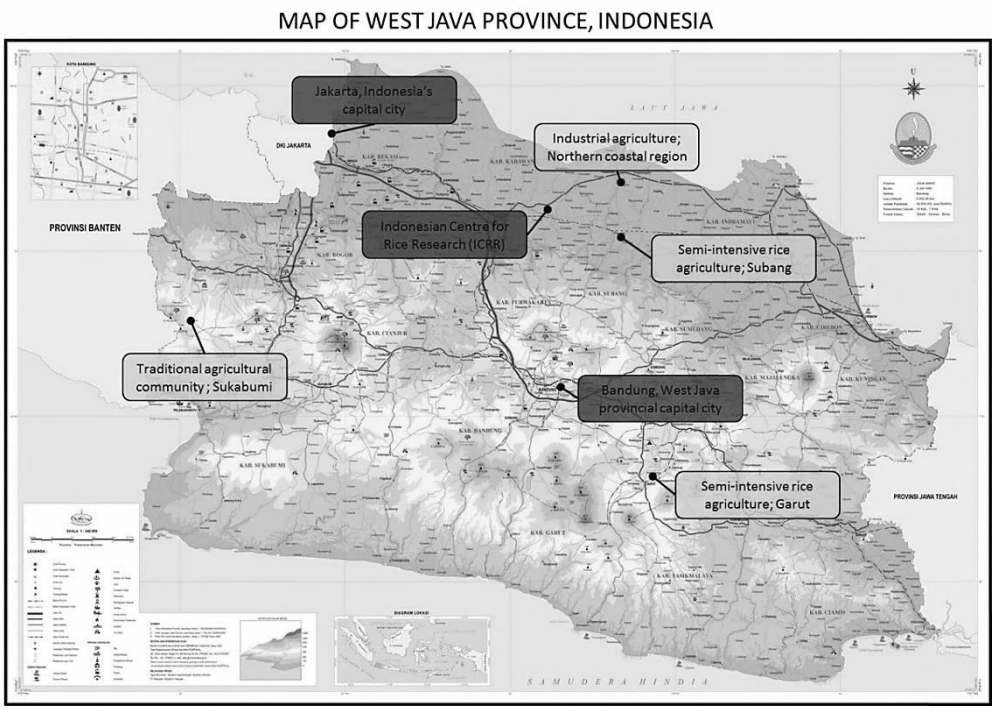

Figure 4.2. Map of West Java province showing three research locations: (1) Northern coastal region, (2) Garut and Subang regencies as semi-intensive rice agricultural centers, and (3) Sukabumi regency with its traditional rice farming communities [Inset: map of Indonesia showing the location of West Java province] (Modified from BAKOSURTANAL, 2003)

Kiwifruit

Field research for New Zealand kiwifruit was mainly conducted in the Bay of Plenty region (Figure 4.3). The region consists of more than 75% kiwifruit orchards (with a total area of 10,230 hectares; Statistics New Zealand, 2011) and a majority of post-harvest operators (Kilgour et al, 2008). Geographically, the Bay of Plenty is a fertile area with warm climate, thus highly suitable for horticultural production and kiwifruit orchards in particular (Campbell & Fairweather, 1998). Research was undertaken mostly in the Bay of Plenty area, focusing on the majority of orchards infected with Psa [7] under the recovery regions (particularly in Te Puke, Tauranga and Katikati areas).

1. Te Puke is the highest kiwifruit producing area in the region, with a total of 5,118 hectares of orchards and 5,569 kiwifruit growers (40% of total growers). Due to its strong industrial infrastructure, the area has the highest proportion of Gold kiwifruit orchards (more than 20% of all kiwifruit orchards) compared to other areas in Bay of Plenty (Zespri, 2012). Te Puke is located 28 km southeast of Tauranga with a population of around 6,770 people. Based on KVH (2012a), more than 1,000 orchards in Te Puke have been identified with Psa-V.

2. Tauranga is the second largest producing area in the region, with 1,740 hectares of orchards and 1,916 growers. Tauranga is also the most populous city in the Bay of Plenty, with more than 100,000 people residing in the urban and territorial area. With regard to the recent crisis, Psa-V was detected in 372 orchards in the area.

3. Katikati is a small area consisting of around 3,500 people. It is located 40 km northwest of Tauranga. However, it is also the third largest kiwifruit producing area in the region, with more than 1,400 hectares of orchards and 1,599 growers. Per 19 December 2012, there were 240 orchards identified with Psa-V, shifting the status of the area from a containment to recovery region (KVH, 2012a).

4.4.2. Interviewing the (human) actors

The initial interview was made with the participants involved in each of the food systems using key informants as a starting point, which expanded to other recommended participants.

[7] Pseodomonas syringae pv.actinidae (Psa) is a bacterial canker that came as a prominent issue in 2010, during which massive kiwifruit orchards were infected. This phenomenon becomes an important factor to understand resilience at the local level – and will be discussed intensively in Chapter 7.

The recruitment method entailed a formal correspondence to the authorities for permission to perform fieldwork, as well as to access farmers' / growers' groups and other important actors in the regions. Formal letters were also sent to other organizations such as research centres and unions inviting them to participate in the research project. As part of the ethical conduct, I disclosed the information about the research to all participants, including the informed consent form to ensure participants' awareness on their involvement in the study. (Examples of information sheets for the interview participants and informed consent form can be seen in **Appendix 1.**)

Figure 4.3. Map of part of New Zealand showing the kiwifruit growing regions. The data collection was focused in Te Puke, Tauranga and Katikati in the Bay of Plenty region (Source: KVH, 2012a)

Initially, at least one representative of each stakeholder group was interviewed. This number increased as a result of "snowballing", and additional stakeholders were identified through participants' recommendations (Flick, 2006). The final number of participants was established when data saturation had been reached, i.e. no additional significant information was gained during the interview process with a total of 30 participants for Indonesia's rice agriculture and 31 participants for the New Zealand kiwifruit industry (Table 4.3).

Participants of the interviews in kiwifruit industry and rice agriculture

Participants	**The New Zealand kiwifruit industry**		**Indonesia's rice agriculture**	
Production-level	Kiwifruit growers: Conventional Green growers Organic Green kiwifruit growers Gold kiwifruit growers	 2 4 4	Rice farmers: Conventional farmers Traditional farmers Organic farmers	 4 4 3
	Workers / Contractors	1	Farm labourers	2
	Beekeepers	2	--	
Extension/Support services	Orchard management companies Private-based Consultants Zespri Growers Support Division	1 1 1	Agriculture Extension Officers (*PPL*) Agrochemical suppliers*	1 1
Processing	Postharvest operators (packhouses):		Hullers	1
Distribution	- Seeka - Apata - Trevelyan's	1 1 1	Small Retailers Large Retailers (*Pasar Induk Cipinang*)	1 1
Exporters and market regulators	Zespri International Ltd. Marketing Division Orchard Productivity Division	 1 1	State Logistic Agency (*BULOG*)	2
Research and Innovation Centres	Plant & Food Research Ltd. Zespri Innovation Division Kiwifruit Vine Health Inc. (KVH)	1 1 1	Indonesia's Centre for Rice Research (*BB Padi*)	2
Policy-makers and regulators	Zespri Crop Protection Division	1	Government (Politician) West Java Regional Food Crop Agricultural Agency (*Diperta*)	1 1
Farmers' Representatives	New Zealand Kiwifruit Growers Incorporated (NZKGI)	2	La Via Campesina / Indonesian Farmers Union (*Serikat Petani Indonesia*)	1
Consumption-level	Tauranga resident	2	*Raskin* beneficiaries	5
Banking	Bank	1	--	
Total Participants		31		30

In Indonesia, my first person-in-contact was a renowned professor in agriculture who subsequently facilitated a link to the State Logistic Agency (BULOG). BULOG was the hub connecting other stakeholders within rice agriculture, which included large retailers, hullers, farmers' representatives, the regional agricultural agency and the Indonesian Centre for Rice

Research (ICRR). To access the traditional farmers' community, I gained assistance from a local anthropologist who has had significant research experience within the region.

The initial interviews in New Zealand were conducted with some of the growers involved in the ARGOS Research Project (Rosin et al., 2008), which consisted of ten kiwifruit growers. Aside from the growers, at least one representative of each of the other stakeholders was involved. There were two recruitment methods for the research. The first method was through growers that have already been involved with the ARGOS Project. The second method entailed a formal invitation to organizations engaged in Psa management (such as ZESPRI, KVH, packing houses, etc.) to participate in the research project. In both cases, a representative from ARGOS helped mediate between me and the participants for the initial contact.

The topics for the interview were designed to address issues relevant to the research questions and the underlying theoretical framework. As the method adopted was a semi-structured interview, the questions expanded depending on the course of conversation and any interesting facts that emerged during the interviews. The questions were focused on the notion of relationships between actors in the industry/agriculture; identifying shocks/disturbances/changes during the actors' experiences; adaptation and actors' responses to changes; scenarios of crises; and participants' perspective of the systems' resilience. Key points of the interviews explored questions such as:

1. What kind of significant shock has been experienced by the industry/farm/orchard in the last five to ten years?
2. What were the set of relationships in the industry/farm/orchard like before the shock, and how did they function?
3. How do the participants perceive, and engage with, the prevailing shock?
4. How do they communicate to, and interact with, different actors with regard to this shock?
5. Are there any new actors emerging and how are relationships with these new actors being shaped?

4.4.3. Data analysis

The interview and observation results were coded for qualitative analysis using CSR NVivo 9.2 computer software. This coding allowed for the grouping of the transcripts based on

themes suited to analysis, which include human and non-human actors. Although the discussions are mostly exploratory and descriptive, coding was still needed to ease the process of analysis. I also mapped the actor-network in each agrifood system in order to illustrate the complexity of the connections woven by actors within the industry / agriculture. The end result of the analysis included narratives of Indonesia's rice agriculture and the New Zealand kiwifruit industry with regard to shocks and crises the food systems have incurred historically as well as recently, which then provided material for the discussions of resilience from the lens of food regime (Chapter 5) and actor-network theories (Chapters 6 and 7).

4.5. Concluding remarks: limitations and positionality

The positioning of the selected theories in the context of the case studies largely reflected my academic journeys, a process that has also provided the thesis with some biases. Two crucial points characterized my view. First, it prepared me to employ a theoretical pluralism as I engaged with different realities. This is not to say that my own perspective does not color or distort the lens. While the nature of resilience thinking is fluid and malleable to the extent that it opens dialogues between disciplines, my own hand is evident in the discussions through my interpretation of the theories. My alignment to the metaphysical relationships of humans and nature brought a nuanced touch of resilience. I focused more on reflexivity, socially constructed meaning, and power play as factors influencing the dynamics of the agrifood systems.

The second source of bias came from my personal engagement with the two agrifood systems in relatively different ways. As an Indonesian, rice is always a significant part of my life. I was raised in a community with an appreciation of rice not only as the staple food, but also as a part of the culture. I have been made aware that rice is irreplaceable and must be provided to the society at all cost. In contrast, kiwifruit is a novel experience for me. I had perceived kiwifruit as an exclusive commodity from the moment I encountered the fruit on a supermarket shelf in Indonesia. As my connection with the fruit deepened, I perceived a different aspect of kiwifruit, the one that reveals the face of New Zealand's agriculture as a modern, export-oriented industry. This, in part, compromises the neutrality of the analysis and acts as a research limitation. Thus, I tend to see rice as an insider and, in a way, add my personal experience to my assessment. On the contrary, I look at kiwifruit mostly from the outside – an engaging customer seeking to find out more about an interesting fruit. Instead of

being impartial, I consider this element of personal engagement to be part of the expected subjectivity of conducting social research.

Lastly, the quality of this research comes not from the validity of the research *per se*, but from the extent to which the research is able to influence the decision-making processes within the agrifood systems – or at the very least provide an alternative lens through which we see resilience and sustainability. Because food regime and actor-network theories perceive complexity differently (as system and network, respectively), I argue that the theories will bring a more nuanced understanding of what resilience is – as either an emergent property or a result of heterogeneous association. With reflection on the distinctiveness of the case studies, this thesis posits that the resultant understanding (and perspective) of resilience will imply a different, and context relevant, strategy and policy as the means to build social-ecological resilience at the agrifood level.

PART III: INSIGHTS FROM TWO CASE STUDIES

CHAPTER 5 FROM GLOBAL TO LOCAL: THE NEW ZEALAND KIWIFRUIT INDUSTRY AND INDONESIA'S RICE AGRICULTURE WITHIN THE GLOBAL FOOD REGIMES

"Agriculture in any nation-state can, in part or in total, be assessed in terms of its insertion or non-insertion in the mainstream developments characterizing the prevailing food regime. This holds for the major players such as the US and EC, as much as it does for so called 'third world countries', developing nations and the newly created eastern bloc nations" (Le Heron, R., 1993: 76)

5.1. Introduction

This chapter presents two contrasting examples of modern agrifood systems—the New Zealand kiwifruit industry and Indonesia's rice agriculture. The former represents a professionally managed industry focusing on the global market, with more than 80% of its production designated for export (Kilgour et al, 2008). In comparison, the latter is an agrifood system that is intended solely for the domestic market, and its product performs not only as a commodity, but also as part of cultural identity (Gerard et al., 2001; Lamourex, 2003). However, the question that intrigued me is less about these two systems' differences than it is about what these commodity-based agrifood systems actually have in common. In terms of the cross-scale interactions explored in resilience thinking, the two systems' common feature is their relationship with the global dynamics of modern food systems, i.e. the way global structures influence and, to some extent, determine the behaviour of these systems. In this chapter, I seek to situate the dynamics of the New Zealand kiwifruit industry and Indonesia's rice agriculture within their entangled relations with global-scale food regimes.

The question is whether, and the extent to which, these systems, or any given agrifood system, are truly entangled within global food relations. In addressing this question, there can be three possible explanations. First, a food regime can be seen as a hegemonic structure that determines the behaviour and trajectories of national level food systems within it. Second, a regime can also be seen as a representation of the existing dominant food circuits in the history of global capitalism that co-exist along with the idiosyncratic food systems with no particular pattern or structure. Third, and to which this thesis is inclined, both food regime and the national level food systems are connected in such a way that each influences the structures and trajectories of another through cross-scale relations. With regard to these explanations, Richard Le Heron, in his book *Globalized Agriculture* (1993), uses multiple

country-level examples to stress the need to understand any development of national level food systems within the global context. The subsequent question can then be posed while assuming that food regimes do indeed act as a global 'state-space' (Walker et al., 2004) that restructures any particular agrifood system to conform to its properties. If this is the case, then how does this global structure affect the ability of the individual food systems to persist and adapt to changes?

This chapter consists of three main sections. The first section will give a brief explanation of the historical development of global food relations using the food regime perspective. This in turn will help the reader to build a context within which the next sections of the chapter are situated. The second and third sections will elaborate the history of the kiwifruit industry and rice agriculture respectively, addressing the extent to which these systems conform to, or contradict, the existing world structure as delineated by the food regimes narrative. I conclude this chapter by aligning the historical developments of the cases and showing the way these historical developments might represent features of resilience, while also raising the need for a more localized understanding of the relationships within the system.

5.2. Global Food Structures

Friedmann and McMichael (1989) have identified broad patterns and sets of stable relationships that they describe as three food regimes that emerged over the course of modern history. The colonial-diasporic or the first food regime occurred during the peak and fall of British colonization between the 1870s and 1930s. The mercantile-industrial food regime grew during the post-World War II era, between the 1940s and 1970s. The third food regime, or the corporate-environment regime, has been growing in divergent trajectories from the 1980s to present. Each food regime rises from and falls back into a structural crisis in food relationships, that then forms the basis for the emergence of the subsequent regime. The following narrative discusses the features of each food regime with emphases on five dimensions of the theory: (1) circuits formed between core and periphery, (2) commodities and nutritional relations, (3) agricultural and trade policies, (4) environmental issues, and (5) crises that established the basis of the new regime. Table 5.1 categorises these dimensions around five elements: circuits of food, types of commodities, nutrition relations, international policies, agricultural practice, and environmental issues.

Table 5.1. Characteristics of food regimes based on features presented in the theory*

Dimensions of theory	1st food regime	2nd food regime	3rd food regime
Circuits of foods	Britain as the centre Settler and occupational colonies	US as the centre Third world countries as informal colonies Emergence of TNCs	Multiple centres (US, UK, Japan) and TNCs Emergence of alternative food networks Multiple trajectories
Type of commodities	Wheat, meat, tropical products	Cheap foods, durable foods and livestock	Fresh fruits and vegetables High-value commodities Food vs. Fuel
Nutrition relations	Energy and protein for low-wage workers and industrial classes	Diet-related diseases (starvation and obesity)	Trade-in-health, 'culture eaters'
International policies	Developing national agricultural model International trade based on imperial influence	Protectionism Government-supported agriculture	Free trade GATT-based policies, cut on subsidies & tariff Patent-based practices
Agricultural practice	Extensive agriculture and exploitative use of land	Intensive agriculture Agro-industrialization	Sustainable agriculture, occurs in parallel with Biotechnology-based intensive agriculture
Environmental issues	Soil and nutrition degradation Loss of virgin forests	Environmental problems resulting from excessive use of fertilizer & pesticide	Concerns over pesticide residue Issues of food safety and GMOs Global Climate change

*) Source: Friedmann & McMichael (1989); Le Heron (1993); McMichael (2009); Dixon (2009); Campbell (2009)

5.2.1. Pre-World War era

In the late nineteenth century, the world was characterised by the rapid development of colonialism by the British Empire and its European counterparts. From the tip of the American continent to the far end of the Southern Hemisphere, European colonial hegemony stretched its wings to touch all exploitable land. In general, there were two types of colonies. The first one was the settler colonies; a situation where a large number of Europeans migrated to land that could support their new livelihood away from competition in highly-populated Europe. The new land provided a similar landscape and environment to their homelands. In their new home, settlers built their life around creating and transplanting simple agricultural activities. They brought along seeds of familiar crops from their home countries and cultivated these in their new landscape. As they settled and adapted to the new environment, they started to replicate the livelihood they had had in Europe. The settlers also maintained a strong relationship with their colonial core – the British and European empires. They received manufactured goods, money, and labour from their respective Empire. In return, they exported their primary products for the benefit of European populations. The

settler colonies' main role was to provide the centre with basic commodities for the industrialization of British and European cities. Durable products such as wheat, meat, and dairy were the main export commodities of the settler colonies. For example, in the United States (US), farm output soared from 1870 to 1900, as a result making it the principal exporter of wheat and corn to Europe (Le Heron, 1993). Australia and New Zealand, on the other hand, exported sheep and beef meat as a source of protein (Hawke, 1985). Through this channel of commodities and circuit of trade, the first food regime was formed with Britain as the centre of accumulation in an emerging empire of food.

The second type of colonies was the occupational colonies. Unlike settler colonies, occupational colonies were designated solely for the exploitation of their products and productive capacity. The empires colonized populations that had already developed advanced production capacities in agriculture. Most of them have been previously connected to trade routes, like India and China whose products were channelled through the Silk Road (Robinson, 2004). These colonies, which lay mostly in the tropical regions, developed different food circuits and commodities compared to the settler colonies. During the pre-colonization era (circa 1600), mass varieties of tropical products such as spices, rice, cotton, and silk were traded independently by small empires. After the culmination of British and European colonization, the British Empire reduced the variety of the world commodities to a narrow range of principal products including sugar, coffee, tobacco, and tea, along with raw materials for the industry such as indigo, rubber and cotton. Frequently, colonies were forced to cultivate commodities that were basically alien to their environment, as in the case of tea in Indonesia (Reid, 1999). This shift in commodities was done particularly to fit into the development of the industrial revolution in Europe (Friedmann & McMichael, 1989). Furthermore, it also demonstrated the changing consumption behaviour of European societies. Types of global commodities were adjusted to fit the nutritional demand and industrial lifestyle during the period – grain and meat for low-wage workers in the industrial area, and tropical products as a luxury diet for the upper classes (Mintz, 1985; Dixon, 2009).

While the relationship between Britain and the occupational colonies emerged as a colonial division of labour, the late nineteenth century gave rise to a new form of nation-state system in the settler colonies. 'The culmination of colonialism' (Friedmann & McMichael, 1989: 96) emerged as these colonial states earned their independence and thus opened the door for a

new type of relationship between the nation-state systems and their empires. The agricultural policies of the new settler colonies led to a model of national agricultural systems that forms the basis of the second food regime (McMichael, 2009). As independent as the settler colonies may have seemed, in terms of international relations, these colonies remained dependent on Europe for their commodity markets and financial liquidity. As an illustration, more than 80% of New Zealand exports of sheep products in the early twentieth century were solely marketed to Britain, and it was only after 1934 that the country operated its own reserve bank to finance its development. This example shows that as Britain became 'the workshop of the world', the financial hegemony of the sterling set a new financial regime in conjuncture with the food circuits of a global food regime (Friedmann & McMichael, 1989).

The pre-World War era was also characterized by the extensive nature of agricultural development, both in settlers and occupational colonies (Le Heron, 1993). New virgin soils were exploited for agriculture and settlement in the settler colonies. Subsistence farming in the tropics was altered into a commodity-based agriculture. This, as it turned out, had direct repercussions on the environment. The US Dust Bowl in the 1930s (Campbell, 2009) and land degradation in Western Australia in the same period (Allison & Hobbs, 2004) were perfect examples of the environmental degradation caused by new styles of agricultural activity, which boomeranged back as shocks to the food regime.

Nevertheless, prevailing environmental crises in the early twentieth century were masked by larger events such as World War I and the Great Depression, which mark the transition period to the second food regime. As a result of the First World War, there was a high demand for wheat and meat from Europe between 1910 and the 1930s. This phenomenon attracted massive imports of wheat from the US and sheep products from Australia and New Zealand, hence briefly bringing about a conducive environment for international trade. This condition, however, did not last long. The effects of the 1929 stock market crash in the US spread across the world causing what is known as the Great Depression, and leading to a rapid decrease in prices of virtually every commodity in the global market. Interestingly, Britain only suffered mildly from the Depression (Hawke, 1985). Yet, as the economies of other countries contracted, the international market became increasingl oriented towards Britain. Other countries channelled their agricultural products towards the British market, thus threatening the market shares of former British colonies such as Australia as well as the US -- that is,

those countries with agricultural markets highly dependent on Britain. Eventually, it created a financial disruption to the British Empire as well. This marked the terminal crisis of the first food regime.

5.2.2. The Second Food Regime (1940s – 1970s)

The end of the Great Depression and the Second World War resulted in a shift of the centre of accumulation from Europe to the US. The shift was mostly driven by the US' and Europe's agricultural and international policy reforms (Le Heron, 1993). The US in particular faced its own dilemma in dealing with an overproduction of wheat. As a new political and economic power post-World War II, the US exploited an opportunity to increase its hegemonic power while also settling its internal agricultural problem. The first key political action was through the campaign to establish the hegemony of the US dollar via the Bretton Woods agreement. At a time when first world countries had been experiencing financial crises and monetary uncertainty post-Great Depression, Bretton Woods provided a fresh chance to restructure their financial systems and avoid total collapse. This instituted a dramatically new global financial regime under the US dollar and governed via the establishment of the International Monetary Fund (IMF).

US hegemony within the second food regime was also solidified by another US foreign policy: a disguised dumping of US excess wheat production through Food Aid programs like PL480 (later called the 'Food for Peace' program (Friedmann, 1982; Le Heron, 1993). The global Food Aid program was basically an offer of help to many newly developing countries in the third world. This policy in turn resulted in a fourfold economic advantage for the US. Firstly, it enabled the US to release its excess of wheat without influencing the domestic market and international prices. Second, it opened US networks to the third world countries, and by doing so created a new circuit of food with the US as the centre. Third, it secured the existence of the US as a democratic leader by suppressing the seeds of communism that were starting to grow in parts of third world countries. Finally, it created a dependency of the US 'informal' colonies on the US, as wheat replaced the role of staple foods in the diet of these countries and transformed many subsistence farmers into urban industrial labourers. The success of this program was also determined by the fact that many third world countries had decolonised and gained their independence and were seeking cheap food to facilitate their newly emerging industries (Friedmann & McMichael, 1989).

Aside from what happened in the third world, the food aid policy also indirectly affected agricultural policy in Europe. As Friedmann (1993:35) notes, "[Food] aid did not simply integrate donor and recipient. As a mercantile trade practice, aid encouraged recipients and competitors alike to adopt the national regulation of agriculture and trade. This replication was built into the international food economy at the same time." After World War II, European countries restricted imports and introduced subsidies to revitalize domestic agriculture as a strategy to counter the impact of depression (Le Heron, 1993). Countries such as the Netherlands and Denmark with their dairy and meat production, or France and Germany with their cereals, had to secure their farmers from further collapse, particularly in the context of US wheat surpluses as well as Australia and New Zealand's massive meat exports. Britain, as a highly industrialized country, placed relatively less emphasis on the agriculture sector, but in the 1960s decided to align with the policies of other European countries so as not to be excluded from the emerging European Economic Community (EEC) (Le Heron, 1992). The pinnacle of European policy on agriculture was the emergence of the Common Agricultural Policy (CAP) to stabilize the European agriculture market, secure the food supply, and increase the income level of European farmers (Le Heron, 1993).

In terms of the types of commodities which prevailed during this time, Friedmann (1993) notes that the second food regime was the era of cheap foods, with the rise of the durable foods and livestock complex. It was apparent that cheap food promoted by the US Food Aid program was perceived as advantageous by many developing countries which sought rapid industrialization. Subsistence farming was replaced by manufacturing and industry, forcing the massive rural population to migrate to the metropolitan and industrial areas where the capital was mostly circulated (Mingione & Pugliese, 1994). To feed the growing urban population and low-wage workers of the emerging industries, cheap food was urgently needed. This mirrors the situation of late nineteenth-century Britain during the peak of the industrial revolution, but with a critical difference in one important aspect: their positions relative to the centre of accumulation. In their effort to access the global market and finance their new-born industries, third world countries were reliant on foreign investment. This situation was exacerbated by the fact that tropical products such as sugar and vegetable oil were eventually marginalized through substitution with products like high fructose corn syrup and soya oil (Friedmann, 1993). McMichael and Kim (1994) illustrated this situation in case

studies of Japanese and Korean agriculture systems that shifted to industrialization in the presence of the Food Aid program.

As the third world's population became dependant on imported foods, they had to have income to purchase food (Friedmann, 1982). To a certain extent, this led to issues of food accessibility and vast starvation in the third world countries. But hunger was only one side of the coin and, as noted by Patel (2007), the affluent on the other side of the world also experienced associated problems. In his book, *Stuffed and Starved*, Patel notes the emergence of obesity as well as diet-related diseases that struck middle-class societies in the US and Europe. The cause was a shift in diet from plant-based food to meat and dairy products (Friedmann & McMichael, 1989). To understand the way this shift occurred, one must understand the relationship between the US and other affluent countries, particularly in the European community.

In maintaining its market in Europe, the US came up with another strategy. Through its restricted policy, Europe placed a high tariff on imported wheat from the US. Realizing the impact of such a barrier during a period of European economic restriction, the US reformed its agriculture for diversification into different commodities such as soybean and maize, and this proved to be beneficial to the US for two reasons. First, it lessened US dependency on tropical palm oil by producing soy oil as its substitute. Second, as soybean cake resulting from soya oil production was known as a good source of protein for livestock, this opened a new market for feedstuff in Europe that, at that time, was encouraging the growth of its dairy and meat production, particularly in the Netherlands and Denmark. Fortunately, CAP, although strict on the import of dairy and wheat, was loose on maize and soy, and thus created an open market for the US surpluses of soy and maize (Friedmann, 1993).

US agriculture in the second food regime was industrialized through mechanization, long-chain processing, and a complex commodity system. Farmers were only a small part in the global commodity chain and were left without control over the fate of their agricultural products. Hendrickson and Heffernan (2002) show the way US agriculture was increasingly controlled by an ever-smaller group of Trans National Corporations (TNCs) which integrated control over commodity chains from upstream (seed, fertilizer, and pesticide production), processing, and even distribution in the form of large retailers. As Friedmann and McMichael (1989:108) note, "for farmers all over the world this shift to manufactured foods meant a

transformation of markets from either local markets or an anonymous mass of distant consumers, to an oligopolistic relation to corporate buyers of agricultural raw materials".

As I have mentioned earlier, economic and political crises that took place in the previous regime became the foundation for the next regime. This was also the case with respect to environmental crises. The 1930s Dust Bowl and the concerns of food insecurity based in Malthusian[8] arguments gave rise to attempts to increase food production using limited available land. What followed in most developing countries was the era of intensive agriculture, commonly known as the Green Revolution. This pattern of agricultural development is noted by Le Heron (1993) as an intensive regime of accumulation, as opposed to the previous extensive regime. New technologies of seeds, artificial fertilizers, and pesticides were introduced to farmers with a strong incentive from the government[9]. At that time, organic agriculture was highly discouraged, in some cases resulting in financial penalties as in the US (Le Heron, 1993) or forced destruction as in Indonesia (White & Wiradi, 1989). This new farming approach proved, yet again, to have catastrophic effects for the environment. The environmental repercussions which characterized the second food regime were not as evident as direct loss of virgin forests and soils under the first regime. Rather, these effects were more subtle, and its underlying causes were concealed for more than two decades. It was not until Rachel Carson published her book, *Silent Spring* (1962) that the world became widely aware of the destructive impact of modern intensive agriculture: lake and river eutrophication, pesticide residues that threatened farmers and consumers' health, as well as severe pest outbreaks that had a devastating impact on farmlands.

5.2.3. Transition to the Third Food Regime

It was economic shocks, however, that brought the second food regime to its final crisis. Friedmann (1993) found that the international oil price crisis in 1973 signified the end of the cheap food era, followed by the food crisis of 1973-4 during which prices soared dramatically. Many third world countries, that is, those dependent on imported food, found themselves in deep need of financial support. At the same time, countries sought to lessen

[8] Thomas Robert Malthus argues that while food production grows in logarithmic manner, population grows exponentially, thus the growth food production will not keep pace to the growth of population.

[9] Interestingly, Garcia (2004) reveals that World War II gave a major influence on the rise of intensive agriculture, as pesticide and fertilizer were basically a modification of nitrogen-based bomb and nerve gas used during the war.

their dependency on the US by attaching themselves to an emerging supranational entity – the General Agreement on Tariffs and Trade (GATT). The end result was a newly configured relationship between the North, consisting of major industrialized countries in North America and Europe, and the Global South, which were mainly developing and underdeveloped countries in South America, Asia, and Africa.

However, the existence of a third food regime is still largely debatable[10]. Although there is clear evidence that some key elements of the second food regime ended after the food crisis in 1970s, I am sceptical about this as being a signifier of the collapse of the second food regime. The fact that existing food relations still occur even to the present date and there is no real 'collapse' as compared to the first food regime makes the argument of a transition to a third food regime relatively weak. This thesis seeks not to identify whether or not a regime concretely exists. Instead, I want to assert that the third food regime is still a useful heuristic tool for analysing the kinds of global dynamics that influenced national agricultural systems during recent decades. Thus, the following section outlines some of the new dynamics that have been proposed as potentially contributing to a third food regime.

In terms of environmental crisis, peoples' awareness of environmental issues in major developed countries created a situation that pushed towards another revolution of their agricultural system. At the end of the 1980s, some scholars argue that the environmental crisis pushed the food regime to bifurcate into two trajectories, both of which forced farmers to reduce substantially their usage of pesticide. The first trajectory was what is known as the gene revolution, the era where biotechnology began to dominate over mechanization and intensive agriculture (Uzogara, 2000). TNCs such as Monsanto and Novartis/ADM (Hendrickson & Heffernan, 2002) were at the heart of this trajectory, as they controlled the technology to produce genetically modified (GM) agricultural products. The second path was a sustainable agriculture that stressed the need to maintain balance with nature (Altieri, 2002). In Europe, it was marked by new audit policies like EurepGAP[11] (Campbell, 2005; Rosin et al., 2008). In most developing countries, the program was introduced by the UN Food and Agriculture Organization (FAO) through Integrated Pest Management (IPM)

[10] A special issue in the *Agriculture and Human Values* journal in 2009 discusses extensively about this debate; see Campbell & Dixon (2009).
[11] EurepGAP is an acronym for Euro-Retailers Produce Good Agricultural Practice, an alliance established to secure European market for healthy and environmentally friendly produce; see Campbell (2005)

(Röling & van der Fliert, 1994). These emerging trajectories thus pushed the existing regime one step closer to a new regime that Friedmann (2005) terms a 'corporate-environmental food regime'.

Although the existence of a specific new regime (or two) is still debatable, what is clear that the 1980s and 90s were a period of major changes in global agricultural relationships. McMichael (2009) characterizes the third food regime (1980s – present) by the emergence of TNCs and multiple centres of power in the hands of the US, the European Community (EC), and Asia (see also Le Heron, 1993; Moran et al., 1996). At the same time, alternative food networks are starting to emerge as a response to an increasing demand for healthy diets and fairly traded products (Raynolds, 2004; Dixon, 2009). Trade negotiations at the trans*national* level through a series of GATT-related trade negotiation rounds raised unresolved issues of protection and deregulation of the agricultural sector (Le Heron, 1993). All of these signal total or partial breaks with aspects of the second food regime. One interesting new feature of food under the purported third food regime is what William Friedland (1994) perceives as the start of the fresh fruit and vegetables (FFV) era, showing a rapid increase of fresh fruit global trading in the early 1980s. In this chapter, I want to draw the readers' attention to the significance of FFV to the so-called third food regime and to the discussion in the following section.

What has made FFV grow at such an accelerated speed? First, I have noted that during the second food regime, tropical products were substituted with artificial products developed in the US via TNCs, thus decreasing prices of these tropical products in the world market. The situation forced many developing countries, particularly in tropical regions, to shift their national economic policy from agriculture to industry-oriented, or upgrading their agricultural commodities into high-value foods. Second, Europe was also interested in differentiating their agriculture, thus resulting in Europe's agricultural policy on diversification of production (McKendrey & Sale, 1984; OECD, 1996). Moreover, European societies were realizing the negative impact of their diet on their health, and sought to consume more varieties of fresh exotic fruits. This had been initiated by wealthier consumers in Britain in 1950s (Yerrex & Haines, 1983), and from then exotic fruits started to penetrate the European market, albeit in a very small amounts until the 1980s. Friedland (1994) notices that:

> "Since the early 1980s, two major developments have created a fundamental change in the advanced industrial countries, where most people now expect to have a wide variety of fruits and vegetables available on a year-round basis. The first has been the extension of the production season through plant-breeding programs, changes in horticultural practices, and the development of many production locations. The second has been the expansion of varieties of fruits and vegetables, particularly tropical."

The third reason was technical progress in the storage and transport of fresh fruits (OECD, 1996), making it feasible to supply distant markets with fresh fruit all year round. McMichael (2009) indicates this as he explains that:

> "… in the early 1990s a discernible transnational corporate 'global sourcing' of foods was most obvious in the technologies of seed modification, cooling and preserving, and transport of fruits and vegetables as non-seasonal, or year-round, access for affluent consumers became available through the management of archipelagos of plantations across the global South." (McMichael, 2009: 150)

However, Friedland (1994) argues that unlike commodities such as corn and soybean, the fresh fruits and vegetables industry is trans-national only in its distributional segment, while its production and marketing are still controlled by farmers and national corporations. This creates a type of global food relations that is more transparent in its chains and bounded to particular localities, to which Campbell (2009) refers as 'food from somewhere regime' (as opposed to McMichael's industrialised 'food from nowhere regime').

The fourth reason for the rapid growth of FFV was the emerging Asian market during the 1980s – 1990s (OECD, 1996). The rise of economic power in Japan and other Asian countries opened new markets for FFV. Jussaume (1994) notes that, in the late 1980s, Japanese agricultural imports accounted for 10% of the total world trade in agriculture and food products. Le Heron (1996) also reports an increase in the New Zealand export market during the 1980s to the emerging Asian market. Negotiations in the GATT Uruguay Round provided another important factor for the expansion of fresh fruit – liberalization of fresh fruit trade through tariff and export subsidies reduction (OECD, 1996).

Although Friedland (1994) and McMichael (2009) have both presented the FFV industry as a dominant food circuit that distinguishes the third food regime from its predecessors, it seems

to be only one of many new global circuits that might loosely make up the regime. Along with the FFV complex, emerging organic and fair-traded commodities (Raynolds, 2004), as well as basic commodities (maize, soybean, wheat) controlled by TNCs (Friedmann, 2005) also came to prominence within global food relations. On one hand, organic and fair-traded commodities are pooled into the same centres as the FFV complex (namely, Europe, Japan, and other affluent countries), thus creating the 'food from somewhere regime' (Campbell, 2009). On the other hand, the basic commodities market forms a similar circuit to the previous food regime, connecting the US with third world countries (Pechlaner & Otero, 2010). In fact, despite its diminishing hegemonic power, to date the US still dominates the world market for wheat, maize, and soybean exported to third world countries (FAO, 2011).

The stability of the third food regime, if it exists, has been challenged by various shocks and crises. In the late 1990s and early twenty-first century, many scholars are still concerned about issues such as diet-related diseases (Dixon, 2009), unfair distribution of resources in the world (Patel, 2007), and environmental degradation resulting from exploitative agriculture (Altieri, 2002). The World Food Crisis in 2007-8 magnified such problems. John Toye (2009) lists the causes of the 2007-8 World Food Crisis as: the impact of the rising price of oil on farming – which illustrates the on-going practice of intensive agriculture – and rising demand for meat and feed grains to compensate for the enormous growth of China. This condition was exacerbated by climate change that caused serious droughts and floods. But if the reasons Toye tried to present was the case, then the food crisis allows the existing questions of food regime theory to resurface. What is the nature of the purported third food regime? Is it possible that a food regime encompasses multiple circuits of distinct global food systems? Or if we have only seen a transition between the second and unseen third food regime, how long is this transition period going to last before a single form of global structure emerges? Is it necessary that we have one dominant global regime, or might a globalised world economy actually be better characterised by the existence of multiple global regimes that are variably competitive or integrated with each other? Food regime theorists argue that the existing global food systems develop into a single, hegemonic regime. Consequently, it is important to envision a regime that is able to provide food sustainably and resilient to multiple crises (Friedmann, 2005). Resilience thinking, by contrast, offers a different understanding of a resilient agri-food system based on the idea of multiple stable-states and panarchy. In Chapter 8, I will address the multiple 'food system' basins of attraction from a

resilience perspective. Using this perspective, not only is it possible to picture multiple basins within the world food system(s), but it is also imperative to nurture this alterity of state-spaces around which local food systems can flexibly shift. However, in the next two sections, I will first use the two case studies, respectively the New Zealand kiwifruit industry and Indonesia's rice agriculture, to illustrate the dynamics of global food relations, as described by food regimes, in shaping the trajectories of local food systems over the course of history.

5.3. New Zealand Kiwifruit Industry

5.3.1. Introduction

For many scholars, such as Warren Moran and his colleagues (1996), food regime theory is considered too large a framework with which to address the specificities of individual agrifood systems in particular areas in the world. However, with respect to my argument, I want to demonstrate that the global structure, at least to some extent, impacts the dynamics of these agrifood systems, either directly through the commodities or through their countries' international policies. In return, the individual systems may also direct the trajectories of the food regime, opening ways for different scenarios and bringing shocks and crises. Using the New Zealand kiwifruit industry as a case study, I seek to understand the relationship between a particular commodity that, in 2001, accounts for less than 1% of the world fruit and vegetable trade (Huang, 2004; FAO, 2011) and the rapid development of the global food circuits.

New Zealand's kiwifruit has an interesting history in itself, and in its relations to the development of New Zealand as a country. It represents New Zealand in global society, but at the same time is somehow distant to New Zealanders themselves. Kiwifruit has always been positioned in the 'upmarket fruit category' (Beverland, 2001). Statistics New Zealand (2006, as cited in Kilgour et al, 2008) indicates that most of the kiwifruit produced in the country are oriented towards the export market, comprising more than 80% of total production. It also comprises 60% of total fruit exports and 30% of total earnings in horticultural exports. As mentioned by Bonanno et al. (1994:10), kiwifruit "manifests true globalization". But to understand this phenomenon, we have to situate ourselves in the context of New Zealand's development, even before the rise of the kiwifruit industry. Only then can we understand the way kiwifruit stands at the vanguard of New Zealand's reach for globalization. As the basis

for the following narrative of the dynamics of pre-kiwifruit New Zealand, I rely on G.R. Hawke's book *The Making of New Zealand* (1985).

5.3.2. Pre-kiwifruit agriculture

New Zealand was colonized, thanks to a British diaspora, at the dawn of the 19th century. The objectives of the British were two-fold: discovering new land for settlement, and exploiting nature as an economic resource in the southern hemisphere. Among the first commodities extracted from New Zealand were minerals, seals, whales, and wood from the kauri, dating back before 1840 (Hawke, 1985). In 1850, early settlers' agricultural products based mainly on grains and vegetables were successfully exported to its neighbouring continent, Australia. These were mainly intended as food stuffs for Australian workers. As reciprocity, Australia introduced sheep to New Zealand between 1850 and the 1860s.

But it was not until the rise of New Zealand as a nation-state that its current agricultural orientation emerged. In 1856, the British Empire granted New Zealanders the freedom to control their economy. From that time, New Zealand started to develop export commodities for the global market, and in particular the British Empire. Its first key product was wool. The industry grew enormously between 1860 and the 1870s; during this period New Zealand sheep production had increased from two to 13 million. In the 1870s, the government started to build infrastructure such as railways to support the expanding industry. In the same period, New Zealand also diversified its agriculture to include cereals and dairy. Technical progress such as machine shearing and wire fencing contributed to agricultural development in the 1880s. But it was the introduction of refrigeration that revolutionized the country's agricultural exporting.

After New Zealand adopted refrigeration in the 1880s, its export commodities expanded to include meat and dairy products, although these were only complementary to wool as New Zealand's principal commodity. The result of this new technology was an exponential growth of New Zealand agricultural production and exporting. However, refrigeration was a global phenomenon and many colonies also adopted the same technology to transport their products. As Hawke (1985:84-85) notes, "… the technical advance which transformed the production possibilities of New Zealand agriculture was the result of an international effort". The flow of

material to Europe increased in a very rapid sequence; however, in 1879 international prices fell and New Zealand, along with other British colonies, experienced a long depression.

During World War I, exports of New Zealand commodities to Britain started to increase in response to high demand for food. But this increase occurred for only a short period of time. The Great Depression negatively affected New Zealand as international prices once again fell dramatically. Agricultural production remained constant at that period, as New Zealand exports were overwhelmingly sold to Britain, which consumed 80% of all of the former country's exports in 1929 and 88% in 1932. But this came at a price – namely, a heavily impaired national income and GDP. In Hawke's assertion:

> "There is no doubt, however, that the immediate cause of the Depression in New Zealand was international. From 1929 to 1931, export receipts fell by 37%; there had been fluctuations in the 1920s, by 21% between 1919 and 1922, and by 18% between 1925 and 1926, but that at the beginning of the 1930s was unusually sharp and deep and accompanied by news of gloom abroad" (Hawke, 1985:127).

Recalling the transition between the first and second food regimes, the Great Depression was responsible for the retrenchment of non-British countries' economies. Many exports were oriented to Britain at that time, forcing the Empire to limit its imports through a revenue tariff barrier. In 1932, New Zealand found a way to maintain its market to Britain. In the Ottawa conference held between commonwealth countries (mainly recently ex-colonies), New Zealand negotiated to be exempted from the revenue tariff introduced by Britain. The negotiation proved successful, as New Zealand was able to secure its market whilst other non-Empire countries such as Argentina collapsed.

The effect of the depression on the international economy was a drop in the ratio between foreign trade and production. In other words, products in many countries were shifted from the export to the local markets. In New Zealand, however, it was not that easy to shift its export products, mainly due to its highly export-oriented commodities and small domestic market. Thus, New Zealand had less movement towards self-sufficiency compared to other countries, and this exacerbated the impact of the Great Depression on New Zealand.

The government attempted to counter the depression through a series of policies. In 1934, the government founded the New Zealand reserve bank to stabilize its financial turmoil. Policies

on employment, industry, and import licensing were also released in the 1930s. The Primary Product Marketing Act in 1936 and 1953 was designed to protect the country's export commodities, and this was followed by more specific policies such as the Dairy Board and the Apple and Pear Marketing Act in the next two decades (Moran et al, 1996). The end result was new state policies oriented towards state intervention. With regard to the second food regime, New Zealand had found its place, partly, in line with other industrialized countries in Europe within the mercantilist regime.

The following decades in the global economy put New Zealand in competition with the EEC. As Britain joined the EEC in 1960s, it reduced its import share from non-EEC countries and consequently, after 1973, New Zealand was forced to reposition nearly all its exports to other countries. This caused problems for the New Zealand dairy industry in particular, as the EEC had a secure supply of dairy products from its members such as the Netherlands and Denmark (Hawke, 1985; Le Heron, 1993). Moreover, it was not until the late 1980s that the Asian market really opened for dairy products, after which Asian milk consumption per capita increased significantly (Delgado, 2003). Thus, Le Heron (1992) notes a significant decrease in New Zealand's exports to Britain in the period between 1960 and 1980, and concurrent increases in exports to other destinations, mainly the US, Australia, and Japan. This also conforms to the second food regime as it indicates a shift of the centre of accumulation from Britain to the US. Le Heron also shows that for a short period in the 1970s, New Zealand dairy exports decreased. While difficult, this situation was not entirely a bad thing, as it created the perfect conditions for the growth of the New Zealand kiwifruit industry.

5.3.3. Early development of kiwifruit in New Zealand (1906 – 1960s)

There is a broad literature that historicizes the development of kiwifruit orcharding in New Zealand; but David Yerex and Westbrook Haines deliver the story in a narrative and personal way through their book, *The Kiwifruit Story* (1983). The story starts in the early 1900s, at which point no one in New Zealand had heard of the kiwifruit. That was because no such name existed during the period. Kiwifruit was introduced to New Zealand as the 'Chinese gooseberry' in 1906 (Yerex & Haines, 1983). It fruited for the first time in New Zealand in 1914 and was first sold to the market in 1917. However, there were no high hopes for the commercialisation of the Chinese gooseberry as it functioned mainly as an ornamental plant.

Around 1924, Bruno Just and Hayward Wright developed a new variety of the fruit, which is known to the present day as the Hayward variety (*Actinidia deliciosa*). In 1937, the first commercial orchard began to operate on 8.5 acres of land in Te Tumu, Bay of Plenty. Since then, consumers' acceptance of the fruit has grown quickly and this put the Chinese gooseberry in a strategic position within the New Zealand domestic market. A government ban on fruit imports in 1940 as a response to a strong protectionist actions between countries resulted in the further spread of this exotic fruit in New Zealand and people started diversifying their orchards to include the Chinese gooseberry.

The 1950s signify the early growth of the industry as the fruit was being promoted overseas, particularly to Britain and the US. The predominant global food relations were, however, centred on basic commodity markets between the US and third world countries (Friedmann & McMichael, 1989), making it hard for New Zealand to establish a new market for Chinese gooseberries. The first shipments to the UK in 1952 and to the US not long after were meant to cater to the upper classes in both countries that were longing to experience new exotic fruits (Yerex & Haines, 1983; Green, 2002). Turners and Growers Ltd, one of the prominent produce companies in New Zealand, worked to handle the marketing of the fruit with overseas outlets in the US. Due to US sentiment toward China and the high tariff rate placed on the gooseberry, Jack Turners elegantly changed the name of the commodity to 'kiwifruit' in 1959 for better consumer acceptance (Green, 2002; Webby, 2004).

Interestingly, the fruit had already been introduced to the US three decades before New Zealand began to export it. In 1935, California horticulturalists had begun to experiment with the kiwifruit (McKendrey & Sale, 1984). However, only after New Zealand kiwifruit was marketed to the US did commercial planting begin to be taken seriously. In the early 1960s, Frieda Caplan of Frieda Inc., a Los Angeles fruit trader that acted as a kiwifruit importer, extensively promoted kiwifruit in the US (Lyall, 1987; Green, 2002). In 1970, commercial plantings of kiwifruit covered 20 hectares of California farmland, increasing to 600 hectares by 1977.

The same phenomenon occurred in the Europe. Italy, with its southern Mediterranean production zone (Le Heron, 1993), was first to adopt kiwifruit agriculture in 1959. Other European countries such as France, Greece, and Spain soon followed. There are four reasons why the kiwifruit was easily adopted in Europe (McKendrey & Sale, 1984). Firstly, as a new

exotic fruit, kiwifruit showed a promising market and profitability in the near future. As Emily Green in her article in the *Los Angeles Times* (2002:3) notes,

> "… while California started the international fashion for kiwifruit, Europe made it a craze. Sliced kiwifruit became a signature garnish of nouvelle cuisine. For pastry chefs, it became the required topping for cream tarts. The French, likening the whole fruit to mice dangling from vines, named it 'souris vegetales' or 'vegetable mice'. Italians, noting that the fruit had twice the vitamin C content of an orange, dubbed it 'frutto della salute' or 'health fruit'."

The remaining reasons had more relevance to the European agricultural situation of the 1960s. Economic uncertainties over existing crops, the emerging regime of CAP that pushed Italy to move out of a reliance on a single commodity like grapes, and technical development assistance made it easier for Europe to adopt the kiwifruit (McKendrey & Sale, 1984). It is arguable that the introduction of kiwifruit to the European and US market occurred in conjunction with the global system states created by the changing structures at the end of the second food regime. The development of the kiwifruit industry in its production centre in the Bay of Plenty strongly substantiates this structural argument, as the following narrative will show.

5.3.4. Dramatic growth of the kiwifruit industry (1970 – 1980s)

Geographically, the Bay of Plenty is a fertile area rich in volcanic soil, with a warm climate and consistent rainfall, thus making it highly suitable for horticultural production (Campbell & Fairweather, 1998; Green, 2002). In addition, it is in a prime location near a harbour that provides the kiwifruit industry with access to pack houses and storage facilities. But prior to the 1970s, aside from the early planters such as Jim McLoughlin, the strongest form of commodity production in the area was in fact dairy farming. So what happened in the area in the 1970s?

As kiwifruit consumption boomed in Europe and US during the 1960s, many New Zealanders began to take notice of kiwifruit. Yerex and Haines (1983) note the rise of second wave growers, during which producers from different backgrounds, in the city as well as in rural areas, were investing in kiwifruit. Hawke (1985:239) also notices that "… in 1970s, as horticulture became more attractive there was probably a genuine increase in small holdings

[of the kiwifruit industry], although kiwifruit developments were attractive too to urban professionals" (239). It caused a kiwifruit production boom in the 1970s (Campbell & Fairweather, 1998). But what also played an important role for this boom were uncertainties within the dairy sector. With the EEC regulating the international price of dairy products in Europe, the New Zealand dairy industry was in a disadvantageous situation (Hawke, 1985). During this transition, farmers consequently responded to the market opportunities that were available to them, with some shifting from dairying to horticulture or selling their land to that effect. To illustrate how lucrative kiwifruit production could be, 190 acres of land used for dairy production only generated NZ$80,000 of income. A kiwifruit orchard of the same acreage could produce a profit of up to $3 million (Yerex & Haines, 1983). The conditions in the Bay of Plenty were documented by Yerex and Haines (1983:45-46) who point out that:

> "The Dairy company was in a difficult position; most of the dairy farmers who had not already broken up their farms and moved into growing kiwifruit, looked on this new industry as a nine-day wonder and were doubly aggrieved that dairying land should be taken over by these 'damnable sprawling vines'. They had already reduced milk production in the district and so increased the factory's unit costs."

The kiwifruit market grew rapidly in the 1970s, with expansion to France, Germany, Japan and Korea. In 1973, the Japan market alone accounted for 6% of New Zealand's total export earnings. At that time however, kiwifruit was only considered as an exotic, alternative fruit, thus needing a boost in marketing. Although the growth of the kiwifruit sector was remarkable, Hawke (1985:238) also notes that "…their growth rates were achieved from levels that were very low relative to the traditional pastoral products and a major switch to horticulture remained mostly a hope for the 1980s rather than a proven achievement." In the early 1970s, the Kiwifruit Export Promotion Committee was founded as a voluntary group to help kiwifruit industries manage their sales (McKendrey & Sale, 1984). It brought a positive effect, as the market was soon to stabilize and increase steadily. However, apparently the industry was not ready for such an improvement. The production became chaotic, leading to undersupply and disorganization of marketing channels. Finally in 1977, the government stepped in through the establishment of the New Zealand Kiwifruit Authority (NZKA). The newly founded authority had a role not only in the marketing, but also in setting standards for export and licensing exporters.

The effort proved successful. The year 1978 was marked by a rapid increase in the area of kiwifruit plantation which was followed by an exponential growth in production and export (See Figure 5.1). But the growing market was not solely attributed to New Zealand. The global production of kiwifruit also increased fourfold in the mid-1980s as the perception of the kiwifruit shifted; rather than an exotic fruit, kiwifruit came to be seen as a mass-consumed fruit (OECD, 1996). The total area of kiwifruit planting worldwide increased nearly 70% in only two years from 13,762 hectares in 1981 to 23,150 in 1983, with New Zealand accounting for 52% of the total planted area (Kernohan & Sale, 1983; McKendrey & Sale, 1985; see Figure 5.2).

Arguably, the New Zealand kiwifruit industry had entered a new phase of global development in which fresh fruits and vegetables, in terms of value, dominated the global food markets. Regardless of the influence of the existing second food regime, New Zealanders have shown their resilience by bringing kiwifruit to world market at a time when the fruit was least favourable. From that point, the efforts successfully helped to initiate the resurgence of new circuits of capital, thus demonstrating New Zealand's capacity as an agent of transformation. The New Zealand kiwifruit industry had successfully become what Le Heron (1993:191) termed 'the harbinger of a third food regime'.

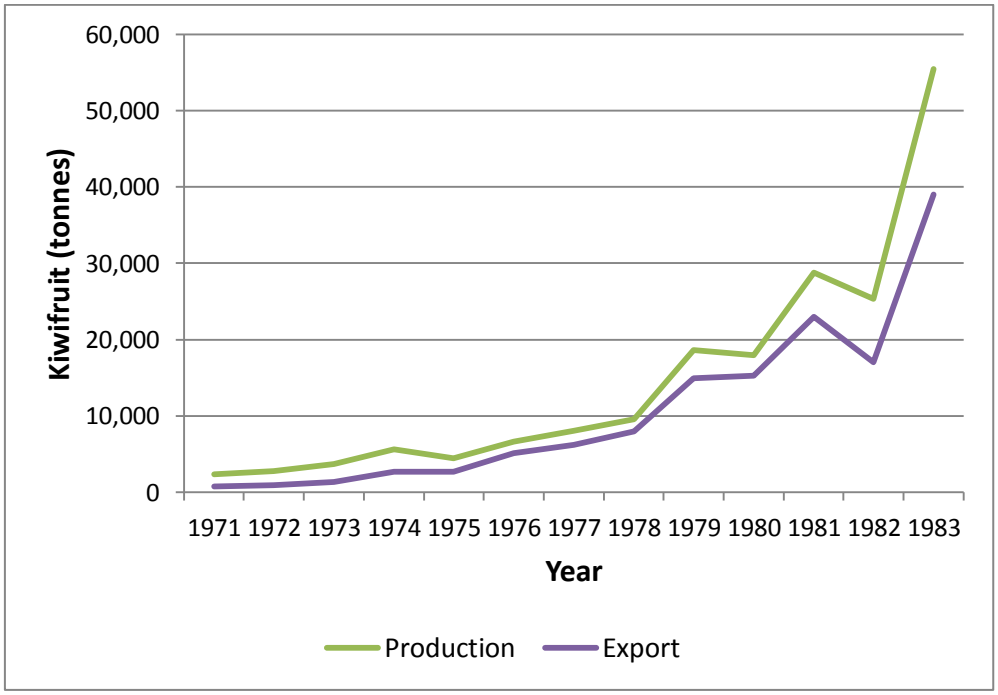

Figure 5.1. Increase in New Zealand kiwifruit production and export between 1971 and 1983 (Source: Kernohan & Sale, 1983; McKendrey & Sale, 1984)

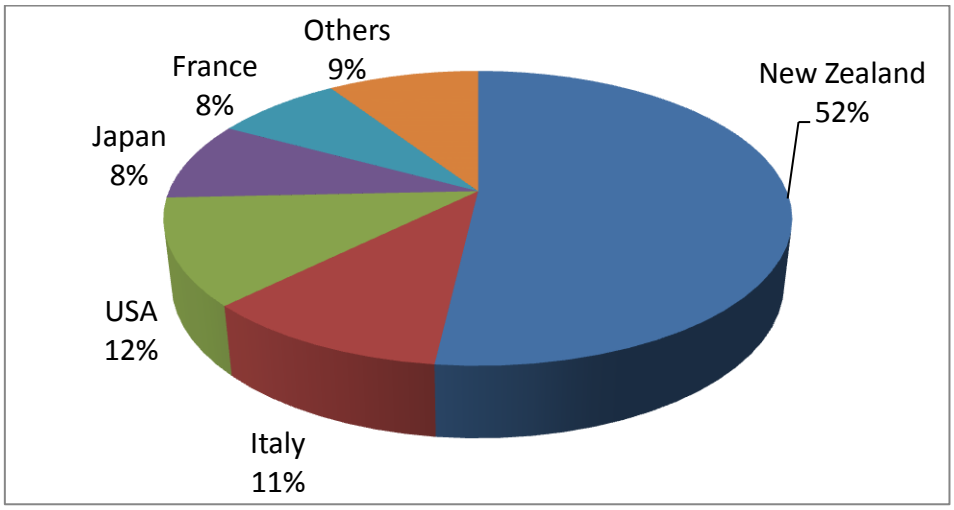

Figure 5.2. Share of total kiwifruit production area in 1983 (Source: McKendrey & Sale, 1985)

5.3.5. Crises and restructuring (1990s - present)

A new regime providing a good climate for global fresh fruit trade was not necessarily a good thing for New Zealand as it meant more competitors threatening the country's market share. As it turned out, the industry reached its peak in the 1980s and from that point experienced several crises due to an amalgamation of shocks, including: (1) a fall in the international price as the result of increased competition in the late 1980s (Kilgour et al., 2008), (2) the Italian residue crisis in 1991 (Campbell & Fairweather, 1998), (3) US anti-dumping disputes in 1991 (Hoadley, 1997), and (4) agricultural and financial restructuring in New Zealand that peaked in the kiwifruit price crash in 1992 (Le Heron, 1993; Campbell & Fairweather, 1998). I address these shocks not as a mere coincidence, but as sequential events forming a 'domino effect' for the New Zealand kiwifruit industry.

The emergence of other kiwifruit producing countries significantly affected New Zealand exports. As can be seen in Figure 5.3, between 1979 and 1983 New Zealand exports of kiwifruit to its four main markets – namely, Germany, Japan, US, and Australia – began to stagnate (McKendrey & Sale, 1985). This is also shown in Figure 5.4 where, between 1982 and 1984, there was a slight decrease in the total export of kiwifruit, followed by a decline in kiwifruit prices. For New Zealand, the situation was aggravated by the fact that, in 1984, the country deregulated its agriculture and macro-economy to comply with GATT's regime of free trade. New Zealand shifted its monetary policy to floating exchange rates and revoked all

government interventions in the agriculture sector (Le Heron, 1993). These changes produced chaotic results in the orchards as well as in marketing channels.

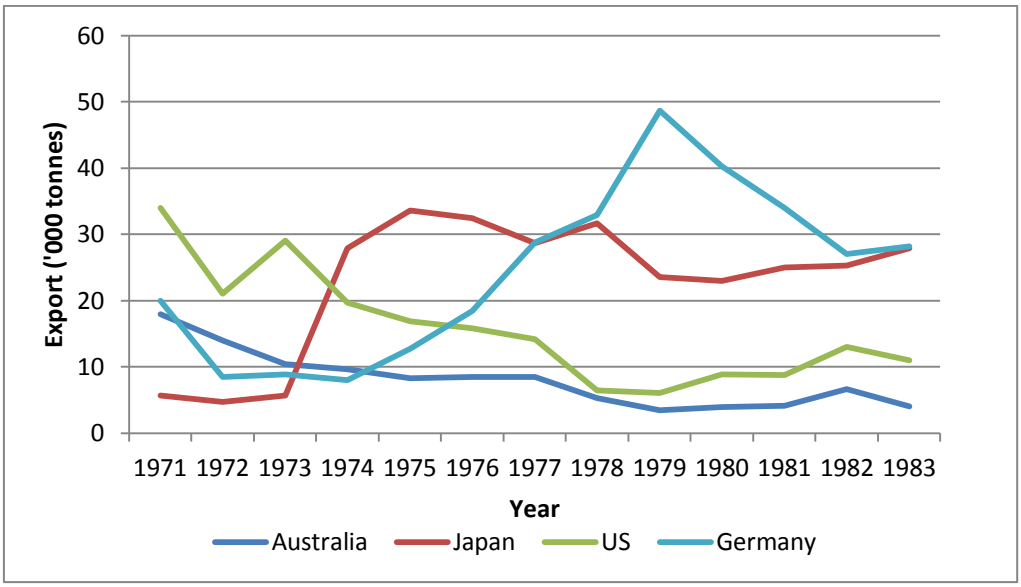

Figure 5.3. New Zealand kiwifruit export to its principal markets, 1971 – 1983 (Source: McKendrey & Sale, 1985)

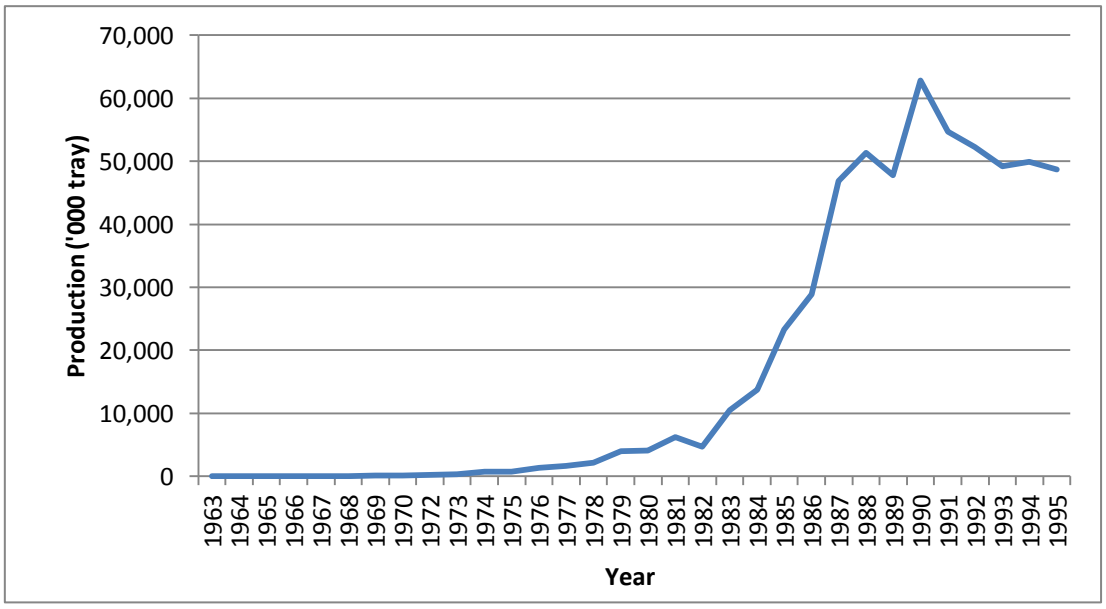

Figure 5.4. New Zealand kiwifruit production, 1963 – 1995 (Source: Webby, 2004)

The resulting financial pressure adversely affected kiwifruit growers in three ways. First, decreases in the world kiwifruit price had reduced growers' incomes significantly. Second, the government removed agricultural subsidies, leaving the growers without any economic

support. Third, the strengthening of the New Zealand currency during the period 1986-88 resulted in a reduction of farm export earnings. The repercussions spread to the marketing channel as the licensed exporters failed to cooperate in the face of rising demands. As Le Heron (1993:167) notes, "... exporters had little control over total marketing, competed with each other on selling price and on harvest price, exercised no control over whom fruit was sold to and did not attempt to verify sales as reported". However, this shock was manageable as New Zealand still controlled 55% of the European market and held 87% of Japan's total fruit import (Laing et al., 1985). Moreover, as production in the northern hemisphere contracted between 1985 and 1989 (OECD, 1996), New Zealand growth was expected to return to normal. In 1988, the government addressed this situation by establishing the New Zealand Kiwifruit Marketing Board (NZKMB) to take control of kiwifruit purchasing, distributing, and marketing, a policy that for a short period proved to be successful and helped to overcome marketing problems (Le Heron, 1993; Campbell & Fairweather, 1998).

Despite the decline in the global production, the expansion of kiwifruit orchards in other countries was remarkable. Between 1988 and 1993, Italy had become the biggest producer of kiwifruit (OECD, 1996; Kilgour et al., 2008). This was not a major problem as Italian production complemented New Zealand's in terms of seasonality. European local production covered seven months from November to May, while New Zealand exported kiwifruit from May to December. There was only a short period of oversupply from November to December, during which international prices fell abruptly. However, in the early 1990s, Chilean kiwifruit production grew spectacularly and, in 1993, the South American country positioned itself as the third largest kiwifruit producer after New Zealand (Kilgour et al., 2008). This exposed the New Zealand producers to critical shocks due to the simultaneous export period of these two southern hemisphere countries. This new competitor had deeply shaken the New Zealand industry.

The emerging third food regime is characterized by continued globalized food productions alongside health and environmental concerns, providing a loophole for Italy to maneuver against New Zealand's domination of kiwifruit exports. Through CAP, the European community set Maximum Residue Levels (MRLs) for imported fruits (Campbell & Fairweather, 1998). In 1991, Italy claimed to detect excessive pesticide residues in New Zealand kiwifruit, forcing New Zealand to withdraw its products from the European market.

The stiff competition in kiwifruit trade in Europe, as well as New Zealand's control over the market share in the US, threatened the economy of Californian kiwifruit growers as well. The US market share in Europe dropped significantly in the 1990s (OECD, 1996). This raised negative sentiment toward New Zealand, whose export was at that time controlled by a single marketing board, the NZKMB. After years of trade dispute between the US and New Zealand, the California Kiwifruit Commission (CKC) finally filed a suit against alleged dumping performed by the NZKMB (Hoadley, 1997). An embargo resulting from the suit was only temporary; but it cost New Zealand tens of millions of dollars in legal fees and lost sales. A resulting supply vacuum during this period opened the door for Chilean kiwifruit to enter the US market, and decreased New Zealand's share of the US market significantly (OECD, 1996).

The series of crises reached its peak after another severe price crash occurred in 1992, which led the marketing board to insolvency (Campbell & Fairweather, 1998). New Zealand experienced a decline in production area due to competition, down 12% between 1990 and 1991 and then 25% in 1993-1994 (OECD, 1996). The situation pushed the kiwifruit industry to a decisive point at which a transformation was needed to get the industry back on track. It was apparent that an undifferentiated kiwifruit industry would not be viable in the era of trade liberalization; the consequences of such a situation were evident in the Chilean kiwifruit industry, which was extremely prone to price shocks because it had not specialized in quality (OECD, 1996). The New Zealand kiwifruit industry decided to conform to the emergence of 'food safety and environmental sustainability' scheme later associated with the EurepGAP (Campbell, 2005) and the GATT Uruguay Round by restructuring orchard management practices through the KiwiGreen program (Campbell & Fairweather, 1998). It implemented integrated pest management (IPM) and, in some orchards, converted its practice to organic farming. These strategies were achieved in 1997, and in 1998 New Zealand had rebranded its kiwifruit as an environmentally friendly commodity produced under 100% integrated management (Rosin et al., 2008). It was a dramatic change for New Zealand kiwifruit but, in the short term, the country had re-secured its place in the global kiwifruit market.

In 1999, the government implemented the *Kiwifruit Industry Restructuring Act* and *Kiwifruit Exports Regulation*. It strengthened the NZKMB's position, with Zespri Group Ltd. as its operating company and as a near-sole authority to purchase and market kiwifruit overseas,

with the sole exception of the Australian market. In the following year, Zespri released Zespri^{TM} Gold, a new variety of kiwifruit introduced for specialized markets. With its differentiated products, Zespri was able to earn a premium price in the global kiwifruit market (Kilgour et al., 2008). After periods of reorganization in its value chain, the New Zealand kiwifruit industry under the management of Zespri International had once again emerged as a robust agrifood corporation (Parminter & Max, 2004; Kilgour et al, 2008).

During the same time, an organisation of European food retailers had established an audit mechanism for healthier and environmentally friendly agricultural products called EurepGAP (Campbell, 2005). This proved to be a welcome development for New Zealand kiwifruit, as the newly established Zespri International and the KiwiGreen program largely complied with this audit mechanism. Zespri also led the development of EurepGAP for kiwifruit in the first place. It became the first global corporation that was accredited by EurepGAP, and was presented to the world as a success story regarding the EurepGAP audit alliance. Since 2003, all kiwifruit export growers in New Zealand have been compliant with the audit scheme; thus EurepGAP secured a privileged market for the New Zealand kiwifruit industry (Rosin et al., 2008).

The continued development of Zespri has been exceptional. In order to expand its market to supply kiwifruit throughout the full 12 months, Zespri established overseas production areas in eight countries under its own brand in 2006 (Kilgour et al., 2008). New Zealand kiwifruit production has also increased incrementally during the past 10 years. Based on FAO data, in 2008 New Zealand became the top exporter of kiwifruit, reaching 376,000 tons and US$690 million of value, a more than two-fold increase from the last two decades in terms of quantity as well as value (FAO, 2011).

This rapid growth depicts not only an exceptional development of the New Zealand kiwifruit industry, but also a new growing market and center of capital accumulation with regard to food regimes. With a saturated kiwifruit market and contracting economies in Europe, Parminter and Max (2004) forecast that a potential growth will be centred in South, East, and Southeast Asia. This is further supported by the increasing economic growth of China, India, and other Asian countries (Driver et al., 2012). The research and development of new kiwifruit varieties therefore is orientated to meeting the growing demand in these markets. Ferguson (2011) reviews the development of these new varieties that occurred

simultaneously in New Zealand as well as other kiwifruit producing countries (particularly in China, Italy and Chile). Zespri had prepared at least three new varieties of kiwifruit (namely Gold3, Gold9 and Green14) in response to pressure from Turners & Growers that was also producing several new varieties. A series of market-tests had been carried out since early 2010, focusing on the tropical sweet taste preferred by the Asian palate.

The rapid growth of the New Zealand kiwifruit industry as well as its alignment with new and growing global food circuits is now challenged by a serious crisis at the orchard level caused by bacteria called *Psa*, which significantly altered the current trajectory of the industry. PSA was first discovered… and has created a profound crisis for the New Zealand industry. One question, thus, emerges: How can an organism so small have such a huge impact at a national, or even global, scale? I argue that food regime theory is not the most appropriate viewpoint from which to address such a question, and in Chapter 7, I propose actor-network theory as a better means to investigate this phenomenon.

In regard to food regime analysis, the narrative so far has demonstrated that the development of a global commodity such as kiwifruit, in an export-oriented agricultural country like New Zealand, is influenced to some extent by the dynamics of the global food relations. The next question is: does the same hold true for a domestic-oriented, culture-based, and subsistence production as represented by Indonesia's rice agriculture? The following narrative will address this question.

5.4. Rice Agriculture in Indonesia

5.4.1. Introduction

This section discusses rice, a commodity that lies at the heart of the Indonesian, and most of Southeast Asian, agriculture and food systems. For Indonesia, rice supplies 35 – 67 % of the total calorie intake of the population and its consumption has been increasing from 1970 to 1990 (Gerard et al., 2001; BPS, 2012). In terms of production, of the 237 million people in Indonesia, 42% of them are farmers with rice as their main commodity, mostly concentrated in the island of Java. The total rice agriculture area in 2009 reached 12 million hectares with total production of up to 64 million tons of rice (BPS, 2012). In addition, rice is not only an Indonesian staple food; it is also part of Indonesian culture and identity (Lamourex, 2003).

Interestingly, Indonesia has become both the third largest producer of rice and, at the same time, one of the largest importers of rice in the world (Hill, 2000; Dawe, 2002; Timmer, 2004; FAO, 2011). As one of the largest rice importers in Asia, Indonesia's economic and political situation has a very significant influence on the volatile international rice market (Dawe, 2002; Irhamni & Nuryakin, 2009). Conversely, rice price fluctuations also have a serious impact on the livelihood of the majority of farmers and urban poor in Indonesia (Dawe, 2001; Timmer, 2004). At the farm level, environmental problems such as drought and pest outbreaks have been shown to exacerbate the effect of price fluctuations (Rolling & van de Fliert, 1994; Keil et al., 2008). Furthermore, unequal wealth distribution in rural areas is considered an aggravating factor for poverty and food insecurity (Husken & White, 1989).

Nonetheless, throughout the long history of its development in Indonesia (stretching over more than twelve centuries from the 900s to the present day), rice agriculture has experienced many shocks and disturbances in the face of which it maintains a fascinatingly resilient state. In contrast to the Irish potato famine in 1840s (Fraser, 2003), Indonesian people somehow have been able to 'survive' and adapt to the ongoing shocks in considerable ways. The subsequent review is intended to provide a historical overview of the development of Indonesia's rice agriculture, and thus to identify the shocks related to its dynamics. I categorize the period of development based on significant changes in social and agricultural state (i.e. pre-colonial [900s – 1800s], colonial [1800s – 1930], revolution and post-independence [1930 – 1965], the 'New Order' regime [1965 – 1998], and post-reform era [1998 – present]); most of these periods were preceded by momentous shocks and followed through a pattern in a manner that resembles repeated and prolonged adaptive cycles. To some extent, this pattern also parallels the boom-bust pattern depicted in food regime theory, as I will investigate in the following narrative.

5.4.2. Pre-colonial history

Many studies have investigated the origin of rice and how it spread to the whole region of Asia, and in particular Southeast Asia. Robinson (2004) notes the first record of rice grain-imprints in pottery from Thailand, dating back to 3,500 BC. Christie (2007) also notes that rice originated from the Irawaddy, Mekong, and Yangzi river deltas in mainland Asia, and was brought to Indonesia by Austronesian settlers 2,000 years ago. There is evidence that the first rice in Indonesia was cultivated as a dryland crop in the form of swidden agriculture

(Peacock, 1973; Christie, 2007). This form of agriculture is still practiced in several traditional communities in West Java, particularly in hilly areas (Soemarwoto, 2007).

The transition from dryland to wetland rice agriculture occurred between the ninth and tenth centuries in ancient Java. Throughout that period, rice became not only a major subsistence crop in Java, but also a market commodity and the basis of agricultural tax systems in several small kingdoms in the region. Because it is part of the geological 'Ring of Fire', Java consists of fertile volcanic soils. Rivers that run straight from the volcanic mountains supply high nutrients for wetland agriculture in the surrounding areas, thus anchoring the population in those locales (Christie, 2007). A sophisticated irrigation system was later developed that eventually reached its peak during the Majapahit era in the sixteenth century, before starting to disintegrate by the nineteenth century (Booth, 1985).

Around the main cities, rice was also produced commercially (Christie, 2007), and was exported to other trade cities in the Indonesian archipelago, such as Malaka, Aceh, Ternate, and Tidore (Reid, 1999). As mentioned by Reid (1999) in *The Modern History of Southeast Asia*, the king of Banjar, a kingdom of Java, once "… closed all coastal cities, centralizing power and monopolizing the country's principal export, [which was] rice" in response to the Dutch monopoly during the seventeenth century. Nevertheless, data regarding the production and marketing of rice during this period are very scarce.

5.4.3. Colonial era (1800s – 1930s)

It is only after the fall of Java to the Dutch in the nineteenth century that more comprehensive data about agriculture is available. Thomas Stamford Raffles, the English Governor of Java at that time, noted in his renowned book, *The History of Java* (1817), that the island was sparsely populated and only one-eighth of the land was productive in terms of agriculture. With a population of 4.62 million people in 1815, almost all of them were absorbed into the agricultural sector, with commodities such as sugar, rice, and indigo being exported for the foreign market (also noted in Husken & White, 1989). During the period of Dutch colonialism, the population in Java increased six-fold within 85 years. The growth was followed (or probably influenced) by the increase in wetland paddy fields (*sawah*). Although between 1817 and the 1860s rice agriculture was identified as a subsistence form of farming,

the period from 1880 to 1915 showed a rapid growth in *sawah* area as well as in rice production, reaching 50% and 55% increases in land and yield respectively (Booth, 1985).

In the social context, Booth (1985) as well as Husken and White (1989) identified the formation of social class within the agricultural societies in Java. In 1870, the social structure consisted of village officials who controlled a large area of *sawah*, peasants with a small portion of land, and landless laborers; the latter two groups constituted 95% of the total rural population (Husken & White, 1989). Aside from the 5% of social elites, most of the population comprised a homogenous group of rural subsistence farmers. The phenomenon of colonization increased the level of poverty and, thus, intensified subsistence agriculture and promoted traditionalism among the peasants, as described by Geertz (1963) in terms of 'Agricultural Involution'.

What Geertz did not see during those periods was that there was already commercialization of agriculture (Booth, 1985; Husken & White, 1989). Peacock (1973) describes how peasants prefered social stability over economic growth, thus assigning rice trading to middlemen, who were mainly of Chinese ethnicity. Subsequently, commercialization had emerged by the late 1800s. During that period the Chinese middlemen controlled the rice trade in Java, and almost 75% of peasants' income was in the form of cash (Husken, 1989). As was also noticed by Husken and White (1989), traditional in-kind payment for rice production labor had transformed into a cash-wage by 1922.

One of the reasons for this commercialization was the Dutch policy on agriculture, namely, the Cultivation System or *kulturstelsel* in 1870 (Palmier, 1965; Husken & White, 1989). By means of this policy, the Dutch endeavoured to transform Java's farming system into commercial cash crops opened to the world market; in Java this was done mainly through sugarcane. In the most arable area of *sawah*, particularly in Central and East Java, the peasants were forced to cultivate sugarcane during the dry period in rotation with rice. Although the Cultivation System ended in the 1900s, larger farmers still produced sugarcane and had better access to the sugar market than small peasants. In short, 20 years of the Cultivation System increased the inequality between peasants and large farmers.

To some extent, the birth of agricultural commercialization in Java was caused by global dynamics. Recalling the first food regime between 1850s and the 1930s, major circuits of

agricultural commodities connected occupational colonies in tropical regions to their centre of accumulation in European empires; in the case of Indonesia sugar and indigo were the principal commodities. Concurrently, a distinct food circuit with rice as its principal commodity also emerged in the South and Southeast Asian region (including China and India), thus creating an intraregional food circuit with Singapore (Huff, 1989), Hong Kong (Latham & Neal, 1983), and Japan (Hayami & Ruttan, 1970) as its centres of accumulation. Yet, as this second circuit predominently functioned through trade routes that operated external to the centre of regulation, it could be considered as only a portion of the global food structure. Indeed, small amounts of rice were also exported to London through major trade centres such as Batavia (now called Jakarta) and Singapore. These centres thus acted as connecting points between the Southeast Asian and European axis of accumulation (Latham & Neal, 1983). International rice prices were clearly influenced by production factors, considering that rice was produced in that particular region was affected by the same climatic conditions. Interestingly, with regard to the global food regime, Latham and Neal (1983) demonstrate that rice prices were also influenced by, and fluctuated in harmony with, British wheat prices, mostly as the result of Indian export and consumption of both commodities. As Latham and Neal (1983:273) note:

> "[T]here were substantial international movements of rice year by year, and that the high correlations between the various series of international rice prices suggest that there was an international market in rice before 1914. This international rice market met the international wheat market in India, rice and wheat forming an integrated market there as close substitutes. Indian wheat, however, was part of the international market in wheat, and it was in India that the wheat world and the rice world met to form a single international market."

5.4.4. Revolution and Post-independence (1930 – 1965)

Global trends in European societies during the culmination of colonization also affected Indonesia[12] and its agriculture. In response to European societies' protests against the uncivilized treatment of people in the Dutch colony, the Netherlands implemented the Dutch Ethical Policy in the early 1900s to boost the welfare of Indonesian people (Palmier, 1965), particularly through education and agriculture infrastructure. The Dutch targeted wealthy and

[12] Prior to its independence, Indonesia was generally known as the Dutch East Indies or the Netherlands India (Huff, 1989). For the sake of consistency, I use the name 'Indonesia' to avoid confusion.

middle class peasants, who they identified as the motor of Java's economy, in the hope that they could improve the productivity of agricultural practice in Indonesia. During the implementation of this Ethical Policy, irrigated land in Java had expanded incrementally. In the 1920s, well-educated farmers began to implement a 'proto-Green Revolution' by increasing the crop ratio and occasionally applying chemical fertilizers to farms (White & Wiradi, 1989). Nonetheless, the targeted policy once again increased the social inequalities in rural Java as the affluent generated much greater harvest yields than the poor.

The Great Depression of the 1930s, however, indirectly lessened social disparities in Indonesia. Husken (1989) notes that during the crisis, Chinese trade in rice fell considerably. The wealthy farmers lost control over lands and peasants, and as rice prices in the world market rose while domestic rice production decreased, people started to lose the capacity to purchase rice and, consequently, replace rice with maize and cassava in their subsistence diets (Booth & Damanik, 1989). The situation is depicted by Husken (1989; as also noted in Husken & White, 1989) as a 'decommercialization' period. In the 'outer provinces' of Indonesia, particularly Sumatra and Borneo, rice shipments from Java decreased considerably, creating a stronger trade connection between these two islands and Singapore. Huff (1989) records an increase in rice import from Singapore from 31% to 36% for the period between 1925 and 1937. It is documented that Singapore engaged in a barter trade system with Indonesia's outer provinces, with the former receiving commodities such as copra, gum, pepper, and rattan in return for rice and Western manufactured goods (Huff, 1989:182). In the subsequent years during World War II, when Japan took over Indonesia, a new circuit of rice was formed with Japan as its centre (cf. Hayami & Ruttan, 1970), during which rice was forcibly taken to feed the Japanese army (Vickers, 2005).

Indonesia claimed its independence from Japan in 1945 and from then experienced a series of wars with the Dutch up until the Netherlands finally acknowledged Indonesian sovereignty in 1949. But after that, the post-independence era was characterized by considerable political turmoil and an inflation crisis in the Indonesian economy. Nonetheless, the first president's efforts to revitalize rice agriculture during this period is worth noting. In the 1950s, farmers were reluctant to shift to intensive agriculture (Hill, 2000), particularly due to the low supply of fertilizers. In the case where farmers were able to access the fertilizers, they prefered to apply it only in small quantities (White & Wiradi, 1989). During this period, the government

campaigned for intensive agriculture by supplying the farmers with 'national improved' seeds, artificial fertilizers, and mass guidance by scholars and activists, a period known as the 'proto-Green Revolution' (Husken & White, 1989). Whilst the peasants' socio-economic state (the result of inflation and land reform) had been one of the issues raised during the political turmoil, the wealthy farmers still functioned as a buffer against economic depression in their role as money lenders, hirers, and purchasers for the peasants. In terms of trade, the government policy at that time forbade the Chinese traders from participating in rural trade (Husken, 1989). Yet, the Chinese traders seemed to evade the restriction through their networks with the local elites in rural areas.

In the world market, the international rice price was maintained at a constant, albeit high level. This was due to the rise of Southeast Asian exporter countries: Thailand, Burma, Cambodia, and Vietnam. Their rice production surpluses gave the world market a continuous supply of rice, even during periods of disaster, e.g. the 1954/5 La Niña and the 1957/8 El Niño phenomena which decreased regional rice production per capita (Dawe, 2002). Problems began to arise in Indonesia during the mid-1960s. The hyper-inflation that Indonesia experienced due to long-lasting political turmoil (Husken & White, 1989) was followed by the 1965 El Niño event which devastated rice production and produced a national food shortage. Simultaneously, the international rice price fluctuated drastically as several exporters exited the market for political (Vietnam, Cambodia, and Burma) as well as economic reasons (Thailand). This resulted in an unstable rice price (Dawe, 2002), which severely affected Indonesia in combination with inflation, i.e. the domestic rice price increased by more than 700% (Lamourex, 2003).

5.4.5. New order regime and intensive agriculture (1965 – 1998)

It is worth noting the relationship between Indonesia's political dynamics and the emergence of the second food regime that was centred on the US during the transition period to the 'New Order Regime[13]'. The US influence over Indonesia was not evident prior to the New Order Regime due to Indonesia's strong inclination towards the Soviet Union. Only after the fall of Soekarno (the first president) did the new wave of supports and aid arrive at Indonesia's front gate. The food crisis that occurred in 1965 was neutralized after the coup, after which the new

[13] The New Order Regime is a term used to explain the revolution within Indonesia as it was orientated more towards the western bloc after the rise to power of President Soeharto; it should not be confused with the term 'regime' in food regime theory, although correlation may appear.

president, Soeharto, opened the country to foreign investment and aid (Sumarto & Suryahadi, 2007). As a result, wheat entered Indonesian markets; but as in the case of Japan (McMichael & Kim, 1994), its entry did not shift society from its staple food. The aid focused more on technical assistance toward the improvement of Indonesian rice agriculture. In the late 1960s, the government, with the help of FAO, restructured rice agriculture through three strategies: (1) introducing High Yielding rice Varieties (HYVs) to farmers, mainly from the International Rice Research Institute (IRRI) in Los Baños, Philippines; (2) giving subsidies for agricultural inputs and credit; and (3) stabilizing the farm-gate price (Gerard et al., 2001). The first two strategies were accomplished by programs such as BIMAS (*Bimbingan Masal*, lit. mass guidance) and the establishment of rural organizations in the form of KUD (*Koperasi Unit Desa*, lit. rural cooperatives) and BRI (*Bank Rakyat Indonesia*, a bank for small farmers in rural areas). Meanwhile, the third strategy was carried out by BULOG (*Badan Urusan Logistik*, lit. State Food Logistic Agency), a government agency which functioned as a price stabilizer. BULOG worked by setting both a floor and ceiling price for rice, while also maintaining rice reserves to keep the price within this price range, i.e. purchasing rice from farmers during the main harvest and releasing this rice to the market when scarce. This mechanism, although effective, was considered very costly and inefficient (Timmer, 2004).

These agricultural strategies were challenged by several events in 1972-3, including a severe El Niño-related drought throughout the Southeast Asia region (Gerard et al., 2001), followed by the international food crisis and oil price crisis between 1973 and 1975 (Friedmann, 1993). Dawe (2002) documents the cascading effect of significant decreases in rice production in Southeast Asia which caused many of those countries to reverse their rice export policy, and consequently created a sudden shortage in the world rice market. Because rice demand was very inelastic, an abrupt deficit of rice inevitably resulted in soaring rice prices during that time (see Figure 5.5). These enduring shocks put Indonesia in one of the worst situations in its food security history (Hill, 2000; Husken & White, 1989). The condition was exacerbated by the continuing 1974 – 1977 severe pest (Brown Plant Hopper) outbreak (Rolling & van de Fliert, 1994) and 1974 student protests against foreign investment (Hill, 2000). Within that period, Indonesia imported 30% of the world rice market, and positioned itself as the largest rice importer in the world.

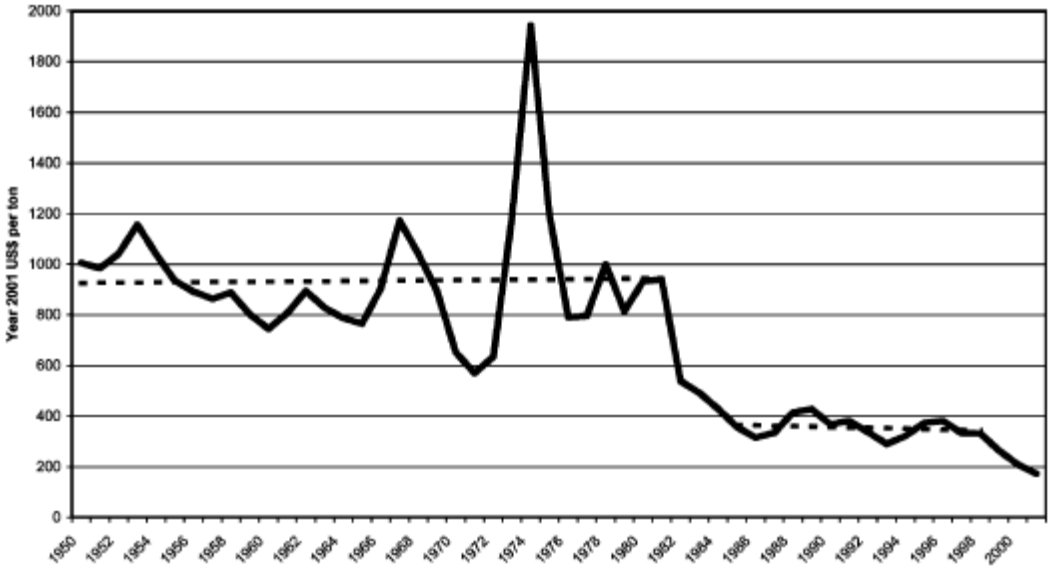

Figure 5.5. Inflation adjusted world market rice prices, 1950 – 2001 (Source: Dawe, 2002)

Interestingly, these coinciding shocks did not cause Indonesia's food system to collapse. This persistence was the result of two main factors: increased revenues from Indonesia's large oil deposits and the strengthening effect of the Green Revolution. While the former factor acted as a direct buffer for the crises, the latter had a more gradual effect. Hardjono and Hill (1989) report an increase in sawah area of 17.3% between 1971 and 1984, in particular due to the completion of Jatiluhur dam in 1974 which supported an irrigation system in the northern coast of West Java. By 1981, dissemination of the technology and tools of agricultural mechanization had proved to be successful. In a survey conducted by White and Wiradi (1989), most farmers in Java had adopted the utilization of chemical fertilizers and pesticides, while HYVs had been commercially planted throughout Java except in a certain area in Cianjur. Larger farmers acted as early adopters of the Green Revolution during the late 1960s (Husken, 1989) due to better access to the technology, although over time there proved to be no difference between classes in terms of technology adoption (White & Wiradi, 1989).

Rice agriculture in Indonesia showed consistent increases in yields in the early 1980s. In 1982/3, another El Niño-related drought occurred, but not as severely as during previous events. In 1984, the government announced that Indonesia had achieved a state of food self-sufficiency (Gerard et al., 2001), with 70% of economic growth being supplied by agriculture (Booth & Damanik, 1989). During that period, Indonesia was able to export its surpluses of

rice and reduced poverty in both urban and rural areas (Sumarto & Suryahadi, 2007). Indonesia faced another pest outbreak in 1986, but this time it did not affect BULOG's rice stocks to a significant level. Nonetheless, the government implemented a new policy of Integrated Pest Management (IPM) in 1987 and suppressed the pest population for a longer period. Subsequent drought in 1991 only made a relatively small impact as demonstrated by a slight importing of rice. This stability was also supported by favorable conditions in the global market. The international rice price was becoming more stable as the prominent exporter countries (Thailand, Cambodia, and Vietnam) re-entered the world market. Furthermore, new exporters such as Bangladesh, Pakistan, and even the US joined the market in the early 1990s, lowering the rice price in the long term and providing a stable and promising situation for rice farmers in Southeast Asia (Dawe, 2002).

5.4.6. Crises and post-reform era (1998 – present)

However, the calm usually comes before the storm. During the mid-1990s, Indonesia was starting to see declining vitality in the agricultural sector. Problems in agriculture began to arise, but these problems were masked as Indonesia focused more on the growth of its industrial sector. After 1990, the government removed the subsidy for pesticides (Rolling & van de Fliert, 1994), and later for chemical fertilizers as well (Gerard et al., 2001; Sumarto & Suryahadi, 2007). Economic growth began to stagnate and Indonesia's resources began to deplete as well, due to an over-subsidised agriculture sector and a highly corrupt government. The situation was worsened by the Asian Financial Crisis in 1997. Following this crisis, Indonesia, which was financially exhausted at that time, shifted its monetary policy to a floating exchange rate, resulting in a dramatic depreciation of its currency and a sudden collapse of its import-based manufactures.

Yet, it was another crisis that was perceived as a greater threat by most farmers. Bourgeois and Gouyon (2001) describe how farmers in Java were more concerned about an impending environmental shock, namely, another El Niño-related drought. Due to this long drought and subsequent delay in the rainy season, farmers had to change the cropping cycle from twice to three times a year. This was a mistake for it provided a conducive environment for another insect pest outbreak - the Brown Plant Hopper (BPH) - something that had not happened in a decade since the implementation of IPM systems. The economic crisis exacerbated these problems because most farmers could not afford to buy unsubsidised pesticides and fertilizer.

Even though most of the countries in Southeast Asia were badly affected by periodic El Niño Southern Oscillation (ENSO)-related droughts, supply of world rice was still stable as many countries outside the region took part in the rice market (Dawe, 2002). This in turn provided a stable rice price during that period. Unfortunately for Indonesia, the simultaneous occurrence of serious inflation caused the domestic rice price to rise by 91% in June 1998 and 230% in September 1998, which was followed by a drop in real income (Gerard et al., 2001). 1998 was characterized by political turmoil, particularly by the fall of Soeharto and massive riots, similar to the political events of 1966, and this turmoil forced a fundamental reform, *Reformasi*, throughout the government's policies and structures. The economic crisis faced by Indonesia was relieved by IMF's financial assistance; but it came at a large cost – Indonesia was forced to rescind all tariff and non-tariff barriers, as well as direct subsidies of its agricultural commodities.

Under the IMF-scheme, the new government had to devise a way to stabilize the social crises without intervening in the domestic rice prices. Its strategy was to channel the subsidies to more targeted beneficiaries, namely the rural and urban poor. Policies such as Raskin (*Beras Miskin*, lit. Rice for the Poor), BLT (*Bantuan Langsung Tunai*, lit. Cash Direct Aid), Social Safety Net, and OPK [14] (*Operasi Pasar Khusus*, lit. Special Market Operation) were implemented as substitutions to BULOG's input and price subsidies (Irhamni & Nuryakin, 2009), and secured the Indonesian socio-economic situation for subsequent years.

With regard to the two competing trajectories discussed in the context of a third food regime, Indonesia now stands at a crossroad between the two global food circuits. Within the last decade, Indonesia has been among the ten biggest importers of wheat (FAO, 2011), thus showing its strong attachment to the wheat complex advocated by the US and its TNCs. Indonesia has also become a supporter of GM-food, opening the door for Monsanto and other seed manufacturers to enter Indonesian markets through the ratification of the Cartagena Protocol on Plant Variety Protections (Deswina & Prasetya, 2009). However, trends toward healthier commodities promoted by alternative food networks have also garnered attention in Indonesia through major campaigns by organic movements, growing markets in Indonesia's upper class societies, and various government programs. Organic products were also exported

[14] Raskin is subsidized low-grade rice for the poor, Rp.1,000/kg with regular price of up to Rp.4,500/kg; BLT is a direct incentive to poor people as much as Rp.100,000/month; OPK is a market operation to inspect rice shortage and supply it with rice stocks

as high value commodities to major developed countries such as Europe, Japan, US, and Australia (Giovannucci, 2005). But the most important factor that complicates the situation of Indonesia within the WTO-based food regime, and that is most relevant to Indonesian rice agriculture, is a domestic countermovement against trade liberalization (Anderson & Martin, 2009). In the first 2001 Doha Development Round, Indonesia, leading the other G33 members of developing countries, argued for the exemption from tariff reduction schemes of several special products – including rice – that were of crucial significance to these countries' food security. As noted by Anderson and Martin (2008:80),

> "… the Group of 33 developing countries, led by Indonesia … is arguing for additional special and differential treatment for developing countries in the form of exemptions from agricultural tariff cuts for special products and for a special safeguard mechanism that would allow these countries to impose tariffs that are even higher than the bound tariffs in years of likely import surges".

Despite much criticism from scholars and practitioners, the government's decision to maintain its protectionism toward rice proved fruitful. During the presidency of Abdurrahman Wahid, the government increased the import tariff barrier for rice to 25% (Fane & Warr, 2009), and at some periods during the main harvests even closed the rice import market to avoid a sudden decline in the price of rice (Timmer, 2004). This mechanism led to a lower rice price in the international market after 2000, which favoured Indonesia and other rice-importing countries (Dawe, 2002). At that time, the newly elected President, Susilo Bambang Yudhoyono (SBY), was determined to regain Indonesia's self-sufficiency with regards to rice. Although he failed to do so in 2007 as Indonesia imported more than 1 million tons of rice that year (FAO, 2011), this was successfully accomplished in the next year, thus showing Indonesia's capacity to survive the World Food Crisis in 2008 (FAO, 2009a; FAO, 2011).

5.5. Conclusions

In the case studies discussed, both New Zealand (particularly the kiwifruit industry) and Indonesia conform to the rise and decline of the global food regimes to some extent. In the New Zealand case, the early development of kiwifruit in the 1950s has gone through difficult periods, and New Zealanders' efforts to introduce kiwifruit to the global market had only resulted in an insignificant portion of the existing agrifood trades. But their efforts helped to build a foundation for the development of the industry in the next two decades. During the

transition in the 1970s to the third food regime, which was characterized by global circuits of fresh fruit and vegetables, kiwifruit stood out strongly as an emerging lucrative commodity. In the late 1980s, as the third food regime revealed its other facets -- namely, the environmental concerns and trade liberalization -- New Zealand kiwifruit faced serious shocks that led to major restructuring, but nevertheless showed once again its resilience in the face of global changes.

New Zealand's strong integration within these global dynamics raises at least two questions for further investigation. Firstly, as the New Zealand kiwifruit industry has become highly dependent on global stability, to what extent will the industry respond to any forthcoming global shocks? An assessment of the influence of global dynamics, including factors such as stricter European import policies and the expansion of Chinese kiwifruit production (Anker-Kofoed, 2008), suggests a significant negative impact on the New Zealand kiwifruit industry. The recent European debt crisis and the rising value of the New Zealand Dollar are indicative of further shocks for kiwifruit exports. A global approach such as food regime theory provides an appropriate tool with which to analyse such dynamics.

Likewise, it is also apparent that Indonesia's rice agriculture, although intended solely for Indonesian consumption, has never been able to escape the influences of the global structure within which it resides. By seeing the situation in a wider context, particularly through the food regime perspective, it becomes clear that Indonesia has a proven ability to persist despite enormous global turbulence. Rice in Indonesia *per se* has never been a major part of international commodity markets; but as a large developing country, Indonesia has become the subject of global market interests, especially given its strategic position connecting Asia with Australia and New Zealand (Lewis, 2008). This, in turn, has affected the way Indonesia set its agricultural policies. But up to a certain point, Indonesia has also acted as an agent against the hegemony of existing food regimes, either in its repudiation of the US food aid program or the struggle to maintain tariff barriers for rice in the WTO's Doha development (and liberalisation) round.

However, to say that Indonesia's rice agriculture is resilient to global dynamics is only partially true. On one hand, it is true because the long development of rice agriculture in Indonesia has proven it to be so, showing its robustness and adaptability to survive various stresses and disturbances during the course of history. But the cost that Indonesia has had to

endure in doing so has sometimes become unbearable. Famine and food insecurity in several remote areas (FAO, 2009b), massive riots in cities as well as political instability (Husken & White, 1989; Gerard et al., 2001), and an excessive usage of the country's capital (Timmer, 2004) are only a few examples of this cost. This touches on a never ending debate about the future of Indonesia's agricultural policy. Should Indonesia open its domestic rice market to a liberalized international trade? Or should it maintain its protectionist policy for the sake of social stability? Many researchers have argued against the latter, demonstrating the inefficiency of such a policy with regard to Indonesia's financial state (Timmer, 2004; Simatupang & Timmer, 2008; McCulloch, 2008), while others encourage a transformation in Indonesian agriculture to a more export-oriented practice (Dillon, 1999).

This raises two questions with regard to interpreting the resilience of food systems: How are these global shocks translated at the local level? And how do the local actors respond to such shocks? For instance, in the case of EurepGAP, Rosin et al. (2008) have noted the efforts New Zealand kiwifruit orchardists had to make to adjust to the changing global schemes. However, the latest research performed by van den Dungen et al. (2011) shows that the orchardists seem to adapt to these external shocks in variable ways, although some of them have also shown a form of resistance. Addressing local dynamics and their relationship with global phenomena has been a point left unobserved in food regime theory (Pechlaner & Otero, 2010). Similarly, in terms of rice agriculture, questions such as "what is it about rice that drives Indonesia to act so strongly against global shocks?" are not easily addressed by food regime theory. In concluding this section, I argue for a micro-level theory that might elucidate such questions. Chapter 6 and 7 explore the use of a more complex approach at a smaller scale to answer these particular questions in the context of rice and kiwifruit agrifood systems' resilience.

CHAPTER 6 THE MULTIPLICITY OF RICE IN INDONESIA'S AGRIFOOD SYSTEM

"Rice [for Indonesians] is irreplaceable, as it has been here since a very long time... [It] is not just a commodity... The concept of rice is interesting and we can't find it in other countries. Here, we know four forms of rice: pari, gabah, beras, and nasi." (Agus, State Logistic Agency)

6.1. Introduction

The previous chapter described Indonesia's rice agrifood system and how rice is both related to the dynamics of food regimes and resilient to global shocks. However, at the end of the chapter, one question remained unanswered: why is rice so pivotal to the resilience of the overall system? The structuralist perspective of food regime theory failed to provide a satisfactory answer to this question. As a result, in this chapter I focus more directly on the components of the food system to comprehend such an issue. The question revolves around the role of rice in shaping the system's resilience. But how significant is rice? Could it be that the significance of rice's influence on the system is such that it should be assigned agency, in a similar manner to the humans? I am particularly intrigued by such a controversial question, and argue that another controversial theory is required to answer it: actor-network theory (ANT). Actor-network theorists, as Bruno Latour claims, "... [are those] who are following common sense. For them, controversies about agencies have to be deployed to the full, no matter how difficult it is so as not to simplify in advance the task of assembling the collective." (Latour, 2005: 50).

In my attempt to elucidate the above questions, this chapter is designated as a story about rice. The story, however, is not entirely about rice, as so many different actors are attached to it. This is a story in which rice is the leading actor, while other supporting actors, both humans and non-humans, negotiate, enrol, and betray one another. The theme is about the resilience of Indonesia's rice food system. Indeed, its resilience is, for me, a paradox. On one hand, rice brings within itself what it takes to drive the resilience of the overall system. It is a very adaptable plant, able to adjust to broad range of environments – from a dry uphill area at the feet of the Himalayas, to deep pools of water in tropical Asia (Hanks, 1972). Its durability is fascinating, as it has been able to exist for more than 15,000 years of human history without changing its function and identity as the staple food for a human population (Lu & Chang, 1980). Its fluidity is no less so, as it appears as more than 112,000 varieties, each with interchangeable traits and properties (Bray, 1986; IRRI, 2012).

On the other hand, rice's resilience is not only about its physical entity. To borrow John Law's argument, rice is "... an effect generated by a network of heterogeneous, interacting, materials" (Law, 1992: 383). Rice appears as it is today not merely because of its features, but also because of the meaning acquired through the relationships it shaped with other actors. Pests and diseases, climate, water, and soil negotiate with farmers and research centres to determine which rice should be planted in a particular area. Consumers, traders, and technology negotiate on tastes, qualities, and quantities of rice being produced. Community groups attach themselves to particular rice varieties for cultural reasons and dietary preferences. Furthermore, the government and political parties have brought the meaning of rice to a different level, as a political tool with which to enrol the whole networks of Indonesian society. Here, the multiplicity of rice (Mol & Law, 2002) is noteworthy as it shapes the complexity of the rice food system and, in this case, its resilience.

The quote at the beginning of this chapter was the answer I received when I asked one of the participants in my fieldwork, "What is it about rice that makes the system so resilient?" For the respondent, it was not only about how rice is produced at the agricultural level. Instead, it was the way rice is embedded within the society; the way it acts in multiple ways. In the Indonesian language, there are different words to explain different forms of rice: *padi*, *gabah*, *beras*, and *nasi*. This also implies that a different actor-network is being represented by each name. *Padi* is the rice plant. It is the actor known by, and that interacts with, the farmers, research centres, soil, pests, and climates. *Gabah* is the un-husked rice grain. It is the symbol of harvest yields and productivity, and the result of many actors interacting and negotiating with each other. *Beras* is the ready-to-cook milled rice. It is subject of on-going negotiation between farmers, traders, BULOG, and consumers. There are two main features that determine this negotiation: price and quality. *Nasi* is the end-product of the rice agrifood system, the cooked form of rice resulting from a personal interaction between *beras* and the consumers.

In the subsequent parts of the chapter, I will present the story of rice beginning with rice as a plant, from the farmers, all the way through the harvest, market and reaching the consumers. As is typical of a good story, the first part of this chapter will introduce the reader to the main actor – its character, where it came from, and how it has become what it is now. The story will then continue with the introduction of the supporting actors, the way they enrol to the networks, the negotiations that take place along the way, as well as the conflicts and betrayal

at the story's climax. The story will end with a resolution – a 'moral' of the story – that is none other than a deeper view of the resilience of Indonesia's rice agrifood system.

6.2. Rice Varieties

I am fascinated by the way rice makes itself known to humans. Many researchers, who have acted as spokespersons for rice to western society in particular, start their introduction with an expression of amazement at the adaptability of rice (see Hanks, 1972; Bray, 1986 for instances). While other researchers would prefer to describe rice in less apparent ways, their main highlight was always its capacity to adapt (Mikkelsen & de Datta, 1980; Lu & Chang, 1980). As one author said,

> "'True rice', *Oryza sativa*, is an amazingly adaptable plant. It grows like wheat on dry slopes as well as in deep pools of water... [O]n the basis of latitude it might also be grown in southern New England [in USA]. We have found upland rice fields in Thailand at altitudes approaching 4,500 feet above sea level as well as in the brackish tidal flats of the Gulf of Siam. In the Himalayas rice is said to grow at altitudes of 10,000 feet above sea level." (Hanks, 1972: 17)

6.2.1. Properties of rice

Rice grows in a very wide spectrum of conditions. Although it is known mainly as a semi-aquatic plant that thrives in swampy areas, it can also grow in dry areas (Lu & Chang, 1980; Bray, 1986). Its flexibility with regard to diverse water-soil regimes is enhanced by the development of a system of air passages connecting the roots and the shoot, enabling the plant to tolerate inundation during certain periods of its growth (Bray, 1986). In fact, certain varieties of rice are not only tolerant to water, but also benefit from flooded conditions. Mikkelsen and de Datta (1980) note that precipitation and water, by and large, enhance nutrient availability, help with nitrogen fixation, and create favourable microclimatic conditions for rice growth. Some varieties have also adapted to the extent that the water level flooding the stem of rice acts as an indicator for the initiation and ripening of its fruits (Vergara, 1980).

But how did the figuration[15] of this particular actant (Latour, 2005) actually come about? The scientific name *Oryza sativa* L. was applied to the cultivated form of rice in Asia by renowned botanist, Carl Linnaeus (hence the acronym 'L' at the end of the name), in 1753. Since that time, several botanists have tried to assign additional names to this species, through synonyms such as *O. glutinosa* Lour., *O. montana* Lour., *O. praecox* Lour., and *O. aristata* Blanco (Vergara & de Datta, 1996). The diversity of names shows the extent to which the variability of this single species was already challenging attempts to categorise it at that time. More recently, botanists such as Vergara and de Datta (1996) have tried to describe the morphology of rice, only to show that it could appear in different forms as combinations of morphological variables.

6.2.2. Origins of rice

However, as often occurs with a fluid object (de Laet & Mol, 2000), it is not easy to define the boundaries of rice through a name. What is rice and what is not? For this, it is also important to track the origin of rice, even long before it was named as such. It is known from this historical examination that, for instance, rice was previously gathered in its wild types (Lu & Chang, 1980). The morphology of these wild types might not be so different from the cultivated types of today, with one significant difference: the wild types were perennial plants. This means that rice was available year after year for the gatherers to consume. It was not until 10,000 – 15,000 BC that annual forms of rice appeared in association with cultivation practices.

It is also understood that the cultivation of rice began independently and concurrently in different parts of the world (Londo et al., 2006). Its annual forms are thought to originate from East India, Southeast Asia, and Southwest China (Lu & Chang, 1980; Bray, 1986). It is estimated that 10,000 years later, rice had successfully replaced root crops and other cereals as the staple food of people living in Asia. This came at a cost. Lu and Chang (1980) note that during domestication, the frequency of cross-pollination with other *Oryza* had declined, limiting its fluidity to those individuals bearing the specific traits. Based on this condition,

[15] According to Latour (2005), figuration means giving a shape to anything or anyone that acts (actant) so that it becomes an actor; i.e. it has significance to the actor-network analysis. By figuration, a non-human can be analysed in the same manner as human.

taxonomists[16] were able to agree that the species of domesticated rice, *Oryza sativa*, had emerged during those periods of selection. But the issue of defining rice does not end there.

Even as its ability to cross-pollinate diminished, rice continued to be a fluid actor that adapted to any environment in which it was cultivated. Domesticated by the early Asian settlers, rice formed three eco-geographic races based on their affinities to specific ecological and geographic characteristics. The first was the *sinica (japonica)* subspecies, its name reflecting its origin in temperate Asia (China and Japan). The second was *indica*, including the tropical rice varieties from India and the Southeast Asian region (Lu & Chang, 1980; Hanks, 1972). The third subspecies had only been identified in 1958 as *javanica* to designate a similar race to *japonica*, but with significant differences in several characters (Bray, 1986), particularly in its affinity to tropical environment. Thus, for some researchers, the *javanica* subspecies is also known as *tropical japonica* (Londo et al., 2006). Of course, this classification is only intended to identify the large groups of Asian rice; in reality varieties have always increased along with the on-going breeding and cultivation processes in different geographic areas. Lucien Hanks noted this as he wrote:

> "As rice cultivation spread, each new field with its peculiar qualities of light, moisture, temperature, and soil set the conditions for advantageous mutations and directions of variation. Year after year each locality of cultivators selected the handsomest, the tastiest, and the most sweetly perfumed to plant in the coming year. Where settlement or strain of seed remained stable, there developed the special virtues that characterize each variety, bearing the scars of drought and epidemic, the shape and color that please" (Hanks, 1972: 18).

At this point, it is necessary to detail the characteristics of the relevant subspecies, as these are vital for our subsequent analysis of rice as an actor. Table 6.1 presents the characteristics of the *japonica*, *indica*, and *javanica* subspecies. The traits that significantly separate the *indica* and *javanica* subspecies from *japonica* are their responses to the duration of sunlight and temperature. *Japonica* responds to changes in duration of sunlight in terms of its maturity (i.e., the initiation and development of the fruits) better than the other two subspecies. By contrast the former is relatively insensitive to temperature.

[16] There is consensus among taxonomists that the definition of a species is based on its capacity to interbreed with varieties of that species. Mayr (as cited by Ruse, 1969: 98 – 99) defines species as "... groups of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups."

This raises an implication regarding where each of these three races are cultivated (alternatively, I might also argue that the location in which these races are cultivated determine these characteristics). *Japonica* is cultivated in Japan, China, and other temperate Asian regions, areas that show significant seasonal changes in the duration of sunlight. This type of rice grows quickly during the long-day period (summer), and matures when the day length is getting shorter (mid-autumn). Temperature does not influence the plant's performance, however, as *japonica* can grow continuously despite a fluctuation in the temperature, which often occurs in the temperate region. Both *indica* and *javanica* share a common feature as both are cultivated in tropical region, where the length of day is the same all year round. An important environmental variable that these subspecies have to negotiate is temperature, with the increase in temperatures during the dry monsoon season indicating the right time to ripen its fruits. The *javanica* subspecies is somewhat less sensitive in this regard and, thus, has a good reputation for its ability to grow on dry upland areas of swidden agriculture (Asai et al., 2009).

Table 6.1. Characteristics of three subspecies of *Oryza sativa**

Japonica	*Indica*	*Javanica (Tropical Japonica)*
Oval-shaped grains	Long grains	Broad thick culmed grains
Quickly become sticky	Remain separated when cooked	Intermediate
Medium tillering	Profuse tillering	Low tillering
Intermediate stature	Tall – intermediate stature	Tall plant stature
No hairs	No hairs	Long hairs on the husk
Medium shattering	Easy shattering	Low-shattering
Soft plant tissue	Soft plant tissue	Hard plant tissue
Responsive to changes in duration of sunlight	Unresponsive to duration of sunlight	Unresponsive to duration of sunlight
Insensitive to temperature	Sensitive to temperature	Insensitive to temperature
Temperate (high altitude)	Tropical (low altitude)	Tropical (low to high altitude)

*) Source: Lu & Chang (1980); Hanks (1972); Bray (1986); Asai et al. (2009)

The reason why I introduce these three subspecies in advance is that each of them, or at least *indica* and *javanica*, has become the main actor in different networks of the rice food system in Indonesia. *Javanica* was, and in some areas still is, the most commonly grown subspecies of rice in the island of Java. It has become well-entangled with the life and practices of Javanese people. The extended negotiation between rice and humans is the basis of a rice culture that colours Javanese people in many ways – through their foods, ceremonies, agricultural practices, and philosophies (Adimihardja, 1992; Soemarwoto, 2007). In the next

section, I explain how the characteristics of *javanica* both define and conform to the traditional agricultural practices of communities in west Java.

The *indica* subspecies, by contrast, is known as the predecessor of modern varieties of rice, particularly in Southeast Asia (Herdt & Capule, 1983). The International Rice Research Institute (IRRI), established in Los Banõs, Philippines in 1962, was responsible for translating this subspecies into what were known as the High Yielding Varieties (HYVs) of rice, taking into account the negotiation with actors such as the growing population, pests, diseases, and the monsoon climate. The results were (at least) three modern varieties of semi-dwarf *indica* rice: IR8 that utilized fertilizer more efficiently so as to attain higher yields, IR20 that contained the genetic capacity to resist pests and diseases, and IR36 that matured faster (Herdt & Capule, 1983:2). As these varieties were brought to Indonesia through the *Balai Penelitian Tanaman Padi* (Indonesian Centre for Rice Research, ICRR), ICRR translated them into even more varieties that supposedly fit the local environment. The third subspecies, *japonica*, was unnoticed by many Indonesians for years, as it had never been significantly enrolled to their society. My personal experiences regarding this subspecies would have been through Japanese restaurants that appeared in Jakarta in the early 2000s, where *japonica*, or the so-called sticky rice, was an essential part of their menu.

In the subsequent parts of this section I will examine more closely the ways these subspecies attempt (and succeed and fail) to enrol, negotiate, and betray the networks of Indonesian society and, by doing so, to bring the other actors with them. But it is neither the development of new technologies nor the emerging controversies that interest me, at least not in the way we normally look. Instead, the story will circulate around the fluidity of rice and the capacity for that fluidity to create openings for new actors to attach themselves to the network. *Javanica* and *indica* have become agents that influence the way in which Javanesse farmers practice traditionalism and modernism in agriculture, respectively, as the story will follow.

6.2.3. Javanica: The remnants of the local varieties in west Java

My investigation of the traditionalism of rice in Java leads me to one particular community in west Java known for its love[17] of rice. It is said that their life and culture circle around rice;

[17] The term 'love' was used metaphorically by De Laet and Mol (2000) to underpin the importance of material objects to which human actors place their affinity.

and not any rice, it is specifically the *javanicas.* Kasepuhan is a Sundanese[18] cultural enclave at a remote location inside a nature reserve area, the Halimun-Salak National Park (Figure 6.1), around 180 km from Jakarta, Indonesia's capital city. The community consists of about 20,000 individuals living in scattered villages around Mount Halimun, at elevations between 700 and 1,200 meters above sea level (Soemarwoto, 2007). They are mostly farmers, practicing rice agriculture for subsistence, along with commercial farming and harvesting of other commodities such as palm sugar, *kapol* (cardamom), and cloves. It is hard to estimate the total area of Kasepuhan, as the practices of swidden agriculture provide the community with a flexible land base through opening of new forest areas. However, due to a limited amount of accessible land and issues around productivity, their practice of swidden agriculture (*huma*, or dryland rice farming) has been reduced significantly and replaced by *sawah* (wetland rice agriculture). Hence, to this point, we can still witness two types of rice farming system in Kasepuhan, with *sawah* dominating paddy fields at the lower altitude and *huma* dominating fields in the highlands.

The road to the villages is not easily accessible by regular car, as part of the area is still a dense forest. For me then, it was either on foot or to take an *ojeg*, a transportation service using a motorcycle adjusted to the heavy track and with a very skilful driver. Considering the time I would have taken to get there on foot, which would be around 10 hours, I chose the latter option. Even then, we had to stop regularly for the driver to check the machine for damage (Figure 6.2). The journey took us about 4 hours in total, but we had to spend a night in one of the villagers' house at the perimeter of the area as it was too dark to continue the journey. The inaccessibility of Kasepuhan, particularly decades ago during which no infrastructures had ever been made through it, was probably one of the reasons why they could still preserve their culture undisturbed.

[18] Sundanese is a culture group that resides particularly in the western part of Java; their cultural practices resemble those of Javanese, but with some distinct characteristics. Historical studies suggest that the early settlers arrived in west Java, bringing with them the dryland rice agricultural practices. It was not until the Mataram kingdom of central Java brought influences to the Sundanese that they started to practice the wetland rice agriculture (Adimihardja, 1992).

Figure 6.1. Map of Halimun-Salak National Park (Source: BTNGHS)

Figure 6.2. The road taken to access Kasepuhan

The first person I interviewed was enthusiastic to tell me about their philosophies around rice. The following information is largely based on this interview. It is commonly known that Sundanese and Javanese cultures, as a part of pre-Islamic animism as well as influenced by

Hinduism, acknowledge *Dewi Sri*[19], the Rice or Prosperity Goddess, to be their central figure in terms of agricultural activities. It is said that *Dewi Sri* was once a princess adopted by *Batara Guru* (Shiva in Hinduism), but then killed by one of his mistresses (in another version by *Batara Guru* himself). She was buried in the land of Java, and from her body grew rice, coconuts, and several other crops important to the people (Wessing, 1988; Newland, 2001). For Kasepuhan, *Dewi Sri* is not an external power regulating rice and their other crops (as most cultures normally perceive their deities), but she is the rice herself. She is the personification of rice. Hence, it is not peculiar that they treat rice in a very reverential manner, through a set of rituals and taboos surrounding this particular product, even to ways of cooking and consuming it. For them, rice is irreplaceable, stating that "without rice, we could not live" (as also recorded in Adimihardja, 1992:57).

In Kasepuhan, life is seen as a cycle – a metaphor that is also represented in their agricultural activities, from preparation to planting, harvesting and preparing the next year in an annual cycle. At the final stage of the rituals, they have what is called *serah taun*, a ceremony open for all members of the community (and even for outsiders as a tourism event) to celebrate the achievement of their harvests and to plan for the coming year.

The Kasepuhan people also acknowledge taboos within their everyday life. While there are no formal penalties for breaking these taboos, they believe that something bad will happen to them or to their family members as a result of doing so. For example, one person claimed that he had experienced four years of unexplained illnesses due to performing a bad deed. Another person had had to come to a hospital every month for a year without the doctors knowing his illness, until he had finally stopped his misconduct. A *dukun*, or shaman, known to cure people having these illnesses, explained the kinds of taboos that were commonly violated. Interestingly, most were related to rice and included activities from production to consumption: planting the modern varieties of rice, using machines and pesticides for farming, still planting paddy after *tutup nyambut* (cease period[20]), planting rice more than once a year, mixing different varieties of rice in the barn, selling rice (or taking part in the process, such as being a waitress in a restaurant), cooking rice not in an orderly manner, stepping on rice, and even throwing away leftover rice. The 'punishment' did not always

[19] There is a plethora of studies conducted regarding *Dewi Sri* and Javanese mythology on rice and agriculture; for further references on this see Wessing (1988), Heringa (1997), and Newland (2001).
[20] A cease period is a period where all rice planting activities have to be stopped. The logic behind this is that it synchronizes the harvest period, which consequently reduces the risk of pest outbreak occurring in a prolonged harvest time.

occur in the way it was expected though. For instance, the community leader mentioned that one farmer had used a machine to plough his field, but nothing happened to him. This reflects the possibility that not all people used the taboos to structure their social relations with rice.

Returning to our earlier discussion on *javanica* subspecies, one question remains: why does the Kasepuhan community still grow and preserve *javanica*? Why do they not cultivate different types of rice? To answer this, it is important to see the way *javanica* rice has been enrolled deeply into the community in a relatively stable network. There are three factors underlying this, as I will explain using ANT terms: (1) its fluidity (de Laet & Mol, 2000), (2) its successful negotiation, and (3) its ability to meet the Obligatory Passage Point (OPP) (Callon, 1986).

The *javanica* subspecies has proven to be a fluid actor within the Kasepuhan community. In 1997, the community reportedly had 146 landraces[21] of rice, classified on the basis of their relative sacredness and characteristics of the grain (*buhun*, ancient; *biasa*, regular; or *ketan*, glutinous), their affinity with a water-soil regime (in *sawah* or *huma*), and the elevation at which they are planted (Soemarwoto, 2007). For instance, *Srikuning* is an ancient landrace present in *sawah* between low and medium elevations. The sanctity of rice also influences cultural protocols. For example, *buhun* rice has to be planted as a prerequisite for farming, on a particular dry-land called *huma,* and with very stringent rules on the procedures of planting. Thus, *buhun* rice is maintained as a constant reminder of the cultural identity within the community. Aside from this, it is the prerogative of each farmer to decide which landraces to cultivate, including the ability to develop personal landraces. As a result of such practices, the community leader claimed that, at the time of our interview, there were more than 500 landraces of rice in the community.

The cultivation of rice in Kasepuhan can also be understood as the negotiations between the farmer and non-human actors such as soil, water, climate, and elevation. For instance, the community leader described such negotiation regarding the community's response to a changing climate:

> "Climate change is indeed influencing the farming pattern, but our *kalender tani* (agriculture calendar) will still be based on what we have agreed upon. Any

[21] I agree with Rini Soemarwoto (2007) in using the term 'landraces' instead of 'varieties' or 'cultivars', as they are identified based on the community's traditional method, and that a further analysis might prevail that there could be two or more landraces representing a single variety, *vice versa*.

> adjustment that we make will only be about the types of rice planted that fit with that climate, such as planting those that are more flood or drought-resistant, etc." (Community leader)

Without realizing it, the community and the rice have developed resilience toward climatic shocks by maintaining the variability of landraces, each of which adapts to specific environmental conditions. This achievement has also been noted by Soemarwoto (2007) in her explanation of risk management in Kasepuhan.

The second factor in *javanica*'s role in the community's resilience is the successful negotiation between rice, the community, and to some extent the environment. Revisiting the characteristics of *javanica* in Table 6.1, four important features relate to the way rice negotiates with the community with regard to their cultural practices: the tall plant stature, the hard plant tissue, the low-shattering character of the grain, and the common upland tropical growth areas. The first two features conform to the way traditional farmers in Southeast Asia use finger knife, or *etem* in Sundanese, to cut the rice stalks from the straw. For Kasepuhan people, rice harvesting is an intimate engagement between the farmer and his crops. The *etem* allows them to treat each stalk in a manner that gives the farmer the opportunity to distinguish between good and bad plants for the purposes of seed selection (Soemarwoto, 2007), in addition to preserving a form of cultural practice (Bray, 1986).

The tall plant stature is particularly suitable for this reason as well. Using the *etem* is a very painstaking work, as farmers have to inact with each plant individually. A taller plant makes the job much easier eliminating the need to bend low to cut off the stalks. Another feature that is of importance for the community is that the rice stalks do not shed the grains easily. It is important because they store the dried rice in stalk bundles, and an easy-shattering variety is impractical for this type of storage method. The stalk bundles are put in a *leuit*, a small rice barn, resembling a house of 4.5 square meters or a larger one of 8 square meters (Figure 6.3a). It is said that every household owns at least one *leuit*, but all the farmers interviewed possessed two to four. Every small *leuit* has a storage capacity of up to three tonnes of rice bundles. Some bundles are kept in storage for four years, showing two important features of the rice variety. Firstly, the shelf-life of rice in its un-husked form can extend to several years without significant change in food or seed qualities. Of course, some of the participants claimed that the rice would become yellowish and a little bitter in taste; but aside from that it is still palatable and they do not really have a problem with that. Secondly, the existence of

four year old rice in the barn implies there has been a surplus in the production of rice each year, or at least sufficient, for the individual farmers as well as the whole community to allow stock pilling. In circumstances where rice production is compromised due to climatic shocks, the community depends on a communal barn called a *leuit si jimat* (Figure 6.3b) located at the central village. Everyone can borrow rice from this barn at any time, and replace it with the same amount he/she has borrowed after the next harvest period. One community elder is responsible for the management of this process, recording the quantity of rice stored in, borrowed from, and returned to *leuit si jimat*. Hence, this particular barn acts as an indicator of rice self-sufficiency in Kasepuhan. For instance, my interview with this elder revealed that for the past five years, the amount of rice stored in *leuit si jimat* had always increased, indicating that there had been surpluses in production during those periods.

The fact that *javanica* rice is available all year round also relates to the third factor influencing its resilience: fulfilment of the obligatory passage point. For both the community and rice, an obligatory passage point has been agreed upon so as to attach the rice strongly to the community: that the rice can produce as many yields as it can, within its potential, to fulfil the need of the whole community year after year. The interview revealed that the average consumption of rice is five bundles per household per week (equal to an average of 195 kg / person / year), a number higher than the annual average of for Indonesia (139 kg/person; BPS, 2012). This happens mainly because during the year, people participate in a series of thanksgiving events, or *hajatan*, involving rice consumption in every part of it.

Figure 6.3. (a) *Leuit* used to store rice in bundles; (b) *Leuit si jimat*, a communal barn

Relevant to this discussion, it is also necessary to examine the extent to which the modern varieties of rice (*indica*) have failed to enrol to this particular community. While a lot of factors contribute to this outcome, much can be explained by the poor suitability of *indica*'s physical characteristics (revisiting Table 6.1) for the agricultural practices of the community; or in ANT term, by the *unsuccessful negotiation* of the relations between the rice and the humans. First, the easy-shattering nature of the modern varieties makes it impossible to tie them in bundles; hence they cannot be stored in the same manner as *javanica*. For this reason, the community calls the *indica* varieties *pare bubuk*, literally meaning 'powdery rice' and referring to the easily shattered grains. Second, their stem is too soft and fibrous to cut with an *etem*. Third, the modern varieties are derived from a semi-dwarf *indica* that is too short for the farmers and, hence, more troublesome to harvest. Fourth, these varieties are more adaptable to the warm climate of tropical lowlands and do not produce as effectively at higher elevations. Fifth, due to a cultivation cycle that differs from that of *javanica*, the modern varieties have become more susceptible to pests and diseases, and at the same time disrupt the agriculture calendar of Kasepuhan. And finally, their shelf-life is far shorter than the local varieties (less than a year as testified by several farmers outside Kasepuhan), showing the inability to be kept for longer periods in the *leuit*.

But if there are so many incompatibilities between the modern varieties of rice and this traditional community, how can they be accepted elsewhere in Indonesia? As the title of this subsection suggests, Kasepuhan is indeed one of the remnants of the hegemony of traditional rice varieties in the island of Java. Why *javanica* resides firmly in Kasepuhan while it is eroded in other parts of Java can be more fully understood by recognising all the actors who negotiate inside the network. *Vice versa*, the same argument applies to what has happened with the modern varieties. The next subsection will address the latter situation.

6.2.4. Indica: The prodigy of the Green Revolution

As explained in the previous chapter, food regime theory has placed the development of the rice food system and, in this case, the rice varieties within the context of global food relations. From the early 1950s, after the collapse of the first food regime, concern over the growing human population and the inability of food production to follow that rapid growth had oriented agriculture and food research to align with the so-called Green Revolution. The main objective of the Green Revolution was to produce food commodities with higher yields and shorter growing periods. For rice, the actor was the *indica* (Herdt & Capule, 1983). But

why *indica*? Arguably, it was not because of relative productivity, as traditional *indica* yielded less than the other two subspecies. Its soft stem tissue and intermediate stature also made it intolerant to high nitrogen inputs, causing it to lodge (the stalk would bent over and the panicles lying flat on the ground) in irrigated fields as it excessively took up nutrients (Barker et al., 1985). The most probable reason for its successful enrolment to the Green Revolution was that the traditional *indica* varieties had spread over the tropical Asia (such as Sri Lanka, Taiwan, Malaysia, and Indonesia; Bernsten et al., 1982; Herdt & Capule, 1983) where many national-based research institutes were developing new rice varieties; hence, *indica* varieties provided a plethora of readily accessible genetic resources for the research[22].

Regional research on rice was formalized through the development of the International Rice Research Institute (IRRI) in the Philippines in 1962 (Herdt & Capule, 1983), followed by the establishment of the Central Research Institute for Agriculture (CRIA) in Indonesia in 1972. The latter eventually changed its name to the Indonesian Centre for Rice Research (ICRR, 2011). Its main role in the rice food system has been a significant one; that is, to perform research on rice varieties, pest and diseases, pesticides and fertilizer use, consumer preferences – in short, all about rice. The ICRR has a strong working relationship with the IRRI, as has been shown by frequent research collaboration and the former's adoption of many HYVs developed by IRRI (all of which were assigned the name IR-). The ICRR has developed more than 200 varieties of rice, each with different features and advantages.

The first HYV developed by IRRI was IR8, a cross between an *indica* variety from Indonesia and a short *indica* from Taiwan. This was a phenomenal variety, as it was very responsive to high rates of fertilizer application and was able to grow during any season regardless of day length (Herdt & Capule, 1983). It was the first variety that complied with the Green Revolution scheme, and has been the predecessor of many new HYVs of rice. This was a breakthrough because at that time most traditional varieties produced very low yields. As a comparison, while a local variety yielded 2 – 3 tonnes / hectare, this HYV would yield up to five tonnes with the proper addition of fertilizer (Lu & Chang, 1980; Mikkelsen & de Datta, 1980).

[22] Although it seems plausible that, similar to *javanica*, the traditional *indica* varieties also bore a cultural significance to farmers in the region, the extent to which the varieties' characteristics have been changed through intensive cross-breeding makes it difficult for the HYVs to align with traditional agricultural practices, thus less likely to be enrolled on the basis of cultural values.

IR8 was first introduced to Indonesia through IRRI in 1967 along with several other modern varieties developed by the institute as well as by Indonesian researchers prior to ICRR (see Bernsten, 1982). The result was remarkable. Within only eight years of the first release, these modern varieties accounted for almost 40% of total paddy fields in Indonesia. The reasons for this successful enrolment were the bitter-sweet negotiations driven by both human and non-human actors.

In many related articles (White & Wiradi, 1989; Husken & White, 1989; Gerard et al., 2001), it has been highlighted that President Suharto during the New Order Regime played a major role in disseminating the HYVs to Indonesian farmers through programmes such as *Bimas* and *Inmas* (see Chapter 5 for details). A former politician from a major party during Suharto's regime noted the way Suharto put social stability above all else, and in his opinion this could not have been done without stability in the agricultural sector. All efforts were made to ensure that self-sufficiency would be achieved. Government programmes were oriented to it. He recalled the situation as follows:

> "Back then, although farmers were weak [politically], they were protected completely with *Inpres* (Presidential Instruction), *Banpres* (Presidential Support), irrigation facilities, fertilizer, agricultural extension officer that stood by 24/7, lived and stayed in the village with proper facilities, being given motorcycle, [they] enjoyed it." (Bomer, a former politician, now a professor in agriculture)

In certain circumstances, the dissemination process had to resort to mandatory state enforcement. Farmers were often made to grow a particular variety of rice, and military power was sometimes involved in order to ensure that no local varieties were cultivated in strategic areas of production. One agriculture extension officer recalled what happened during the 1970s compared to the present situation:

> "Back then [during the new order regime], the programme was to grow [a particular] variety X, [we were] not allowed to say no. If you didn't follow, there would be consequences. Now, we're not allowed to do that, because now we have a new regulation on cultivation. Farmers can choose any [varieties] they think would be profitable. Back then, if we were instructed to plant variety X, then everyone had to obey that..." (Aman, Agriculture Extension Officer)

I argue that the capacity of human actors to enrol HYVs to the network of Indonesian farmers would not have been effective without the balancing influence of the non-humans. In particular, the fluidity of rice, its negotiation with other non-human (such as pests) and human actors (such as the farmers and consumers), is a noteworthy aspect in ensuring the acceptability of new varieties. The combination of both types of actors determined the success and failure of the enrolment process.

One example of such negotiation is that between HYV and consumers in terms of taste preferences. My interview with a researcher at ICRR opened up the issue of consumer preferences with regard to rice varieties in different parts of Indonesia, with majority preferring *pulen* rice, which is rice with low amylose content that forms a sticky consistency when cooked. Bernsten et al. (1982) reported that the introduced variety of IR5 had been modified for this dietary preference by crossing it with *Syntha*, a domestically improved variety. As a result, it had been widely accepted by farmers and consumers in Indonesia. However, for a particular group of consumers, especially the upper classes, their preferences involved more than amylose content. For them, the fragrance was also considered an important quality. For example, Cianjur in the southern part of west Java produces the famous *pandanwangi* variety – an aromatic rice strongly related to the *javanica* subspecies (Damardjati & Oka, 1992; Garris et al., 2005). The rice is then sold at a premium price for upper class society in Indonesia. Unlike several other traditional varieties cut off from the rice food system during the suppressive regime, *pandanwangi* seemed to be resilient to the incoming shock. From an ANT perspective, this particular variety had successfully negotiated with the consumers and the government to avoid being excluded from the agrifood system, particularly through its attractive aromatic properties.

A second example is the negotiation between rice, research centres, the government, and a particular pest, the brown plant hopper (BPH). The modern varieties developed before 1970 had performed exceptionally well in terms of productivity. However, this phenomenon had created yields that were favourable for the rapid growth of BPH. In 1973, BPH infected major parts of Java; and in no more than five years all parts of Indonesia, excluding Maluku and Papua, had been severely infected by this pest (Bernsten et al., 1982). Researchers realized that the first batch of modern varieties did not have a capacity to resist BPH. In 1976, a BPH-resistant variety called IR26 (Bernsten et al., 1982; Herdt & Capule, 1983) was released to counter this emerging shock and was widely accepted by the farmers, showing

another successful negotiation between human and non-human actors. However, it did not last long as the BPH had, using Callon's (1986) terminology, betrayed the network. In 1986, a new biotype of BPH caused another pest outbreak. In response, the ICRR in cooperation with IRRI released IR64, new rice variety resistant to this new pest (Suprihatno et al., 2011), in combination with an Integrated Pest Management (IPM) program (Röling & van de Fliert, 1994) to overcome this outbreak.

IR64 was the star of rice agriculture in Indonesia at that time. Not only did it have the capacity to resist BPH, it also had the preferred cooking quality sought by consumers and the productivity by producers (Suprihatno et al., 2011). However, in 1997, climate entered the on-going negotiations in a more forceful way in the form of an ENSO-related drought, which contributed to another outbreak of BPH (Bourgeois & Gouyon, 2001). At this point, even IR64 could not cope with the shocks. Its position in the stable network of the rice food system was questioned. Following a new regulation to allow farmers to plant whichever variety they consider suitable and profitable, the position of IR64 was eventually displaced by new varieties, either released by ICRR through certified seed producers or developed by farmers themselves. Within four years (from 2004 to 2007), the percentage of paddy planted to the IR64 variety decreased from 33% to 17%.

The negotiation between rice, land, and the farmers is well demonstrated in *pantura*, the north coast of Java, which because of it production is known as Indonesia's rice silo. The majority of farmers in this region use *Ciherang*, a variety derived from IR64 with higher yields and higher resistance to pests. Those who use this variety are able to maximize the production both for commercial (sale) as well as personal purposes (consumption). Other farmers may use either IR42 or glutinous rice, both of which have a higher market price and are targeted for processing. These two varieties, however, are not used directly for household consumption. Consequently, the farmers that produce these varieties are more dependent on the market for their staple food. The decision regarding which of these varieties to use is based on profitability, financial capital, and market availability, as one farmer explained:

> "In the previous planting season, I used Ciherang INPARI13 [a new type of Ciherang] Well, there are a lot of IR64 [derived] varieties, plenty of them. [...] I could spend more than 6 million Rupiah per hectare – that's minimum – for the IR64 variety. For IR42 or glutinous rice, it usually costs more, especially for the spraying [of pesticide]. [...] but its price is more lucrative. It's superior, but not

> many people grow this. Most of us, like in the uplands [referring to non-*pantura* area], plant IR64; we rarely plant glutinous. My relatives there, they don't eat glutinous rice" (Udin, farmer in Pamanukan, *pantura*)

In different areas in west Java, farmers prefer specific varieties that are suited to the physical environment, the market and their personal preferences. In general, most commercial farmers in the southern part of west Java choose exclusive varieties, those with better taste and higher consumer preference, such as the aromatic *pandanwangi* rice. An official in the Regional Agricultural Agency stated that this is due to the low productivity of their soil and poor infrastructure; it is more feasible for them to plant premium rice which achieves a higher price. But not all farmers in the area agree with that assessment. Farmers from the north coast (*pantura*) as well as the southern region claimed that land ownership has also become an issue. It is noteworthy that in the north coast the term peasant is applied to those with farm areas of 1 – 2 hectares. In their opinion, the small farm size makes it impossible to viably practice rice agriculture. Conversely, farmers with more than a hectare of land in the southern region are considered wealthy. In this region, the peasants, who practice a subsistence form of agriculture, own less than 0.25 hectare of farmland. For these farmers, premium varieties of rice are not even an option. When I asked a farmer about the type of rice she is using, she responded:

> "Well, I don't know what it is, but it's not *pandanwangi*. It's just regular *segon*[23] rice, I don't even know the name, but because the husk is yellowish, I just call it yellow rice." (Emak, a peasant in Bandung)

Other southern farmers, although more aware of the variety they are planting, admitted that they would never sell the yields unless it is really necessary. Yayat and his seven family members always consume all the rice they have produced by the next harvest period; sometimes, they must buy rice from the market if their stock is not sufficient. Their choice of the type of rice entirely depends on the availability of seeds and their suitability for the climatic condition at that time. One farmer said that she made a mistake by planting *Sarinah*, the most common local *indica* variety in the area, during the wet season:

> "Varieties that we [usually] planted are *Bagendit, Sarinah, Cibodas*, and *Sariwangi*. In the first (wet) season as today, we've taken the wrong strategy by

[23] *Segon* is a term known by local farmers to refer to modern varieties of *indica*. The term is derived from the word 'saigon', the capital city of Vietnam, probably remarking the birthplace of this particular type of rice.

> planting *Sarinah*, whereas it has a tall stature. During the rainy season, it is more likely to lodge due to rain and wind. We should've planted it for the third (dry) season." (Bu Haji, a farmer in Garut)

Reflecting these examples, I believe it is possible to argue that the modern *indica* rice is truly resilient. Its resilience exists because it has been fluid enough to translate from one actor (IRRI) to another (ICRR) to another (farmers), just like the bush pump in Zimbabwe (de Laet & Mol, 2000). At the same time, it is durable and retains its identity during the process of translation. It is, at one level, just rice; but its identity can also manifest in different ways. It is a lucrative commodity for the farmers, a political instrument for the president and community leaders, a valuable research object for the rice researchers, the most important food for Indonesians, and a plentiful resource for the pests – to paraphrase Mol and Law (2002), rice can be seen as *single* but also *multiple*. In my argument, the multiplicity of rice is one of the sources of the system resilience. Although the phenomena mentioned in the previous paragraphs do not picture a stable network for the rice food system, the relations they develop do resonate with the ideas of adaptability and (functional) diversity needed to build a resilient system (Folke et al., 2003; Walker et al., 2006), as Chapter 8 will elaborate.

Up to this point in the narrative, rice has been the central point of the analysis. However, resilience of the rice food network is shaped not solely on the basis of the material agency and multiplicity of rice. The agency of rice is due not to its characteristics *per se*, but to the different actors who have attached themselves to these characteristics – and, by doing so, have given meaning to rice; hence the idea of *relational agency* (Latour, 2005). Thus, the resilience of rice is the result of networks of heterogeneous associations. The failure of HYVs to enrol to the Kasepuhan network was due to the failed negotiation between the rice, the climate, farmers, and the community leader. On the other hand, their success in enroling to wider Indonesian networks was also the result of negotiations with climate, pests, consumers, land, soil, and even the president. Resilience of the rice food system is then shaped by these actors that played roles as shocks and agents – through the way they have created openings for other actors to be enrolled to, and negotiate with, each other. It is thus necessary to further identify and acknowledge those other actors that participate in the enactment of resilience of the network. As a start, the following subsection will focus on the actors shaping *gabah*, the rice grain that symbolizes productivity. It is the story of multiple actors – land, soil, climate,

pests, and diseases, along with the government, farmers, and agribusiness firms – assembling the resilience of rice production through a series of enrolment and betrayal.

6.3. Assemblage of multiple actors

In 2011, President Susilo Bambang Yudhoyono announced that Indonesia should have at least 10 million tonnes of *gabah*, the un-husked rice, in the government stock by 2014. As a consequence, the Ministry of Agriculture targeted 70.6 million tonnes of production by the end of the year, and this was translated by the Province Agricultural Agency as a 7% increase of rice production in west Java alone, or about 12.6 million tonnes of dried rice (*Gabah Kering Giling*, GKG). My interview with an official from this agency has revealed strategies they have been working on to achieve such a target. There are basically three strategies: increasing the total area planted, increasing the frequency of planting per area, and increasing the productivity. In this analysis, these strategies can be seen as ways in which the government negotiates with different actors in rice agrifood system. The first strategy is about a negotiation with farmers and their land. The second is about water, climate, and irrigation systems. The third is about agricultural technologies (fertilizer, pesticide, and machines), along with pests and diseases. I will talk about each strategy and the implications on the rice actor-network by following particular actors.

6.3.1. Of Land and Water

The first and second strategies involve efforts to increase the total area of *sawah* (paddy fields) and to restore the irrigation facilities supporting them. However, the biggest hindrance to these objectives is the increasing level of land conversion from *sawah* to other purposes, from other cash crops to housing and industries. My interviews with several stakeholders in agricultural sector, such as university researchers, the State Logistic Agency, the Regional Agricultural Agency, and the Indonesian Farmers Union (Serikat Petani Indonesia, SPI) reveal that land conversion is indeed a dilemma. Bomer Pasaribu, a former politician who is now working as a university professor, provided information about the rate of land conversion in the last ten years, which is up to 140,000 hectare / year. Thus, instead of adding new *sawah*, the government has focused on maintaining the number of *sawah* so as not to decrease even more.

In Indonesia, land is a big issue in rice agriculture; but the government has yet to acknowledge that land is also an important actor in the network. It is not just land; it is the

result of negotiation between, among others, soil, water, farmers, government, local authorities, fertilizer, and the rice. In the southern region of west Java, there have never been any public disputes regarding land. Of course, most of the region's farmers own a very small plot of land, limiting the viability of their agricultural activities. Yet, subsistence farming has become a part of the farmers' life, strengthening their bond with the land. Ironically, a high level of land conversion has, in fact, occurred in *pantura*, or at least that has been the place where it has become an issue. This is ironic considering *pantura*'s reputation as Indonesia's rice silo. It contributes around 20% of the total rice production in Indonesia, and more than 49% in West Java alone (Ministry of Agriculture, 2011; Diperta, 2011). One farmer informed me that "*pantura* has to achieve the production target, because it is an industry, not just [farming for] consumption".

Land, in this case *sawah*, embodies certain qualities important to rice farmers (e.g. soil nutrients, water retention capacity, and location). Consequently, it strongly influences how the farmers practice rice farming in a particular way, which subsequently contributes to the stability and resilience of Indonesia's rice agriculture, as I will describe in the following paragraphs. In terms of its soil quality, one farmer identified two types of *sawah* in *pantura*. The first one is called *sawah daging* (highly productive paddy fields, literally means 'meat paddy field') and *sawah biasa* (the regular paddy fields). These two *sawah* differ in their soil structure, water supply, and the relative intensity of fertiliser regime. *Sawah daging* has the capacity to produce more yields in a season, and it is also able to provide three production cycles in a year due to its greater access to water. The variation in soil qualities has become one of the biggest concerns for farmers in *pantura*, leading to different practices of spraying and fertilizing. Some farmers, due to the pressure to produce more, have exposed their fields to massive amounts of chemical fertilizers over a long period of time, causing their land to be less productive. At least two farmers from the region realized and explained this issue:

> "During the new order regime, when the soil was still fertile, giving only 25 kg of fertilizers could make the plant grew fast. After feeding [the soil] with urea year after year there in *pantura*, well, one hectare of land could use up to a ton of fertilizer, without giving any significant result to the plant." (Pak Haji, a farmer in Pagaden, Subang)

> "In the long run, land in *pantura* has already become saturated [with fertilizer]. They kept on adding the chemical fertilizer, so when it was previously

> recommended by the Department of Agriculture to put only three quintals [of fertilizer] per Ha, they are now using twice the amount. If they didn't add the dosage, their yields would have decreased. So to compensate for this, they add even more. But at a saturation point, even that increase of fertilizer would not lift the production level. I have had an experience seeing this, in *Cibinong* (one of the areas in *pantura*), the farmer had to provide a ton of fertilizer, but he only got three tonnes of harvest. That's just ridiculous." (Cucu, an organic farmer in Subang)

But it is not only productivity that the farmers in *pantura* are seeking. Above all, it is the profitability of their rice agriculture. For many, the acreage that they have presents an obstacle to fulfilling economic goals. An agriculture extension officer explained this issue to me in the following manner:

> "Actually, rice agriculture is a very promising business. I am also a farmer, and for me it is very promising indeed! [...] But this depends on the total land we own. The smaller the land, the higher the costs would be. [...] For rice agriculture to earn a profit, it has to be at least three hectares. Less than that, well, you could still have a bit of profit, but it then depends on the normality of the price and the environment." (Aman, agriculture extension officer)

Some farmers refute this assessment, saying that even a small amount of land could still provide them with sufficient return to run the next cycle of farming: although in some situations it would not enable them to make ends meet. One farmer showed me that by having more than two hectares of land, he could buy more land for the next cycle from the profit he gained. This phenomenon has resulted in a situation where some wealthy farmers own tens to hundreds of hectares of land by acquiring the small farms around their fields.

Another issue of land ownership among Indonesians is the culture of inheritance in which a father must divide his properties, in this case his *sawah*, among all of his children equally when he dies. This means that, for a father with four children, a four-hectare property has to be divided into four one hectare plots. This amount of land is not enough to run a profitable agriculture. This situation is often exacerbated by the inability of the offspring to carry on the

legacy. Beneficiaries of 'rice for the poor[24]' (*beras untuk keluarga miskin*, Raskin) confirmed this, as they said:

> "Back then my mother had 60 *tumbak* [equal to 840 square meters], my brother had 40, so in total we had 100. It was enough for the whole family. [...] But now, it has been divided, so what's left for me is this house." (Umi, raskin beneficiary)

> "I don't know if I want to sell my *sawah*. When I die, I think this land will be sold by my children. But for me, as long as I can still work in my land, I don't want to sell it." (Emak, a small farmer in Bandung)

Further investigation revealed that these issues do not entirely explain land conversion. For the farmers in the southern part of west Java, land conversion is yet to become an issue, although participants raised concerns regarding people from Jakarta starting to buy land from them.

> "People outside [from Jakarta and Bandung, the two largest cities in the region] are starting to buy our land, but mostly those in the upland area, for plantation. They haven't bought *sawah* yet, but sooner or later probably will. But even though someone indeed buys land here, he will mostly use it as *sawah*..." (Yayat, a farmer in Garut)

The reason is that most of the paddy fields sold were used for more productive practices of rice agriculture. The selling of land is better understood as an effort to rejuvenate rice production. Some farmers will certainly lose their land; but it does not mean that they have to stop their farming activities. One farmer informed me that he only owned 30 *tumbak* (around 420 square meters) of paddy fields. It was less than sufficient to make ends meet, let alone to run a profitable agricultural enterprise. Yet, he also worked for a larger farmer in managing the latter's paddy fields using the *maro* system (a profit-sharing scheme between owner and manager). At the time of the interview, he was working on more than 200 *tumbak* (1,400 square meters) of paddy fields, and that was enough for him to earn a living from.

So what is causing the land conversion? From an ANT perspective, the failed negotiation between farmers, soil, water, and fertilizer is not sufficient to disentangle the stable rice

[24] Rice for the poor is a government program of a targeted subsidy for poor families to facilitate the purchase of low-quality rice. It has been employed since 2004 in attempts to compensate the reduction of fuel and agricultural subsidies. For details see Irhamni and Nuryakin (2009).

network. For a betrayal (in this case the conversion of land) to occur, additional actors must be acknowledged: the industrial spokespeople. In a business perspective, the value of land is the space rent it can provide to different types of economic activities. This means that the preferred land use reflects those economic activities that give a higher return from the same amount of land. In *pantura*, the space rent for agriculture is far less promising than other land uses such as factories and housing. The decision to convert or sell their land depends on the extent to which networks of industrialisation and urbanisation have enrolled other actors in the area.

Karawang, a region in the western part of *pantura* that was – and still is – known for its productivity, provides a perfect example of this phenomenon. Karawang is located adjacent to Bekasi, a satellite city of Jakarta where economic development for real estate and industrial complexes are growing rapidly. On the other hand, Karawang is also an important source of rice for Jakarta and west Java in general. The government has actually established a regulation to protect *sawah* from conversion, particularly in the productive area of Karawang (and other parts of *pantura*). Furthermore, Karawang is one of the most fertile lands in west Java in terms of rice agriculture. It is one of the three regions in west Java that are able to produce more than one million tonnes of rice in a year (the other two are Indramayu and Subang; Diperta, 2011). Facilities such as irrigation and agriculture technologies are centred in Karawang, due to its proximity to Jatiluhur dam (the source of water for irrigation) and Jakarta. The latter also provides Karawang with ease of market access. So why is it also among the regions with the highest rates of land conversion?

Viewing this situation from the perspective of ANT, it is possible to explore how actors in Karawang have betrayed their own network in the process. The first case involves the famers, local authorities, and water. The regulation governing land conversion clearly states that wet areas and land with irrigation facilities must not be converted to a different land use. Therefore, it is impossible to sell a paddy field for conversion to an industrial area, unless the land in question is no longer wet irrigated land. Farmers, encouraged by local authorities, stopped the irrigation from reaching the area, thus declaring the land to be dryland and allowing it to be legally sold to for industrial use.

Another case involved a relatively complex set of actors. First, rice failed to meet the obligatory passage point of productivity, with a decrease in fertilizer use and soil fertility

likely to have reduced productivity. Second, spokespeople from the industries enlisted local people to identify farmers willing to sell their land. These people started to negotiate with farmers. In this situation, this group even negotiated with the pests. For example, knowing that several pests were responsive to light (a behaviour referred to as phototaxis), this group installed lights in the middle of the fields at night to attract the pests to the rice. This exacerbated the viability issues of rice production and lessened the farmer's attachment to the land, eventually leading to its sale to the industries after further crop failures.

Despite the significant media attention devoted to these on-going problems, land conversion has not occurred in other parts of *pantura*. As a matter of fact, the farmers interviewed in Subang convinced me that land conversion never happened in their area, or at least not to a significant extent, and that local people were more eager to remain farmers than anything else.

> "Here, a lot of people want to become a farmer. It's not that they don't want to, but [some] just haven't got any land to work on. And they don't have the money to rent. They really want it actually. It's nice to be a farmer; it's comfortable, and you don't need to work continuously. [...] Of course, there are problems with pests, but it doesn't happen all the time. You just need to monitor the water and watch for any presence of the pests. Now we have a lot of merchants trying to be a farmer. The good thing is we still have paddy fields, not turning into a factory." (Asep, a farmer in Pamanukan, *pantura*)

The keyword, I propose, is network. In contrast to Karawang, no industrial actor-network has reached farmers in Subang; hence no negotiation has taken place and no betrayal has occurred between land, farmers, and other actors. The rice food system in *pantura* is a stable network in its own right. Yet, that does not mean that betrayal is not something to be aware of. Betrayal may occur as one or more actors start to propose new goals, as the obligatory passage point is no longer met, or as a new emerging actor-network is being entangled in the process.

6.3.2. Of Climate, Pests and Diseases

My interview with the Province Agricultural Agency about achieving rice surpluses by 2014 initiated a long and interesting discussion on the third strategy: rice productivity. It was understood that West Java does not have sufficient productive land to be converted to paddy

fields; and, if it did, the efforts in converting them would be excruciating. Based on the interview, the best strategy the government could pursue was increasing the rice productivity of the limited amounts of land. This strategy has been followed since the early development of modern rice agriculture through various extension programmes and infrastructural supports. Interestingly, the actors that have played a major role in enhancing this progress are in fact non-humans: climate, pests, and diseases[25]. On one hand, these actors have had devastating impact on the rice food system; and yet, they have also shaped the system's resilience through on-going processes of negotiation, enrolment, and betrayal. Evidence to support such an argument lies in the spaces that climate, pests, and diseases have created for the enrolment of new actors such as agriculture extension officer, agribusiness firms, a diversity of pesticides and growth hormones, as well as different forms of fertilizers.

The ways those actors have enrolled to the rice actor-network involve farmers' perceptions of their relationship with pests and diseases. In Kasepuhan, farmers do not classify anything as a pest. Their philosophy is founded on the tenet that all components of the world are basically in unity. The so-called pests are actually a part of their life, and of the rice agrifood system. Efforts to eliminate one component of the system would cause an imbalance to the whole relationship. In their world view, the insects and the rats are entitled to feed on the rice, as everything has its own share of the resources. Consequently, no spraying of pesticides is allowed in their taboos. But the way they perceive this is also determined by the fact that there has not been a severe pest outbreak that caused crop failure during their agriculture history. This in turn may be influenced by their agricultural practices that conserve the diversity of rice varieties and maintain a single planting cycle in a year, reducing the risk of pest outbreaks to a minimum. This reciprocal relationship between farmers, rice, and pests has formed a strong network that prevents the enrolment of new actors.

In *pantura*, the situation is entirely different from Kasepuhan. Interestingly, farmers in *pantura* perceive pests and diseases as certainties. These actors *per se* are not considered shocks; however, farmers' concerns involve the severity of the impact, and this, to some extent, relates to the changing climate felt over the last four years. Even without the cascading impact of pests, drought has always been a significant shock to the farmers. This is

[25] The most prominent pests and diseases recorded by the ICRR are the brown plant hopper (BPH), a fungus called *Pyricularia* causing leaf and neck blasts, *tungro* virus brought by a variant of the plant hopper, and the yellow stem borer, occurring in combination with, or following, severe ENSO (El Nino Southern Oscillation)-related droughts and floods.

mainly because most farmers in *pantura* still depend on rain water to irrigate their fields, even in the presence of irrigation facilities. An agricultural economist that I interviewed had found that, from the total of 7,230,183 hectares of irrigated land in Indonesia, more than 50% are in a condition of poor irrigation infrastructure. This finding was confirmed in discussions with several farmers in *pantura*, most of whom acknowledged the situation. Some farmers have had to compete with their neighbours to access water during the dry season, sometimes involving inducement to the irrigation officers. Two farmers remembered that, in 2009, drought occurred during three seasons in succession, resulting in crop failure in their area. The situation was exacerbated by a pest outbreak during the following wet season. Those areas with good irrigation facilities had to endure the impact as the outbreak spread from the neighbouring fields. In some places, the yellow stem borers infested the paddy fields during the period between 2008 and 2009, followed by the BPH in 2010. In different places, the BPH outbreak had occurred earlier, but then was followed by *tungro*, a virus transported by the green plant hoppers. As a result of the sequence of events, production plummeted in some cases to two quintals per hectare (compared to the normal yields of 60 – 80 quintals / hectare). The extent of these impacts is evident in the farmers' recollections as shown in Table 6.2.

Table 6.2. Farmers' recollections of major pest outbreaks, 2008-2010

Farmers / location	**Interview quotes**
Pak Haji / Pagaden, Subang	"In 2010, we had *sundep* (yellow stem borers) outbreak. During harvest, the grains were there, but they're empty. Another disease we'd been startled with was the neck blast. We could only harvest half of our yields. It's just died before the grain was produced. I know the scientific name, *Pyricularia*. That's 2010. We haven't had that this year, well, hope we won't."
Udin / Pamanukan, *pantura*	"Yes, we called it *mejen* (*tungro* virus). There was this time where almost all farmers had it, not only us. Almost all [sawah in] west Java were damaged, in 2009, on the third cycle. When the disease stroke, the rice couldn't produce its panicles, at all. We only got two quintals per hectare, the best we could have was ½ ton. Especially glutinous rice, it was terrible."
Asep / Pamanukan, *pantura*	"For farmers here, the worst [pests and diseases] we've had were *mentek* (*tungro* virus). We usually had rat, *mentek*, and BPH. But [in 2009] *mentek* was the worst. I heard it's because of a virus. And it's related to plant hoppers too. [...] Luckily we didn't have that this year."

So what have the farmers done in response to this situation? Or, to ask this in a different way, what kind of negotiations have the prevailing shocks stimulated? Which new actors have enrolled to the network in such situations? In this case, the negotiation of pests and climate is shown to open space for new actors.

One actor successfully enrolled was the agricultural extension service, but not in the form of ordinary extension. This special unit was established in 1986 as a response to emerging BPH outbreak and El Nino-related drought during the period. Its members are called Plant Pests and Diseases Monitoring officers (lit. *Petugas Pengamat Organisme Pengganggu Tanaman*, POPT). West Java province has 381 officers assigned for this position. At the farm level, these officers were more commonly known as *Pak Mantri* (the nurse), *Pak Guru* (the teacher), or *dokter tikus* (rat doctor). Such names are a clear indication that the farmers perceived POPT as both healers of the illnesses suffered by the rice and trainers of the farmers in handling pest and disease problems. Their role is to monitor the presence of pests, diseases, and impacts of climatic change at specific permanent locations. Each officer covers an area of approximately 5,000 hectares within two or more districts in the rural area. These officers work four days a week, on the fifth day reporting their findings to the main office. The POPT have the final authority to declare whether a particular area is officially infected by pests or diseases. But during the 1980s, their role did not end there. POPT was also the entry point for the enrolment of agribusiness firms and their pesticides to the rice food system.

As discussed in the previous subsection on the enrolment of rice varieties, the rice agrifood system was a durable network formed between the government, farmers, rice, and pests. To some extent, the government had become a spokesperson for the farmers. Hence, enrolment of new actors had to be done through the government, in this case through its research centre (ICRR) and extension officers (POPT). As it turned out, many agribusiness firms have conformed to the way in which the stable network was maintained, and thus were successfully enrolled to the network. My interview with a researcher at ICRR revealed this as she said:

> "Aside from collaborating to manage particular pests, we have also cooperated with the agribusiness firms to test the efficiency and effectiveness of certain types of pesticide. [...] We would then supply a recommendation for these products. We'd usually make a plain report of the situation, how efficient they

> were, whether they're feasible to be released to farmers." (Restu, a researcher at ICRR)

The certified product would be assessed in the field by both POPT and the company. These companies normally delegate spokespersons known by the farmers as formulators. Together with the extension officer or POPT, this actor negotiates with the farmers, rice, and pests through an intermediary: the pesticides.

After the fall of Suharto in 1998, Indonesia's rice agriculture was influenced by trade liberalization in every part of the system. The north coast of Java, known as the centre for commercial rice production in Indonesia, has become an easy target for the marketing of various pesticides and fertilizer products. Agricultural companies played more significant part while the influences of the agricultural extension service on rice production decreased significantly. Many of the extension officers, once a significant actor in the network during the new order regime, have lost their credibility amongst the farmers. Funding for the service was cut. Distrusts emerged as the stable network between farmers and the extension service that had been woven during the early 1990s disentangled due to another pest outbreak coinciding with Asian financial crisis. One farmer recalled this situation:

> "The extension, they actually had the capacity to reach the village level. But they didn't significantly change to increase our rice production. Well, I remember, yes we had technologies, but it wasn't the answer for our problems after all. I mean... good planting methods, manure, pesticide, good pest management... but then, we still couldn't harvest because of the stem borer and BPH. Are those technologies brought by the extension the answer? Crop failure?" (Dedi, a farmer in Pagaden, Subang)

The farmers' growing distrust of the extension officers was a weakness that allowed the formulators to root deeper into the system. Several farmers have considered the formulators to be alternative private-based extension, particularly for those that lost their trust in the public sector. The relationship sometimes became personal. One farmer even considered a particular formulator to be his mentor.

The situation often becomes more complex than that mentioned above. The trusts that many formulators earned from the farmers were used as negotiating leverage to the company they worked for. If this formulator betrayed the company he used to represent, he would bring the

whole network of farmers with him. Therefore, the company has to maintain its influences through many incentives and facilities offered to the formulators, as well as better (or cheaper) pesticides and other agricultural products for farmers. By the time I came to *pantura*, it has been a battle zone for pesticides and the companies. Figure 6.4 illustrates the situation.

Interestingly, the network between farmers and pesticides has not been stable as well. New types of pesticides have come and gone rapidly. Farmers in *pantura* have learned that pests can develop resistance to a particular pesticide. Agricultural companies continue to negotiate with the pests by releasing new pesticides that work better and more effectively. Farmers are then forced to use this new product, as the older one is no longer effective, let alone available. The farmers do not, however, understand why a longer lasting product has not been developed.

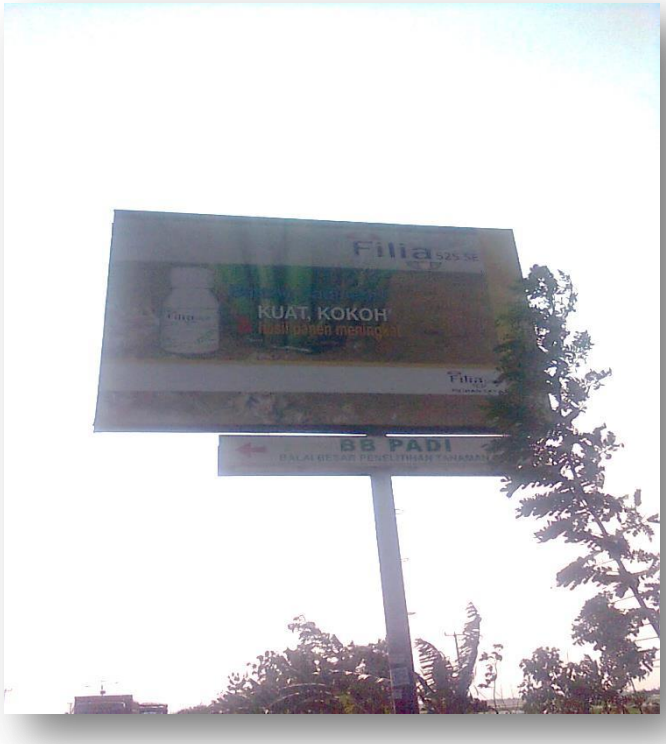

Figure 6.4. A Billboard advertising a pesticide product in *pantura*

"I remember back then in 1986, [a pesticide named] powdery Applaud, it was a help from Japan. It's really effective. But we can no longer find it now. I don't understand, when one product was in high demand, it was suddenly gone [from

> the market]. [...] it's like a travesty, I don't understand. So farmers always have to try new things; our knowledge is never completed. It's like, reading a book but can never get to the end." (Asep, a farmer in Pamanukan, *pantura*)

The fact that each brand of pesticide uses similar active ingredients (with a slight increase in the dosages) has been concealed from the farmers. Some, however, have sufficient knowledgable to understand this scheme, as one farmer explained:

> "All with –trines at the end of its name is contact pesticides, whereas the one starting with dipho- is systemic. [...] So farmers often said, 'well, he used a good pesticide', but in fact the active ingredients and the functions are the same. We'd prefer to use the cheapest, but with higher dosage." (Pak Haji, a farmer in Pagaden, Subang)

Nevertheless, the role of agribusiness firms goes beyond providing pesticides to the farmers. There is also a relationship between farmers, suppliers of agricultural products, and another type of actor: the financial institutions. This network acts as a buffer against shocks, through the mechanism of risk spreading between actors. Long before the 1998 crises, farmers had been reliant on money-lenders. The classic story of farmers being forced to sell their crops to a sole middleman due to debt-bondage (Husken, 1989) no longer is the predominant situation of farmers. Since 1998, the trade liberalization scheme has provided farmers the flexibility to choose between different financial institutions and agricultural facilities providers. Banks compete to offer a lower interest rate and flexible *force majeure* scenarios, such as providing a guarantee that farmers need pay only the loan interest in the event of crop failure. Farmers also collaborate through the development of farmers' networks. These groups support farmers in need of financial capital by connecting them to government agricultural supports. These supports came in the form of facilities (subsidized fertilizers, pesticides, machines) as well as funding. Such flexibility has alienated the money-lenders from the whole rice network.

Suppliers of agricultural products also offered options similar to those of the banks, for example: delayed payment for products until after harvest periods, commonly known as *yarnen* (*bayar panen*, literally 'payment-at-harvest'). For small agribusiness companies, it is a risky and difficult proposition with which they have to contend; and one that has contributed to the rise and fall of agribusiness companies in the rice agrifood system. I follow one particular product to illustrate this situation. BioReg was a plant growth-hormone developed by a researcher in Bandung. It was a very effective supplement that significantly

increased rice productivity up to 30%. The ingenuity of BioReg lay not only in its performance, but also in its attachment to the inventor. The researcher often came to the farmers to help them solve farming problems when no extension officers could. It was not unusual that, by engaging in the negotiation between the farmers and pests and diseases, BioReg introduced the researcher to additional benefits of its use. For instance, in the field, he realized that BioReg could reduce yellow stem borer infestations. BioReg provided rice with a capacity to increase the uptake of silicate from soil, hence strengthening its defence against the pest. After a year of negotiation, BioReg (and the researcher) had finally enrolled to the rice network in *pantura*. From 1997 to 2006, BioReg was known widely to farmers and local authorities. Yet, there were problems along the way, resulting from a precarious network that has been woven and the inability of one particular actor (who was the 'centre of calculation'[26]) to negotiate with the variable actors enrolling to, or dissociating from, the network (e.g. chemical compounds, pests, other products, etc.).

As an actor in the rice network, BioReg was the result of long networks of heterogeneous materials. Its main active ingredients were imported from overseas. It was first developed in a university laboratory through the negotiation of multiple components and actors. It had been re-formulated and re-tested through research and experiments. Yet, it had always been the idea of one researcher. It had never been patented nor reported in scientific publications (at least not under the commercial name). By the time the researcher retired from the university, he remained the 'centre of calculation' for the whole network (Latour, 1987), and the factory was moved to his garage. BioReg was still being produced to meet the increasing demand from *pantura* and many other regions. However, its vitality depended almost entirely on the researcher – his financial situation, mobility and health.

As a small-scale industry, BioReg lacked resilience to price negotiations. The researcher remembered a time when his product failed to enrol deeper to the rice network because the agricultural extension, an entry point to the network at that time, would not agree to bring BioReg to the farmers at the given price.

> "Those extension officers, when the price was Rp. 20,000 / bottle, he said he would help, but only if he got 12,000 from each bottle. 8,000! That's far below

[26] Bruno Latour (1987) uses 'centre of calculation' in the earlier version of actor-network theory that focused on control and strategy. He describes the way in which a particular actor(s) (such as the Wall Street) connects to, and to some extent controls, the wider actors surrounding it.

> the production cost, so I said to myself, no need to go through the extension officers. Just straight to the farmers. Luckily I found a figure in the farmers' community, a youth, graduated from an agriculture background." (Mumuh, Inventor of BioReg)

However, a new scheme of payment emerged among the farmers: the *yarnen*, payment-at-harvest. It was hard for the researcher to continue the production following this scheme. In 2004 – 2005, a pest infestation occurred in the area, followed by another outbreak in 2008 – 2009, particularly with the BPH. As the farmers experienced crop failures, they could no longer pay for the supplement. At the same time, the supply of the active ingredients had been temporarily interrupted. The resultant failure of BioReg to enact in the rice network left a gap for other similar products to exploit. When BioReg was eventually available, it proved difficult to re-enter the network. Now, as the researcher's health weakens due to old age, BioReg is weakened as well in terms of its attachment to the rice agrifood system.

The above example shows several important things. Firstly, the strong competition among agribusiness firms in the rice agrifood system has created a situation that is less favourable to small industries. These industries have become vulnerable to various shocks; this situation is, however, also beneficial to the rice network, at least from the farmers' perspective. The trade liberalization in production has influenced the resilience of the rice agrifood system. I argue that the continuous enactments of the network by various actors (rice, pests, diseases, climate, farmers, agribusiness firms, pesticides and fertilizers, financial institutions, etc.) are essential for this resilience. It is apparent that the rice agrifood system, particularly in *pantura*, does not embody a stable relationship among its components. But, resilience is not about stability. It is about on-going adaptive measures performed by (the actors within) the system so as to ensure that the whole system functions as expected. From an ANT perspective, this means that an obligatory passage point (that rice has to maintain its production of *gabah*) is being kept by these actors (even by the pests!) throughout the processes of negotiation. And this is what happens at the rice production network.

This raises the issue of whether the same conditions operate at the other part of the network. What kinds of negotiations are occurring in the rice market? In the next subsection, I will introduce the other facets of rice – that of a commodity and a food. Once rice becomes a consumer commodity, rather than as varieties and other internally embedded characteristics,

rice is seen through its grain qualities (which determine its taste and texture for consumption) and other meanings which the various actors attach to it.

6.4. What has become of rice?

In the marketplace, rice is no longer seen as *gabah*, the un-husked form. It has become something new, a white shiny grain called *beras* (the milled rice). In this subsection onwards, the term 'rice' will refer to this particular form. Indeed, the quality of rice in the market is no longer the result of different varieties, although it still is one of the considerations. Rice quality is a reflection of the way the rice is processed from the time it is harvested until it reaches the consumers' hand. Some actors, such as water and climate, still leave traces of themselves in the quality of rice; but diverse new actors are enrolled, among others, the traders, the husking and polishing machines, the rice mites, the State Logistic Agency, and consumers. The negotiations are made between these actors with regard to physical qualities (percentage broken, moisture content, degree of polishing, etc.), cooking qualities (taste, fragrance, stickiness, etc.), and brand, with the end results reflected in price.

6.4.1. Rice in the market: the rule of 64-3

The rule of 64-3 is a colloquial term commonly used in *Pasar Induk Cipinang* (PIC), the largest rice market in Jakarta. It is a shortened form of 'IR64 – third quality', indicating the benchmark to measure the quality of regular rice. The quality distinction itself was set based on the Indonesian National Standard (*Standar Nasional Indonesia*, SNI), a standard developed by National Standardization Agency (*Badan Standardisasi Nasional*, BSN) for all registered products in Indonesia. The rice SNI-based quality came with various parameters, such as the milling degree (the degree of which bran is still intact with the kernel), moisture content, percentage of broken kernels, percentage of head rice, and many others. The rice is then categorized into five quality classes; the first being the best. The third quality is the most common rice in the market, hence making it the benchmark for other qualities of rice. Aside from these qualities, some types of rice are considered premium or super, having features absent in the regular IR64 rice. For example, varieties such as *pandanwangi* and *rojolele* are high in demand due to their aromatic feature. At the time I was conducting interviews, the price of third quality rice was 6,800 Rupiah / kg. Prices for the better qualities are usually 200 – 300 Rupiah higher. The prices increase as the rice is taken along the distribution chain. In one local market in Bandung, the consumers have to pay 8,000 Rupiah / kg for the same rice

quality sold for 6,800 in the central market. With a difference of 100 - 200 Rupiah between links, we can imagine the long distribution chain the rice has to pass until it reaches a household consumer.

The parameters of rice quality are, however, merely guidelines. Quality, I suggest, is created by negotiations between traders and consumers (and rice), and thus becomes the subjective assessment of these actors. There are many other qualities that SNI fails to account in any manner, particularly those related to the cooking qualities. Two traders that I interviewed have had long experience in rice trading. For them, simply holding the rice on their hand provided sufficient information to identify the quality of the rice. Not only could they determine the physical quality, but also the cooking quality such as stickiness (*pulen*) and taste of the rice.

> "Here, we already know, for this kind of rice, how the quality is. Simply by holding the rice, we can know for sure the moisture content, no need to use a device. Let alone the moisture, even the amount of rice per litre is identifiable. [...] I've been working in this field for 20 years." (Nelis, a trader at PIC)

> "We, traders, can identify the quality of rice simply by holding it. If you want to know whether it's *pulen* (sticky after cooked) or not, you could, but it would take a long while, probably 2 – 3 years of learning." (Lala, a trader at a local market, Bandung)

Many of the rice quality parameters are the results of post-harvest processing of rice. In particular, the percentage of broken rice, the moisture content, the milling degree, and the level of contaminants depend on the way the traders negotiate with rice, hullers[27], the husking/polishing machine, and to some extent the weather. In Indonesia, there are more than 110,000 hullers; around 85% of which are small-scale hullers with the capacity to process no more than 1,500 kg of rice per hour. These small-scale hullers usually operate on a husking machine with one polishing device and no sieve. My interview with a representative of Indonesian Rice Hullers Association (*Perhimpunan Penggilingan Padi Indonesia*, PERPADI) revealed that this condition prohibited the production of highest rice quality.

[27] Here, I define a huller as a person or company works to de-husk and polish the rice, and in some circumstances also dry the un-husked rice grains. In other literatures (such as Steffe et al., 1980), a huller is defined as the machine responsible for the process. To distinguish the latter, I will use husking machine to refer to the non-human actor.

> "This is the situation of rice hullers in Indonesia. With that small scale, the yield (weight percentage between husked and un-husked rice) is low, probably around 56 – 62%. The percentage of broken rice can be more than 20%, even up to 40%. [...] The quality would only fit in to second or third class." (Nur, Rice Hullers Association)

The process of transforming rice from its harvested form into marketable milled rice is prolonged and involves significant reduction in weights. As an illustration, from 100 kg of wet rice grains (*Gabah Basah*), a drying process removes around 20 kg of its weight. The 80 kg of dried un-husked rice (*Gabah Kering Giling*, GKG) is then transformed into 64 kg of so-called brown rice, that is, the husked rice with bran still attached to the kernel (Steffe *et al*., 1980). A small portion of consumers prefers to eat the healthier brown rice that, due to the remaining bran, contains higher amounts of vitamins, minerals, protein, and lipids. However, the great majority do not appreciate the chewier texture and longer cooking time of the brown rice (Spadaro et al., 1980). Further weight reduction during the milling process (transforming the husked into the milled rice) results in about 56 kg net milled rice (a total yield percentage of 70% from the GKG). This is, of course, the best-case scenario with advanced husking and polishing machines. As quoted in the above interview, the average yield percentage of small-scale hullers is only between 56 – 62%, a significant difference if one considers the amount of GKG being processed in a day.

Weather, another actor that influences this negotiation particularly during wet season, sometimes exacerbates the conditions contributing to lost production. Most small-scale hullers in Indonesia do not have a drying machine for the un-husked rice. To gain a maximum of 14% moisture content, they have to dry the grains under direct sunlight. Problems occur during the wet season when the rainfall is high and humidity prohibits the achievement of the aforementioned moisture content. Hence, in order to continue their business, the hullers have to process the rice at a higher moisture content, sometimes up to 20%, resulting in a lower quality product with a shorter shelf-life. Rice dried on the floor is also commonly contaminated with debris and other particulates that affect its quality. Hence, many small-scale hullers confront three limitations to producing high quality rice. In an effort to mitigate these limitations, the hullers' association has been negotiating with farmers for a better quality of harvested grains, with traders for a higher price, and most of all with the rice

through the machines (and in particular one part of the machine: *the sieve*) as intermediaries for a higher yield percentage.

> "We, as a professional organization, have been providing training for the hullers. We have had 440 hullers trained during the year. [Our training] is about using a sieve, so when the grain reaches the husking machine, it is processed and sieved so as to separate the head rice from the broken kernels, and then it can be milled. The percentage could increase to 66%, even to 68 in some cases, well, it depends on the grain." (Nur, Indonesian Hullers Association)

Apart from the physical quality, most qualities of rice, and particularly those that relate to eating preferences, had often been regarded as inherent traits of the varieties. For instance, *pandanwangi* is known for its fragrance, but is less preferred in terms of stickiness. Another variety such as *ciherang* does not have any fragrance, but contains lower amylose and, thus, is stickier. However, the interviews revealed that a diverse group of actors including the irrigation water is involved in delivering the particular cooking quality. One trader informed me that, as he bought rice from different parts of west Java, he could classify the quality of the rice based on the region in which it was planted. For instance, he said:

> "Rice from Subang, from the hilly part, the rice tastes good, because the water [used to irrigate the fields] came from the mountain, it's clean. In *pantura*, which is closer to the coast, the rice is a little bit soft and its colour is not white enough, because it is influenced by sea water." (Lala, a local trader in Bandung)

It is noteworthy that the physical quality of different rices may be very similar from one to another – yet the cooking quality can be extremely different; there are no clear boundaries on the identity of rice in the market. Figure 6.5 shows how different types of rice, each with different origins and prices (although the variety may be the same), are indistinguishable from the point of view of a layperson. Furthermore, different combinations of various types of rice cooked in the same pot may result in different cooking quality. Accordingly, we may find in the local market (as well as in the supermarket) a grading of the quality and price of rice formed by different combinations of varieties of rice; in a way, it has produced new rice of its own. An official from the State Logistic Agency confirmed this as he performed surveys of the rice markets.

"In the market, [the quality of rice] also depends on the brand of the rice product. So people no longer see varieties, but instead they see the brand. The brands could be variable while the variety might only be one." (Agus, an official at State Logistic Agency)

Figure 6.5. Different types of rice in the local market

The negotiation between traders, consumers, and different types of rice influences the dynamics of rice trade in the market. The premium rice such as *pandanwangi* and *rojolele* is limited in production and availability. In West Java, only specific regions produce this type of rice. This has caused the price of premium rice to be relatively higher compared to the regular IR rice, reaching up to 12,000 Rupiah / kg at the same market. Due to this reason, the premium rice only serves a particular market segment of upper class consumers. Meanwhile, the regular rice dominates over 90% of marketed rice. Therefore, the regular rice acts as an agency that shapes the overall price in the market. Between the regular and the premium rice, combinations of both in various proportions act as the intermediate qualities bridging the price dynamics of both rice types. Hence, the prices of the premium rice will follow the dynamics of the regular IR rice in the market.

In PIC, the availability of regular rice determines the price fluctuation throughout the year. During the harvest season (usually between January and March), the central market is flooded with new rice from most of the rice-producing regions, causing the price to plummet rapidly. This situation is clearly detrimental to the producers. On the contrary, during the planting season, the rice stock in the market decreases considerably, so as to cause the price to sky-

rocket. This, in turn, causes a negative impact on the consumers, particularly from the low and middle classes. In either case, the price dynamics have the potential to influence social stability and the bargaining position of the government, creating an opening for another important actor.

The State Logistic Agency (BULOG) was established in 1967 with the main objective of stabilizing the price fluctuations of rice and other important crops, although in 1998 its scope of work was limited to rice. BULOG works by purchasing rice from the producers during the harvest period and releasing it to the market at times when stocks are low. Doing so helps to ensure that the price fluctuations stay within a tolerable range, i.e. the lowest price is high enough so as to provide returns to the farmers, and the highest price is still within the purchasing capacity of the lower and middle social classes. This strategy has been pursued mainly through the establishment of 1,600 Logistic Depots (*Depo Logistik*, DOLOG) or warehouses in 600 locations throughout the country. The total capacity of DOLOG warehouses is up to 4.5 million metric tonnes of rice, or around 12% of the total rice production (Arifin, 2007). DOLOG provides the means to maintain the government's iron and buffer stocks[28]. An interesting feature of these warehouses is the doors, designed to exclude pests such as rats and, thus, provide safe storage throughout.

BULOG also has a network of 4,000 business partners, mostly traders and farmers' groups, from which it procures the rice. The government sets the floor prices for rice as a standard with which BULOG purchases rice from its partners. In the event of widespread pest outbreaks and crop failures across several regions (such as those in 2009), rice production is not sufficient to fill the government stocks. In such situations, the government has no other options than to open its gate for imported rice. Of course, the extent to which Indonesia has to import rice is very vague, and often the subject of political motives. This has been the source many debates among politicians and the farmers' union, as a quote from the interviews demonstrates:

> "It's strange, coming close to the general election, or when the world price is at the lowest, [the government] states that we're in a food crisis. The price in Thailand, for instance, was 3,200 and here was 4,000 – 5,000, we were told that

[28] Iron stock is the amount of rice the government should procure in order to stabilize the national logistic needs, while the buffer stock is made for unprecedented fluctuations of rice in different regions due to socio-political as well as natural shocks (Arifin, 2007)

> we're having a deficit in rice, thus in need of imports. I noticed this. When the world price was high, just like in 2008, we're suddenly in surpluses of rice. So it seems that BULOG has done whatever it takes to gain profit out of this. [...] In 2003, we protested against rice imports, because we're sure that farmers could achieve the targeted production. So, there was a mechanism to close the import channel during two months prior to, and three months after, the harvest period. But now, it's not working anymore. In 2010, even during the harvest period the government was still importing rice." (Ahmad, *La Via Campesina* Indonesia)

At the consumers' side of the distribution chain, BULOG consolidates with the central markets, particularly the PIC, to monitor the rice prices in several central markets, noting periods where the price is increasing. In this manner, PIC plays a major role as an indicator of rice availability.

> "PIC is the barometer of the rice market in Indonesia. The demands in PIC are approximately 2,000 – 3,000 tonnes of rice per day. That's to fulfil consumers' demands in Jakarta and surrounding areas. But we sometimes connect with markets in different islands. So, if the supply in PIC is less than 1,500 tonnes in a day continuously over a two week period, that's a signal that the price will rise, because the supply is insufficient." (Nelis, a trader at PIC)

However, as one trader informed me, the situation has not always been as plain as this. There are circumstances in which the rice supply is relatively high while at the same time the rice prices appear unnecessarily high. In other circumstances, the situations were influenced by the way two important actors, the traders and the warehouses, played important roles to speculate with rice stocks. The year 2007 was a good example of this. At that time, it was rumoured that the government was planning to import rice to supplement its buffer stock while the supply was still high. Imported rice flooding into the market would only cause the price in the market to drop. Many traders decided that it was better to withhold their stocks rather than release them in the market. This resulted in a decrease in the rice supply in several central markets, forcing the government to open its door to imported rice. During the year, Indonesia imported 1.5 million tonnes of rice from overseas (Ya'kub & Samon, 2010). The warehouses played an important role because they were able to preserve the quality of the rice for a year. The stocks retained in the warehouses were then released in the subsequent year, during which the oil price crisis occurred concurrently with massive pest outbreaks in many Southeast Asian countries. According to some analysts, this situation was one of the

reasons why Indonesia could achieve self-sufficiency in rice at the time where many other countries were experiencing food crisis.

It is interesting to see that even at the distribution end of the rice agrifood system, negotiations between human actors (farmers, traders, consumers, BULOG, and the government) and non-human actors (rice, husking machines, the sieve, and the warehouses) have shaped the resilience of the system. The warehouses act as buffers against fluctuations in the domestic rice supply. The sieve and the machine play a role in increasing the capacity of the hullers. The human actors use rice to navigate their political motives. And, importantly, the fluidity of rice in the market provides it with price flexibility. In the next subsection, I will provide more descriptions on how this fluidity has strengthened the resilience of poor families, which comprise the majority of rice consumers in Indonesia.

6.4.2. Rice for the poor: How poor is it?

For many politicians, social stability is the keyword to seize positions in the political arena. Given the nutritional needs of 17.4 million poor families in Indonesia, rice has become an instrument to gain a massive number of votes. It is not surprising then that many government programs are focused on this particular issue. At the level of BULOG, this is translated into a program called market operation (*Operasi Pasar*, OP). There are two types of market operations in practice. First, the general market operation is conducted in several central markets in Indonesia during the period of peak rice prices. BULOG releases its stocks to the market with lower price to pull the average prices down to an acceptable value. Second, the special market operation (*Operasi Pasar Khusus*, OPK), a continuation of the social safety net program in 1998, that is then translated into what is known as 'rice for the poor families' (*Beras untuk Keluarga Miskin*, RASKIN). This particular program has operated since 2004 and has received mixed reviews from the public since.

RASKIN is a targeted subsidy distributed every month to poor families throughout Indonesia. The rice is sold to the beneficiaries for a quarter of its average price, which is around 6,400 Rupiah / kg (hence, RASKIN prices are at 1,600 Rupiah / kg). Each month, BULOG, in cooperation with the local authorities, releases 270,000 tonnes of RASKIN rice through 55,000 distribution points. Two officials I interviewed at BULOG explained how RASKIN has been intended as price stabilization policy over time and place.

> "Seeing the supply and demand curve, RASKIN and market operation have acted as an important factor in shifting the supply curve to the left. Without RASKIN and market operation, the supply curve would shift to the right, and this is not good for price." (Agus, BULOG)

> "Both RASKIN and market operation are crucial to price stability. Due to the large quantity, which is 270,000 tonnes per month, and the significant difference in the price, it really influences the price stability across time, between seasons, as well as across space, between areas of surplus and deficit. [...] This is extraordinary, because it has a significant impact on the price fluctuation. " (Ismet, BULOG)

The availability of RASKIN through time and space, as well as the incredibly low price, are worth noting. But these advantages also come with a trade-off. As farmers often sell their lowest quality rice to BULOG during the harvest period, RASKIN rice is generally of poorer quality. The situation is sometimes exacerbated by the fact that this rice is often kept for a long period of time (over six months in some cases) before it is distributed to the beneficiaries, causing the quality to deteriorate slightly. All of the beneficiaries that I interviewed confirmed that the low quality is an issue. However, as the price is very lucrative, the beneficiaries saw this issue as a necessary compromise.

> "The taste is only rarely good; it's probably because they are old rice. So it's still edible, but a little bit smelly and crumbly. I rarely found any good one. Compared to what I produce now, it's so far off." (Emak, peasant in Bandung; RASKIN beneficiary)

> "Sometimes it's smelly and crumbly, but not always. Well, and it's not really that crumbly now, it's better, so I still want to buy it. It loosens up the [economic] burden, compared to buying the regular rice, it's so expensive." (Rum, RASKIN beneficiary)

For poor families, rice purchases account for more than 50% of their disposable income. Hence, finding affordable rice offers significant relief, even if they frequently have to compromise on quality. It is a common practice to mix RASKIN rice with regular rice as a way to make it more palatable. In certain regions, where the enumerated number of poor families is lower than the actual number, the local authorities have to adjust the situation by reducing the quota of rice per household or the frequency of provision, for instance from

once-a-month to once-in-three months. For some families, this has reduced the extent of their relience on RASKIN, although they acknowledge that it has been very helpful for them in times of crises, such as after another inflation in 2011.

The RASKIN program has expanded not only in urban and sub-urban areas, but also, and most importantly, in rural areas where the number of poor families is greater. Based on an interview with an officer from BULOG, around 66% of RASKIN rice is distributed to rural areas. As has been confirmed by Irhamni and Nuryakin (2009), most rice farmers in Indonesia are also net-consumers of rice. Thus, an increase in the price of rice, instead of improving the welfare of the farmers, will only exacerbate their condition. This situation can be caused by variable factors in different regions in West Java. In the southern regions, relatively small land areas have caused even subsistence farmers to purchase rice from the market prior to their harvest period. A farmer in Garut confirmed this phenomenon, noting that 60% of the rural population have to eventually purchase rice from the market as their rice stock diminishes. However in *pantura*, where the area of land owned is relatively larger than the southern regions, the situation is slightly different. As a commercial form of agriculture, many farmers in *pantura* are bound to agriculture-related debts. Not many farmers are able to retain a portion of their harvest as they are urged to pay for the mortgage and debts, particularly with the payment-at-harvest scheme. One farmer remembered that formulators and debt collectors were sometimes seen at the paddy field during harvest. As he received his payment for the crop, the money went directly to the creditors. It is an irony that many small-scale farmers in *pantura* find it necessary to plant high-value rice varieties such as the glutinous rice and IR42 that they do not consume in order to purchase more affordable rice (including RASKIN), while they could produce consumable regular rice otherwise.

In Kasepuhan, the story about RASKIN is entirely different. As I described in one subsection in this chapter, Kasepuhan is a traditional community in West Java that is able to maintain its own production of rice. Surprisingly for a place that is self-sufficient in rice, however, both regular rice and RASKIN, in their milled form, enrol to the community with relative ease. Although there is a strict prohibition against selling rice in the community, there is no restriction on buying it. Everyone is allowed to purchase regular rice from outside the community. Some people are attracted to this flexibility because buying rice means that they do not have to pound the husks off the rice in order to consume it, an activity which occupies much of their time and energy. RASKIN rice is more alluring in particular because it is

available as a cheaper price than the regular rice and it is distributed directly to the local authorities (about one hour trip from the villages by car). This makes access more convenient than buying the regular rice from the local market (four hours from the villages). Interestingly, as few people have money for its purchase, RASKIN rice has become a commodity for the upper class of the community. In a way, consuming RASKIN rice in Kasepuhan is a privilege for the affluent, given that they do not have to spend a lot of efforts in pounding the husks off as their poorer neighbours do. One farmer there informed me of this as she said:

> "The wealthy people here often buy RASKIN rice, with a price of 3,000 Rupiah / kg, even though they already have their own rice in their barns. Those people are just so *kedul* [slackers] and greedy." (NJ, a peasant in Kasepuhan)

Of particular relevance to this analysis is the understanding that rice, in the form it was intended to be, can be translated into an entirely altered meaning as a result of its attachment to different actors. Rice brings within itself qualities, which can be perceived differently by every actor. Here, even RASKIN, rice that through its quality embodies a symbol for the poor, is translated into an object of affluence and privilege as the many actors attach themselves to it. The next subsection will provide another example of the multiple meanings of rice as it was translated from one actor to another: the case of organic rice.

6.4.3. Enroling the organic rice

Organic is a strong word among Indonesian farmers. It embodies transformation, improvement, and sustainability. For other farmers, it is also the opposite of productivity and intensification. In the eye of farmers' movements such as *La Via Campesina*, organic rice is not only about good farming practice – it is a movement to resist mainstream agro-industrialization and to build alternative pathways. However, for some farmers and traders, organic rice is a way to reach new market segments through premium prices. So what exactly is organic rice in Indonesia?

International standards for organic agriculture are increasingly codified and accepted (IFOAM, in Lockie et al., 2006; Giovannucci, 2005). These have also influenced a definition of organic developed by Indonesia's Ministry of Agriculture (Sulaeman, 2008), which emphasizes holistic management, naturally-made and quality-oriented products, and agricultural sustainability (Sulaeman, 2008). However, the implementation of organic

practices in rice agriculture in Indonesia varies to some extent from place to place and the label 'organic' is applied to various types of rice and the agricultural practices embedded within them.

By definition, practices of organic agriculture have been in use in subsistence rice farming in Java long before the introduction of Green Revolution. Many traditional communities, including Kasepuhan, have demonstrated that their agriculture is, in practice, environmentally sustainable as well as sufficiently productive to fulfil their own consumption needs. However, as the soils in many areas have been exposed to chemical fertilizer and pesticides, the traditional farming methods can no longer be practiced in such areas, or at least not in a way that can produce sufficient rice for the society. For many farmers who have grown accustomed to the more intensive rice agriculture, shifting to more traditional agricultural practice is not an easy task. One organic farmer reflected on this situation:

> "The general view of organic is changing all agricultural inputs from chemical to organic. Yet, organic is not entirely about that. That's only a small part of organic. Organic is a system which includes biodiversity, soil fertility, the food web, and biological control. These four components have to exist. [...] However, in practice, not all of our members can implement [these principles]. It has to be a step-by-step process, starting from reducing the chemical fertilizer and pesticide; it takes time. And it needs sacrifice; there are times where the yields will slightly decrease." (Cucu, an organic farmer)

But, viewing this in the ANT framework, implementing (or enroling) organic technology is not entirely about the farmers. It is also necessary to acknowledge the negotiations with many different actors: the soil, the rice, the pests, and the whole network woven by them. In *pantura*, the enrolment of organic technology is considered unsuccessful because of the failed negotiation between these actors. During interviews, several farmers in that region expressed their eagerness to implement the organic system. A few of them have realized that the conventional system is not environmentally sustainable. Some wanted to break away from their dependency on expensive agricultural inputs. The others are attracted by the premium price and the growing market for organic rice. Their efforts to adopt organic practices are challenged, however, by the fact that most rice varieties they have used are bred to respond to chemical fertilizer. Furthermore, the productivity of soils in *pantura* has been degraded and

requires continuous external inputs. But the principal worry most for many farmers is the emergence of pests.

> "It's not that we don't want to [practice organic system], it's just that when the pests come, we often get overwhelmed, and it seems that there is no other way to manage that aside from using pesticide" (Dedi, a farmer in Subang)

Issues around organic rice also stretch to the marketing side of the agrifood system. As with many other organic products, the price incentive offered by the exclusive market is very lucrative for the farmers. At the same time, the farmers can detach themselves from the strong network of conventional rice which, in many cases, is detrimental to them.

The growing organic rice market in Indonesia is not yet governed by audit schemes. Certification schemes have been developed by several institutions, both in the private (Tjahjadi, 2010) and the public sectors (Sulaeman, 2008). However, the extent to which they reach consumers as well as producers is minimal, with a significant number of consumers basing their consideration solely on trust. Two of the organic farmers that I met acknowledge that the lack of a certification scheme is indeed a constraint to accessing a larger market. Nevertheless, with their limited production, reliance on their own network for marketing has been sufficient.

> "No [I don't use label], because I am not a trader, I am just a farmer [...] I only sell my product to my friends and relatives. It's all about trust. If you don't trust me, just come to my paddy field and see for yourself!" (Cucu, organic farmer in Subang)

> "I have a consumer of Chinese ethnicity, and he told me not to use [organic] label. He didn't trust it, frankly speaking. No use of having a label. 'I once bought rice with a label, but the quality was bad', he said. [...] So the main thing for us is trust. It's not that we want to ignore the lab test. But for me, I really rely on trust to market my product. This consumer even came to our farmers' meeting, went to the paddy field with me." (Aman, organic farmer in Subang)

Certification is not the only hindrance for organic rice to enter the mainstream market. Many farmers are constrained due to their scale of production. An organic farmer has been offered an opportunity to supply organic rice to a larger market in Jakarta, only to find that his harvest quantity is not even close to an economically viable supply.

> "My closest relative, she asked for 10 tonnes of organic rice per month, which means 40 tonnes per season, or around 80 tonnes of *gabah* [taking the weight reduction into account]. [...] Another distributor asked for a container per shipment, it's about 7 tonnes, no less than that. [...] So, the demand is actually high, but we're still sporadic." (Cucu, organic farmer)

From my observation, there are basically two types of organic rice agriculture in west Java: the mainstream and the alternative (Raynolds, 2004). In areas relatively untouched by government intensification-oriented subsidies, such as in the southern regions of west Java, large-scale organic rice agriculture is easier to enrol to the mainstream market. My interview with the Province Agricultural Agency noted that there are cooperatives developing organic rice in Tasikmalaya, the regency located in the south-east of west Java, with a scale large enough for the export market. These cooperatives have complied with the audit scheme issued by an international organization (The International Marketology, IMO) as well as the government (SNI) (Herlambang & Yuli, 2011). However, in *pantura*, where the network woven by the conventional agricultural system has become so strong, organic rice exists only as an alternative movement. In *pantura*, organic practices were first introduced to address the farmers' awareness of the deteriorating effect of conventional farming. It has been an effort to shift farmers' culture and lifestyle, by enrolling organic rice to their livelihood at both the production and the consumption side. The dilemma of practicing organic agriculture in *pantura* lies in the fact that the region has always been designated as the principal producer of rice for the whole of Indonesia. Introducing organic farming to *pantura* means that the government would have to compromise with the availability of national rice stocks. This was proven in 2004 when the 'Go Organic' program launched by the government was only to be followed by the introduction of hybrid rice, which are basically fertilizer-intensive rice varieties. The inconsistency of the government policy was often criticized as lacking a clear vision in the agricultural sector. In my argument, the issue is more than that. The growing organic movement has embodied a new network exclusive from the conventional rice actor-network.

Organic rice is an emerging actor-network woven by various actors: universities, NGOs, farmers, and elite consumers on one side; as well as enhanced microbes, livestock, household wastes, and various herbs on the other. An example of the enrolment of organic rice to one particular farmer in Subang describes this actor-network. In 2005, a researcher from a

university in Bandung was enrolled to the farmers through a mediator, enhanced microbes that are able to efficiently decompose organic materials. These microbes offer an effective way to manage the farmers' household waste, while at the same time providing a rich organic fertilizer for the farm. Meanwhile, an NGO introduced a livestock project, specifically sheep and goats, which would be used to provide an additional income for the farmers. The enhanced microbes negotiated with effluent from the livestock, the household waste, and the soil to provide an optimum growing environment for the rice plant. Another group of microbes, in combination with several types of plants, functioned as a natural control for the pests. The result was an organic rice that was also healthy and tasted different (Figure 6.6). This rice was sold to the researcher and, through him, was introduced to his network at the university. Since then, the farmer has produced the organic rice from two hectares of his paddy field. The above example shows that the enrolment of organic rice is an enrolment of all actors (both humans and non-humans) attached to it. The government efforts to promote organic rice without involving the whole set of actors are deemed a failure.

Figure 6.6. An example of organic rice produced in Subang

6.5. Concluding remark: the resilience of rice

The ultimate question of this chapter deals with the resilience of Indonesia's rice agrifood system to shocks. I will elaborate this in more detail in Chapter 8; but two points can be drawn from this chapter: fluidity and multiplicity. Fluidity relates to the capacity of rice, as an object and symbol, to connect to various actors. Rice is a fluid object that is easily malleable. As a plant, it can fit into almost any environment. Different varieties can provide desirable characteristics for the grower: from pest resistance, extreme environtment tolerance, good taste, to high yield. Yet, it is able to maintain its identity as rice, a staple food for majority of Indonesians. Because of its fluidity, rice also has the capacity to enact various meanings. Rice in Indonesia demonstrates multiplicity as it simultaneously becomes a cultural identity, a lucrative commodity, a source of social cohesion and a political tool. Both the fluidity and multiplicity of rice provide means to build the resilience of the agrifood system.

The capacity of rice to remain fluid and multiple is not unique to Indonesia, as many countries in Southeast Asia demonstrate a similar situation (e.g. Thavat, 2011). However, fluidity and multiplicity are not inherent properties of rice. They are the result of heterogeneous associations. Rice is fluid because other actors (pests, diseases, farmers, research centres) are able to connect to different facets of rice. The dynamics of rice network, in this case, is unique to Indonesia, and even to West Java, because although the rice is similar in various places in Southeast Asia, the combination of the supporting actors is distinctive. Such uniqueness will be a recurring topic in my exploration of resilience thinking in Chapter 8, in which I develop the argument that the enactment of resilience is unique to every place and contingent on the components within the locale. The next chapter elaborates the same argument (i.e. of uniqueness, localities, and assemblages of various actors), although for a different phenomenon: the transformation and continuance of the New Zealand kiwifruit industry.

CHAPTER 7 RESILIENCE AND TRANSFORMATIONS IN THE NEW ZEALAND KIWIFRUIT INDUSTRY

"By reading the accounts of the plant explorers, old gardening and horticultural journals, missionary records, and reports and files of government research stations, and by talking to older growers and nurserymen, we can trace almost every step in the domestication of the kiwifruit. We can follow it from its origin in China to its dispersal throughout the world and its development as an important horticultural crop" (Ferguson, A.R., 1983: 24)

7. 1. Introduction

In Chapter 5, I observed dynamics of the New Zealand kiwifruit industry by viewing it from above, paying attention to and highlighting the way the industry shapes, and is being shaped by, global dynamics in the terms of food regimes. In doing so, I took the industry as a single unit of analysis, a large entity within New Zealand with arms stretching across the globe. The New Zealand kiwifruit industry was presented as an entity that grows and adapts to shocks. Indeed, the conclusions suggested that the industry is resilient, having survived and risen from one shock to another. However, it has also transformed itself during the process; each transformation incorporating a better and more adaptive feature appropriate with the current environment. Resilience, from this perspective, is seen as an inherent feature of the system. Yet, one question remained from the previous analysis. Despite its usefulness in identifying when (and at what point of its development) the industry is resilient, the perspective could not fully capture how and why resilience occurs.

At the end of Chapter 5, I suggested approaching the industry from a different angle, to have a closer look at what happens. Instead of perceiving a single entity, I suggest a complex weave of networks, connecting various heterogenous actors, be they human or non-human, from one place to another. It is just like observing a human body when a person is sick or repairing an automobile when it is broken. In examining the bits and pieces of the industry, I seek to escape from the trap of punctualization (Law, 1992). There are no solid boundaries around the network as newer actors across the geographic landscape are being connected. Without boundaries, there is no longer a self-regulating system or an external shock. The network transforms and evolves over time. Some actors are seen to be durable, to exist in their original form over decades. Some, however, come and go or transform in considerable ways. Yet, transformation also means persistence. In assembling and reassembling the entity,

the actors negotiate a recurring goal: the survival of the kiwifruit industry. Here, transformation is a way to be resilient. Thus, the term 'transformative resilience' (Gotham & Campanella, 2010) becomes relevant as my baseline in communicating and translating the kiwifruit industry to academic texts and graphics (such as the one that summarizes the whole of the narrative I develop in this chapter; see Figure 7.1).

This chapter, thus, discusses the resilience and transformations of the New Zealand kiwifruit industry. To unravel the network, I follow an actor that has been within the network since the beginning: a group of plants called *Actinidia*. The plant was brought from China, a place where the fruit was never so strongly associated to humans as it is today, and was an insignificant plant amidst the rich biodiversity of the country. Since then, it has participated in many translations through which it has been transformed; and, at the same time, it transforms the whole relationships between other actors in New Zealand, and even the world. Unlike in other countries such as the United States and England, the fruit was enrolled successfully in New Zealand even from the beginning of its insertion (Ferguson, 2011). It negotiated well with a whole set of actors: the climate, the soil, the horticulturalists, the enthusiasts, even the government. It has become a mediator[29] for the country to fruit-lovers and healthy consumers around the world.

My exploration of kiwifruit is then necessarily geographical, traveling with the support of documents, archives, reports, and word-of-mouth from China, to New Zealand, the United States, Europe, Asia, and back to New Zealand. This chapter is presented as follows. I start by introducing what kiwifruit, or Chinese gooseberry, or *Actinidia* was in its origin. I follow the seed as it was brought from China to New Zealand. I then focus on what happened to the fruit as its scale of production grew from a few acres of orchards to larger scale plantatons during its first transformation. Within several decades, the fruit had helped the formation of a stable actor-network in the Bay of Plenty region. I follow the fruit as it was becoming materially durable, through negotiation with scientists and cool-storage technology, and also becoming mobile as it was marketed worldwide. At that stage, I return to New Zealand because some actors, at a distance, betrayed the network by casting New Zealand's kiwifruit out of the arena. There was too much kiwifruit, the same old hairy green one, at the table requiring New Zealand's kiwifruit to position itself as being different. Orchardists surviving

[29] The term 'mediator' is used because it carries the burden of "transforming, translating, distorting, and modifying the meaning or the elements [it is] supposed to carry" (Latour 2004:39). It contrasts with 'intermediary' that transports meaning without transformation.

with the green kiwifruit were a necessity at that time for the industry to survive, as the fruit had contributed significantly to the country's export earnings. Nestled away, in laboratories, scientists were exploring new ways of putting the industry back on its feet. Again, scientists played a role in another transformation, this time from laboratories to orchards. They introduced Hort16A, a new Gold kiwifruit variety, which they and industry leaders expected to be the pot of gold at the rainbow's end.

The subsequent part of this chapter follows another invisible actor: *Pseudomonas syringae* pv.*actinidiae* (Psa), a bacterial disease specifically associated with kiwifruit – or to be precise, to the existing Hort16A. After a rapid spread of the disease, supported by many non-human actors, including plant material, the climate, and equipment, Psa has infested almost all of the gold kiwifruit orchards in the Bay of Plenty region. What followed was a series of unsettling negotiations, a situation in which frustration, depression, blame, conflict, and betrayal took place. In the process of finding a new configuration, I document how people worked their way out of the crisis. Indeed, new goals and new configurations, as the results of the negotiation, placed another transformation within the complex network of the New Zealand kiwifruit industry, as epitomized by the rise of a promising new Gold3 variety. I conclude the chapter with two interesting points taken from the narratives: (1) Psa as an invisible actor – yet indeed an actor – alters the relationships between other actors and thus performs a form of agency; and (2) kiwifruit, in the pursuit of resilience, transforms itself into different entities (Yang tao, Chinese gooseberry, Hayward green kiwifruit, Organic Green, Gold kiwifruit, SunGreen, Gold3) and, while doing so, entirely transforms the shape of the industry.

One thing to note is that this chapter is not intended to be a comprehensive historical narrative. Instead, it allows me to become a spokesperson for the various actors of the New Zealand kiwifruit industry hidden at the background. Furthermore, following Annemarie Mol's (2002) "foregrounding the practice", I attempt to flatten the time dimension and put the narratives in the single space of the pages in this chapter. Thus, although the description seems to form a history of kiwifruit, some narrative may flip from one timeline to the other – in a way that enables actors to be revealed across them.

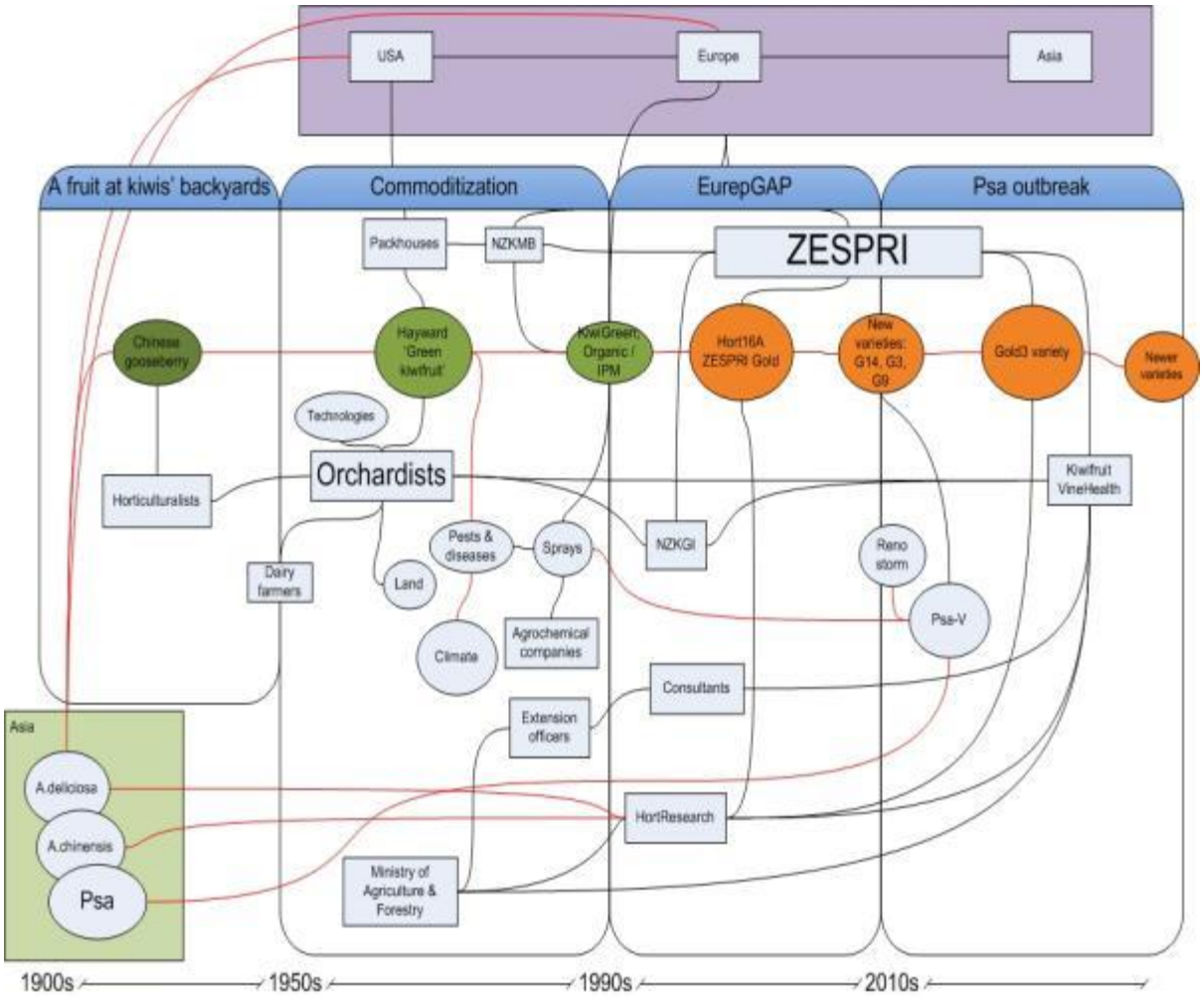

Figure 7.1. Mapping the transformations of the kiwifruit actor-network

7. 2. Where it all began

7. 2. 1. From China to New Zealand

In his article, A.R. Ferguson (2011) elaborates the evolution of kiwifruit as a crop as it started to achieve worldwide recognition at the end of 19th century. Prior to that, it had been hidden amidst other vegetation in the mainland of China, and was known only as a wild plant called *yang tao* or *mihoutao* (Ferguson, 1983). On its discovery, kiwifruit was enrolled to a network in which it negotiated with European botanists, exploring every corner of the world for plants with economic potentials. China was one of the main targets for such exploration, as it was still a relatively unknown country. British domination of China forced the Chinese empire to allow westerners greater access to the country. In 1847, Jules Emile Planchon, a French botanist, identified an extraordinary plant soon to be known as kiwifruit and named it *Actinidia chinensis* (Liang & Ferguson, 1986). A male plant and a fruit, which was yellow

fleshed and glabrous, were then brought to Europe in 1886. Around the same time, E.H. Wilson found a different type of fruit from a similar plant, classified as *Actinidia deliciosa*, in the western part of China. This fruit with hairy skin and green flesh was considered remniscent of the European gooseberry in flavour and, hence, received the common name of Chinese gooseberry.

At the beginning of the twentieth century, the plant had spread across the globe and was domesticated outside the country of origin. Isabel Fraser, a school principal residing in China, brought seeds of *A.deliciosa* to New Zealand in 1904. The plant was enrolled to the incipient New Zealand kiwifruit industry through negotiation with various actors. The horticulturalists and fruit enthusiasts were obviously important actors. Yet, it was the climate and soil of New Zealand that reassured the growers of the fruit's potential. In the United States and England, it failed to be enrolled: in the former because it failed to reach maturity; in the latter because it produced small, scruffy and unappealing fruits. In New Zealand, however, the fruit was produced satisfactorily, stimulating interest among enthusiasts. They swapped seed, bought plants, and started to grow it in a larger area. After successful cultivation in individual backyards, the fruit was planted commercially by Jim McLoughlin on 8.5 acres of land in Te Tumu, Bay of Plenty in 1937 (Yerex & Haines, 1983). From then, consumers' acceptance of the fruit was good, putting the Chinese gooseberry in a strategic position in the New Zealand domestic market. Another actor played an important role at this point: the New Zealand government. During World War II, the government created a policy that banned fruit imports as a response to strong protectionist regulations between countries. It resulted in the further spread of this exotic fruit in New Zealand as people started diversifying their orchards to include the Chinese gooseberry.

7. 2. 2. The first transformation: a commodity for the world

Yet, the first transformation of the fruit (not so much in its physical features as in its meaning) in 1948 was signified by the enrolment of cool-storage, an industrial artefact resulting from negotiation between a commercial firm (Frozen Food Ltd.), a research institute (the Department of Scientific and Industrial Research, DSIR) and the technology itself (Ferguson, 2011). Trials were undertaken to test the impact of cool storage over extended periods of time on the quality of the fruit. In this manner, the actors sought to render the fruit durable. This objective was realised when the technology demonstrated the ability to store the fruit for significantly long periods at 0^{o}C. However, the success of the technology required an

active effort from the fruit itself and, to be more precise, from the actors delivering the fruit for storage: growers, fruit-pickers, packers. In order to remain durable within the cool-storage, the fruit had to be picked at during a specific period before it was mature. A manager at a packing house company referred to the process as follows:

> "Why New Zealand loves kiwifruit [is] basically because Green kiwifruit, unlike almost any other crop, [...] keeps remarkably well. [It] can be picked before it's mature and will then keep for a very long time and still end up in a good eating condition, and that's what makes it pretty useful to New Zealand, because we're a long way from every market." (Manager of a packhouse)

The introduction of cool-store technology and a novel understanding of the fruit's properties had created an opening for new actors to be enrolled. Furthermore, the opening established the foundations for the transformation of the kiwifruit actor-network. Growers adopted new crop management techniques. Coolstores were being established in packing houses. The fact that the fruit became durable had also opened new marketing opportunities overseas. As Ferguson (2011: 34) writes:

> "Within a couple of years, growers adopted the practice and soon coolstores were being constructed primarily for kiwifruit. Cool-storage also allowed the fruit to be sent by ship to the other side of the world. This was the first major contribution that scientific research made to the developing industry and it meant that growers could be confident that the fruit they produced could be shipped overseas and marketed in good condition."

The first international network to be enacted centred on England. In the early 1950s, London importers were looking for new exotic fruits to satisfy the growing demand of upper-class consumers in Britain (Yerex & Haines, 1983). The first shipment to London was delivered in 1952 along with commodities such as lemons and tamarillos. The shipment proved to be more successful for the kiwifruit than for the other commodities—apparently because the fruit proved to have a longer shelf-life, staying fresh while the other fruits rotted. The network was replicated with connections to the United States. Turners and Growers Ltd. handled the marketing in the latter country and creatively transformed the fruit's name from

Chinese gooseberry to 'kiwifruit' (Green, 2002; Webby, 2004), implying that the fruit now belonged to, or originated from, New Zealand[30].

New Zealand's kiwifruit had also performed agency at a distance. With the new transformation having taken place, kiwifruit also rekindled the enthusiasm and interest of horticulturalists in the US. As documented by McKendrey and Sale (1984), California horticulturalists who originally experimented with the plant in 1935 began to take the commercialization of the fruit seriously after New Zealand's kiwifruit proved to be successful. In a cascading effect, extensive commercial orchards were later opened in Italy, France, Greece, and Spain. In this manner, I argue that the transformation of its name, also symbolized an early transformation of the kiwifruit industry into an economically viable and internationally competitive one, not only in New Zealand but also internationally.

7. 2. 3. Formation of a stable network

Over the decades following kiwifruit's enrolment to global food networks, it became an agent that enrolled other actors, including humans, to its own actor-network. By the 1960s, a durable actor-network of kiwifruit, packing houses and coolstores, growers, ships full of chilled fruits connecting the Tauranga port to the US, London, and other parts of Europe was formed. The enrolment of actors continued to strengthen the network as negotiations took place and translations occurred. The success of the kiwifruit actor-network can be assessed according to the four moments of translation proposed by Callon (1986): *problematization*, *interessement*, *enrolment*, and *mobilization*). In this section, I use these moments to reflect on the ways in which actors from the New Zealand kiwifruit industry negotiated to create a stable and resilient network.

Problematization refers to a process by which particular actors strategically "determined a set of actors and defined their identities in such a way as to establish themselves an obligatory passage point in the network of relationships they were building" (Callon, 1986: 6). It requires each actor to be identified and associated with each other. Horticulturalists and keen gardeners, particularly in Te Puke, were the ones responsible for this task. They first assessed the potential for growing kiwifruit in a controlled environment. Kiwifruit is a perennial plant, meaning that it grows and produces harvestable fruits relatively slowly, but is able to persist

[30] Although kiwi is actually the name of a flightless bird endemic to New Zealand, the term kiwi has been used colloquially worldwide as demonym for New Zealanders.

for decades. The 'Hayward' green kiwifruit vine needs seven to nine years before reaching full production (Morley-Bunker & Lyford, 1999). The nature of kiwifruit is such that a large investment has to be made in orchard development without immediate return to the orchardist. The plant has been positioned to be a long-term investment goal. Consequently, it attracts only those actors that are willing to participate in a long-term commitment. Retired professionals, looking for a different lifestyle in warm, quiet and comfortable rural areas, as well as dairy farmers trying to find a less painstaking work and a diversification of income at a time when dairy was less viable, were the prominent actors. It was apparent that kiwifruit orchards provided higher returns than dairy or sheep farms (Yerex & Haines, 1983; Hawke, 1985). However, many growers also translated the meaning of kiwifruit, from a commercial exotic fruit to an object that provided a lifestyle.

> "So, we're doing such a thing as a retirement plan, [...] we saw a way to remain active, and to do something that we enjoy, because we're both keen gardeners." (Kiwifruit grower, Te Puke)

> "I thought the lifestyle particularly was good. We had two busy seasons which was the winter and the summer, and there was a break in the spring and the autumn, and I thought, well, I could have perhaps a family holiday. I wasn't a family man then, but I thought that would be quite nice, you see? So it was the lifestyle that particularly appealed to me, and also I really like the fruit itself. I thought it was a particularly good tasting fruit and it had marvelous marketing quality, I could see 12 month marketing qualities. The fruit was magical, to be winner." (Kiwifruit grower, Te Puke)

The Bay of Plenty region has always been an attractive place to live. The region, the land, the climate, and the soil act as agents to the extent that they are able to "make someone do something" (Latour, 2004:58). With kiwifruit, the actor-network assembled had rendered a stronger power of attraction. In this context, it is interesting to re-visit the concept of non-human agency in symmetry to human agency, as, contrary to common explanations, people are enrolled and influenced by the non-humans. Excerpts from the interviews showed such an enactment.

> "[The reason I chose kiwifruit was] to move to the Bay of Plenty area and be involved in something connecting to the land, I suppose." (Kiwifruit grower)

> "The opportunity arose, and we took it. Really, you know I didn't set up plan to be a kiwifruit orchardist, put it that way. It just, it evolves. Okay, the job that I had led to

> kiwifruit people around me, and just went on from there. Well, we still make a living, and you have a lifestyle." (Kiwifruit grower, Te Puke)

Yet, the early growers had one small disadvantage: they did not know how to manage an orchard. This is where new actors were enrolled. Consultants, be they government officials, private-based, corporate-based, or packhouse representatives, acted as mediators between the growers and the kiwifruit.

> "Because we were newbies, we needed people around us who would be able to guide us, so we employed consultants, and that process started even before we bought the land, we made sure that we had several people who knew about this block of land, viewed it ... talked to us, and because we wanted a good block of land." (Kiwifruit grower)

> "I'm working with people who are looking to change, or develop, or improve, or monitor their system of performance, and it would be at whatever level it's appropriate to each client. So it's very much a client-focused business rather than a standard product that we have to offer, it is a service oriented type of work." (Consultant)

The level of support given to the growers created a stable relationship conducive for the association of another actor, the banking industry. A kiwifruit orchard is an ideal business for the banking sector. It offers a long-term and stable investment as it is supported by a multitude of actors. Being connected by the same thread, the actors endeavoured for a common goal, or in ANT vocabulary, an obligatory passage point (OPP): to produce as many kiwifruit as possible under a particular set of methods and standards. For kiwifruits, the OPP enhanced the viability of the vines. For growers, it was an economically reasonable return and comfortable lifestyle. For scientists and horticulturalists, it was publishable research and innovations. And so other actors such as packhouses, consultants and banks also share similar goal for their own objectives.

Yet, problematization is not a sufficient basis to ensure connection. There must also be the means to tie the actors to a specific network. For an actor to be enrolled, it must be separated from its surrounding so as to prevent unaccounted connections. Thus, the second moment of translation is *interessement*, referring to an actor/device that is interposed between actors in

order to dissociate them from, and associate them with, others. To illustrate, T-bar, pergola[31] and other orchard management devices helped to 'anchor' kiwifruit vines to the orchard without being interrupted by other non-human actors (pests, diseases, climate, etc.). Contract agreements between growers and packhouses, incentives from the exporters and bank loans were examples of interessement devices that associated growers with other actors. The better the devices are, the stronger the association is, and the higher the chance for enrolment becomes. In the Bay of Plenty, the disassociation occurred in relation to, for instance, dairy farming and professional jobs in big cities like Auckland.

Enrolment is the result of a successful interessement; where an actor successfully plays a role in the network. The vines were able to produce kiwifruit for commercial purposes. Growers complied with the quality standards needed for exporting and paid their mortgage on time. Banks were willing to provide funding for larger investment. But during the early stage, only a small portion of those actors were involved in the negotiation. For a larger number of growers, packhouses, banks, consultants and kiwifruit to be enrolled, enrolment has to be followed by *mobilization*. Successful mobilization occurred in the next several decades where the number of orchards and production increased rapidly. Within the next 30 years, it had become the most prominent agricultural commodity in the Bay of Plenty area, and in the next 60 years, Te Puke, a small town in the region, was assigned as the kiwifruit capital of the world.

By the time the growers were enrolled to the kiwifruit actor-network, they were attached so strongly that the network seems to be stabilised. The large investment that the growers put into the establishment of their orchards, the indebtedness with which they were forced to live, and most importantly the lifestyle of which they were unwilling to let go, were part of the negotiation to render kiwifruit indispensable to the growers. For some of them, an OPP of surviving with kiwifruit committed them to do what was necessary to remain viable. As one grower explained:

> "Sheep never looked so good, but I've always missed that lifestyle. But there've been other lifestyle benefits from kiwifruit. I've had a lot more leisure time I guess from kiwifruit than what I would've got from farming. Yeah, we have thought of what we'd

[31] T-bar and Pergola are support structures that help to position the growth of kiwifruit vines to a desired basic structure, so that the vines can grow effectively for production and the fruits be picked easily.

> do if kiwifruit were worth nothing and a large chunk of our capital basis are tied up in kiwifruit" (Kiwifruit grower)

What happened in the next several decades of the New Zealand kiwifruit industry was a series of negotiations and control, sometimes in proximity to the centre of production, but most often at a distance. The long network that rendered kiwifruit mobile is enacted by the shipping channels, marketing outlets and consumers; all of them can be considered as agents. They were also the agents that shook the rigidity of the network to an extent that transformation was inevitable. The long distance actors in Law's (1986) terms would betray the network. The subsequent section describes this betrayal and transformation in more detail.

7. 3. On being different

7. 3. 1. The second transformation: at a distance

In Chapter 5, I identified three factors behind the collapse of the New Zealand kiwifruit industry in 1992: (1) the increasing level of kiwifruit production around the world causing the price to fall, (2) the government's adoption of neoliberal policy that was soon followed by price crash, and (3) the 1991 Italian pest residue crisis that finally disentangled the existing network. In this chapter I want to, first, foreground the other, previously hidden, actors that made the collapse and transformation possible; and then demonstrate the way these actors also took part in the subsequent transformation of the actor-network.

The central actor was, of course, kiwifruit – but not only New Zealand kiwifruit. When the first transformation occurred, the actor-network had created an opening for the enrolment of more actors not only in New Zealand, but also in other parts of the world. Around the same time at which kiwifruit was massively produced in New Zealand, the world market was filled with other kiwifruit – from Europe, US, South America, Middle East, and Asia (McKendrey & Sale, 1984). The first transformation put kiwifruit production in an extensive mode. This, in turn, came at a price. As actors sought to push orchard production to the limit, new transformations began to unfold involving the shift of kiwifruit from an upmarket high-value product to a well-accepted commodity (OECD, 1996). Exporters from New Zealand lost their ability to set the price for consumers and retailers in export markets. The New Zealand actors (growers, packhouses, and exporters) were not ready for such a transformation. They felt betrayed and needed to re-negotiate with the overseas actors to re-establish their position in the network.

At this stage, I focus on the government—a fascinating and multifaceted actor that sought to control the kiwifruit industry in many, and at times contradictory, ways. The first facet was the New Zealand Kiwifruit Authority (NZKA), conceived in 1977 to manage exporting activities, including promotion, formulation of standards for export and licensing of kiwifruit to the global market (McKendrey & Sale, 1984). The regulating body proved to be successful for several years; but the government, in a different facet as the Ministry of Finance, deregulated the economy and rendered the NZKA ineffective. As Campbell and Fairweather (1998: 18) documented:

> "[A]gricultural deregulation in 1984 affected the kiwifruit industry more negatively than almost any other agricultural sector with many growers ruined by highly leveraged properties and high interest rates combined with rapidly declining world prices and an inflated New Zealand dollar" (Campbell & Fairweather, 1998: 18).

The New Zealand Kiwifruit Marketing Board (NZKMB) was created in 1988 as a response to the failure of NZKA, and enrolled to a network that was spreading far more extensively. As the single-desk kiwifruit exporter, the NZKMB sought stronger control over longer distances by establishing international offices in London, Brussels, and Seattle to handle off-shore activities (Le Heron, 1992). However, the marketing board stood on shaky ground. Not only did the industry face a precarious moment with economic deregulation and volatile prices, but the board itself was subject to scrutiny from competitors within New Zealand and overseas, particularly due to its monopoly over kiwifruit export (Waitangi Tribunal Report, 1995; Hoadley, 1997).

This precarious network was shaken again by the enactment of another actor, this time a non-human one. The third actor was an insect pest of specific taxa: the armoured scale of the Diaspididae family (Blank et al., 1990; Tomkins et al., 1992). It had been infesting the kiwifruit orchards since the early 1960s in its multiple forms: greedy, *latania* and *oleander* scales being the most predominant. Entomologists gathered to investigate these insects and their effect on kiwifruit orchards. In doing so, they became the spokespersons of the armoured scale insects (In their article, Blank et al., 1990 described the process of scale infestation clearly).

There were minimal impacts of the armoured scale on the vines' productivity as the pests reduced its vigor and, consequently, its fruit production. However, a relatively major impact

was detected on fruit and fruit quality. The majority of infested vines produced fruit that was shrivelled and covered in scale, a cosmetic defect that was never an acceptable quality in the market. As a result, the fruit had lost the ability to negotiate. Based on the export standard from the NZKA (and NZKMB), the fruit affected by scale were unacceptable for market (Blank et al., 1993), and this was a large threat to the industry. However, the solutions were quite simple. It appeared that instars of the insects were vulnerable to pesticide, and the adult to mineral oil. If the pesticides and the mineral oils could settle on the vine's surface over a regular period of time, they would prevent the infestation of the orchards. Thus, a scheduled spraying of pesticide was proposed (Tomkins et al., 1992).

In the 1980s, routine spraying was an important part of the kiwifruit orchard management, as well as other horticulture in New Zealand. It was documented that the growers "emphasise high yield, high quality and stable yields by a variety of production strategies such as *routine spraying* and monitoring pests, crops and climate" (Martin, 1996: 36, emphasis added). Routine spraying apparently was the highest priority strategy employed by the kiwifruit growers (Martin, 1996). Ironically, the very measure introduced to prevent the fruits from being excluded from the international market eventually contributed to its rejection in the event of the 1991 Italian residue crisis.

Around the same time that routine spraying was implemented in New Zealand, Italy had increased its kiwifruit production and began to dominate the European market. The quality of their kiwifruit was, however, inferior to that produced in New Zealand (OECD, 1996). As Campbell and Fairweather (1998) assert, the fierce competition between Italy and New Zealand in the European market created a negative sentiment against the New Zealand kiwifruit. The routine scheduled pesticide usage exacerbated the problem when residue was detected in the fruit.

> "During 1991, European authorities began to invoke national Maximum Residue Levels (MRLs) for chemicals in kiwifruit and prosecuted suppliers of New Zealand kiwifruit which exceeded these levels. The board suffered immediate losses as fruit were impounded …" (Campbell & Fairweather, 1998: 18)

Like a cascade, the conflict shook the weak ground on which the NZKMB was standing. The combined impact of the scrutiny to which this government body was exposed and the betrayals in every corner of the industry pushed it towards collapse. In a necessary step,

NZKMB was restructured and split into two bodies: the Kiwifruit New Zealand (KNZ) as a statutory body and Zespri International Ltd. (Zespri) as a marketing entity. At the same time, the 'KiwiGreen' best practice scheme was introduced, creating openings for the enrolment of diverse facets of kiwifruit including organic (Campbell & Fairweather, 1998).

Which actor was responsible for the series of crises? Was it the NZKMB, the armoured scale, or the kiwifruit? The complexity of the network relations prohibits a clear assignment of blame to a particular actor. This uncertainty is not unexpected from an ANT perspective, as the theory is not intended to analyse the causal relationship behind a phenomenon (Latour, 2004). Rather, ANT foregrounds the interplay of a multitude of actors connected to the complex weavings of an actor-network. By doing so in this case, ANT shows that the collapse and transformation of the New Zealand kiwifruit industry was an active ensemble of heterogenous actors enrolling, negotiating, and betraying each other over a wide space/time continuum.

7. 3. 2. The rise of Zespri

Although bearing a new name, Zespri was not a new actor in the kiwifruit industry. It was, after all, a mere transformation of the NZKMB. Or was it? Can the transformation truly be considered insignificant? From an ANT perspective, transformation is a complex process that involves a comprehensive re-negotiation of the relationships among actors in the network. In some cases, transformation can be seen as a way for the actors to remain within the network. In 1991, New Zealand kiwifruit growers agreed to elect spokespersons under the name of New Zealand Kiwifruit Growers Incorporated (NZKGI). For a decade, the spokespersons negotiated with other actors so that growers would retain their power over other actors. This long negotiation led to the formation of Zespri, which NZKGI expected to be beneficial to the kiwifruit growers.

> "The organization that was before Zespri was like Zespri in many ways. Zespri was a structural change and a name change; but the real purpose didn't change. The structure changed in 1997, and that's when the real change happened, and that's when the industry went to a single marketer. And a single marketer has a different shape and form, and it became Zespri in 2000 […]. So we all have been together for a long time, but it rose up around 1987 with a change in the structure. And that change in structure happened as the growers weren't making any money, about a dozen exporters, and we decided enough is enough. Part of the thing that happened in 1987 is the creation of this

> organization, because the grower doesn't have a voice, they thought." (New Zealand Kiwifruit Growers Incorporated, NZKGI)

With the enrolment of Zespri, the kiwifruit actor-network was re-assembled. Some actors were still associated to the new "center of calculation" (Latour, 1987); but some, such as exporters, had to be dissociated. Some of those that did attach had to re-negotiate their association with Zespri in order to establish new obligatory passage points (Callon, 1986).

The kiwifruit, as an actor, had to negotiate so as to be a unique product amidst the undifferentiated commodity (Campbell & Fairweather, 1998). Under Zespri, fruit qualities were re-defined; these quality standards became a new obligatory passage point. If the fruit was unable to fulfil those standards, it would be rejected and eliminated form the network.

> "Taste is number one. So effectively, taste, quality, and consistency are the cornerstone of our product and our brand obviously. So if you've got fruit that doesn't store well, doesn't consistently deliver in terms of ripeness, and doesn't taste good, and it's expensive—because our fruit is very expensive compared to other kiwifruit, generally we're at the higher end of cost—then you are not going to attract consumers to come back and repeat purchase." (Zespri's Marketing Division)

Zespri exerts control over the fruit, with the ability to trace every single fruit from an overseas outlet at the other side of the world back along the supply chain to its grower. Through this ability, Zespri controls not only the fruit, but also the packhouses and growers. Thus, these actors had to negotiate with Zespri to be enrolled to more stringent marketing standards under EurepGAP (Rosin et al., 2008), particularly with regard to pesticide residue control.

> "We implemented a very extensive residue program, probably the most extensive residue program that has ever been implemented in the world for a crop. We're able to provide pretty much 100% confidence that no fruit that entered the market had any […] residues. So from a business perspective, […] it has created some additional work for the market, particularly Europe who is very sensitive to residues. And we had worked very hard with the local regulation and our customers to assure them that our fruit is still sound." (Zespri's Marketing Division)

Yet, negotiation is never a one-sided process and reciprocity is needed for a successful enrolment. Despite its control over other actors within the network, Zespri also had to

negotiate with other actors – growers, packhouses, retailers, consumers, even the kiwifruit – to achieve a socially legitimized monopoly over kiwifruit exports from New Zealand to markets all across the globe. Because of the nature of these relationships, Zespri has been enacted as a paradox. On one hand, it is a grower-owned co-operative, implying that it is an enactment of growers to gain control of overseas activities. On the other hand, it is also a corporate-based marketing company that continuously seeks control over the production through stringent harvest criteria based on market standards. Zespri is the actor that renders growers indispensable, durable, and resilient. Yet, it is also the actor that controls, translates, and transforms growers (and other actors as well). This shows that an actor-network can become transformative and, at the same time, resilient. A transformation in one part of the network can also mean resilience in another, particularly for those actors seeking to remain indispensable. This condition in the kiwifruit actor-network is exemplified by the kiwifruit, or more precisely the 'Hayward' green kiwifruit variety (henceforth is called 'Green kiwifruit').

7. 3. 3. Surviving with the Green

In the last part of Section 7.3.1, I mentioned that some kiwifruit growers have become so attached to the industry that it is hardly possible for them to escape the entanglement. They are, in a sense, trapped by a situation in which too much capital has been invested in the industry and connectivity is at its highest, creating an extreme form of stability (or resilience) that impedes any transformation to a more desirable state. The situation is often perceived as a pathological state for a system. It is, thus, a necessity for a system to avoid or escape the lock-in trap.

A network perspective puts more emphasis on the actors' capacity to detach themselves from the network. It is also important to note that not only human actors matter, but non-human actors also have the same agentic capacity as the humans. Through negotiations and enrolment, actors work to position themselves strongly in the network so as to remain indispensable to other actors. Thus, it is not the system that creates a lock-in trap; it is the actors that lock themselves in. The so-called trap is then the product of their negotiation among themselves (e.g. the strength of the OPP, the effectiveness of the interessement devices, the actors' willingness to be enrolled and mobilized). It is not always a process of enrolment that leads to 'lock-in', but this could also be a process of betrayal.

In the case of the Green kiwifruit growers, the first betrayal of the kiwifruit network since 1980s was a result of the the combined effect of Green kiwifruit prices and production costs. Kiwifruit prices are largely dependent on two things: supply and demand in the global market and the New Zealand exchange rate. Since 1999, Zespri has tried to manage these fluctuations in order to maintain the orchard gate return (OGR) at a stable state to the extent possible. As a marketing company, Zespri has the capacity to control the allocation of earnings. However, it does not have the capacity to control the production costs. While kiwifruit prices at the orchard gate remained relatively stable, production costs rose incrementally, leaving the growers with decreasing returns. This situation left some growers on the edge of collapse as their returns were barely sufficient even to cover their expenses.

> "God, barely, barely! Just, only just. It's actually making a small, well, it's not a profit, surpluses, at the moment, but it can't go on like that." (Mr. Y; A green kiwifruit grower)

> "Marginally. The cost is still going up, and it's still a 4 dollar crop. So far probably, since about 1992, the price has sat at a bit above or a bit below 4 dollars each year, depending on the exchange rate, and our cost has been creeping up every year. And so Zespri has managed to maintain a payout in about 4 dollars on the increase on the market. In the marketplace it had probably gone across those extra, shipping and coolstoring and packing costs. But on our Orchard cost, we still have to come out of the 4 dollar, have been creeping up wages, fertilizer, sprays." (Mr. Z; A green kiwifruit grower)

But why has the betrayal not caused a disentanglement of the network? As is evident in the kiwifruit sector, the association between growers, kiwifruit, banks and other actors was so strong that price fluctuations and decreasing returns failed to dissociate the growers from the network. For some growers, their level of indebtedness and volatile land prices were among the determining factors of their attachment to their orchards. For those who did not have to pay a mortgage, their attachment to the lifestyle the kiwifruit had to offer was enough to make them stay in the business.

> "You've got the retired farmers who have come here to live by the water with their boat. They don't want to live in town because they've lived on the land. They have an orchard, again, they come and pay cash for their orchard, they got no debt servicing. They still got money left from selling the farm and a bank account earning interest or invested somewhere. So again, if the orchard makes a bit of money, covers its rates,

> they got all the space they can go and mow the grass and get the farming feel, it suits them. You know, it's so to say that the Green industry's doom is not quite feared because it would survive and last because of that exact reason, because of the type of people that own the orchard, it's very unique." (Mr. X; Director of an orchard management company)

Another reason why the actor-network was difficult to disassemble was that the Green kiwifruit had become so indispensable, to both the growers and the other actors in the industry. Green kiwifruit was, and still is, the backbone of the industry. Infrastructure (packing and storage facilities, orchards, and transportation) had been developed specifically for, and because of, the Green kiwifruit. These were the devices of interessement, the tools that made the Green kiwifruit attachment to the network so strong.

> "Green is the backbone, Green allows the infrastructure that sits in Zespri, the shipping, contract rates, the volume; it's the broccoli of the vegetables. [...] It's the staple diet that everyone knows, that generates the life that is having around in the Bay." (Mr. X; Director of an orchard management company)

> "In saying that, the Green kiwifruit, because of its share volume at the moment, about 70 million trays, is still a really significant chunk of income to the industry, and is still the backbone, if you like, of the kiwifruit industry in New Zealand, because we have a massive supply chain set up here, who have huge facilities and investments in processing kiwifruit. So, volume is part of their financial equation. So for us, Green kiwifruit is still a very important product, but it's increasingly difficult for us to extract value from that product because our competitors are stepping up and our ability to differentiate at a price level given all that other factors, is challenging for us as an industry." (Marketing division, Zespri)

As the Green kiwifruit (in combination with other actors such as Chilean and European producers) betrayed the network, each actor had to re-adjust their goals and inclinations. Not only did the growers have to revisit their management practices, but Zespri would also have to reorient their marketing and research strategies. Research and innovation were focused on improving yields and taste. Consultants were called to support growers in increasing the quality of fruit produced to comply with Zespri's standards. Packhouses competed with each other for better services and returns to growers. Even the NZKGI struggled to defend the growers' share for a higher return.

> "We were very focused on trying to help the green growers to improve their orchard gate return, OGR. It's very economically focused and the key thing we were focused on was basically improving yield and improving taste." (Orchard productivity manager, Zespri)

> "All the, what I would call, the traditional ones, an ongoing call to manage the orchard for improved return, so we're looking for all the things that give growers incremental income from Zespri: dry-matter, earliness of maturity, fruit size, storageability of fruit, all the incentives, productivity, yield itself. It's of no use producing a lot of small fruit, so a high yield but small fruit won't produce any value, and then really looking at techniques to improve productivity." (Consultant)

It is apparent from both resilience theory and ANT perspectives that the growers were indeed trapped in an undesirable situation. The system, or network, was resilient, albeit in a negative sense. What differs between the two perspectives is what locks the system in. The former approach sees the system configured such that the components have no capacity to escape the trap. The theory suggests that there is a need for an external intervention and restructuring to unmesh the entanglement (see Gunderson & Holling, 2002; Walker et al., 2006). The latter, by contrast, sees that resilience is an enactment of negotiations between actors; and, because of that, it is the actors themselves, through the display of power and control, that associate with, and dissociate from the network, leaving other actors feel trapped. In the case of the kiwifruit sector, the robust network was challenged by a betrayal, causing the actors to question the value of the fruit variety in the face of industrial transformation. Resilience, which was once considered good, was not necessarily seen as such (a situation that Holling et al. [2002b] refer to as mal-adaptive). For the network to remain durable, actors had to work together to maintain themselves (and others) as indispensable. The weakest link, in this case the Green kiwifruit and people who insisted on its production, was shaken. Actors re-negotiated to replace (or at least complement) the Green kiwifruit with something better (and more controllable). The new actor was Hort16A, better known as, *Zespri™ Gold*.

7. 3. 4. Gold at rainbow's end?

The Zespri™ Gold kiwifruit (henceforth is called the Gold kiwifruit) was a special actor designed and prepared for the new structure of the industry. It was an exclusive, high-quality product intended for a new emerging market in Asia. This variety has been introduced earlier in this chapter as *Actinidia chinensis*, a name which recognises its origins in China. It is

distinct from the Green kiwifruit, having a fruit that bears no hair and has yellow flesh. The selected Gold variety tastes sweeter and less acidic, with a flavour profile similar to tropical fruits. Gold kiwifruit is also characterised by a small beak at its tip, which is of significance to its enrolment within the actor-network. The vines grow more rapidly than the Green variety, and continuously through autumn (the Green vines stop growing at the late summer). The bud break and flowering occurs 4 – 5 weeks earlier, and the plant reaches maturity (ready for a full production) faster (Morley-Bunker & Lyford, 1999). It was the ideal replacement of Green kiwifruit. It has, however, one limitation. The license to grow this plant is owned by Zespri. This was Zespri's strategy to gain full control of the variety; it was their interessement device.

The New Zealand Institute for Plant and Food Research, Ltd (or *Plant & Food*, then known as the Horticulture and Food Research Institute of New Zealand, *HortResearch*) was responsible for this device (it was). Plant & Food is a government-owned research institute that focuses on providing research and development around plant and marine-based food industries (Plant & Food, 2010). It is a successor to DSIR (see, Chapter 8, Section 8.2.2), an important actor that played a role in the first transformation of kiwifruit. With an office based on Te Puke, Bay of Plenty, a division of Plant & Food was specifically assigned to handle the bulk of research on kiwifruit, the prominent commodity in the area.

> "Plant & Food has a number of roles within the kiwifruit industry. Principally, it's to provide research services to the industry for the benefit of the industry, so our role, if you like, or our mission is to seek growth in the kiwifruit industry and we provide research services to do that. That can be in a number of ways, one, we have a contract directly with the industry, but two, we would be the biggest investor in research in kiwifruit, in our own right." (Business Manager, Plant & Food)

The successful development of the new variety took over 10 years. The process started with the collection of seeds from China. It involved stringent breeding and screening based on climate suitability, pest and diseases resistance, vines productivity, nutrient content, fruit quality and consumers preferences. Particular to the latter, the research process required a negotiation process between consumers and the kiwifruit to identify the preferred taste and quality (Jaeger et al., 2003; Harker et al., 2009). In order to facilitate year round research, Plant & Food, in collaboration with Zespri, also opened a research station in the northern hemisphere. The Gold kiwifruit was released to the market in 2001 (Ferguson, 2011) as a

unique product that no other company could ever produce. Zespri was able to leverage more value from the Gold kiwifruit in the market because it had full ownership of the Plant Variety Right (PVR) from Plant & Food. They had the flexibility to create prices – firstly by negotiating with the retailers, and secondly by limiting the volume of production. With this interessement device, Zespri had control not only over the fruit, but also over the growers, packhouses and consumers. It was a huge investment, but it came with a sweet victory.

> "I think very rarely in the world do you see a licensed variety, a PVR-ed variety actually used in constraining production. If you look within the stone fruit industry or the pip fruit industry, or grape industry, most of the PVR-ed varieties, the money is made in selling the plant, not in constraining the volume. The secret, really, to Zespri is it can constrain volume." (Orchard productivity manager, Zespri)

In the orchards, some growers, particularly the early adopters, had been waiting for Gold kiwifruit as the next big thing. They understood that Green kiwifruit is uneconomical and considered the regrafting of their vines from Green to Gold kiwifruit to be a logical step.

> "Yes. We knew that Green is a 4 dollar a tray crop, meaning that it was going to reach a point at which it would become uneconomic, maybe, or marginally economic to grow, and then as time went, it would become uneconomic because the cost would keep going up and we have a farming strategy here to increase our production by 10% a year, of our gross farm income by 10% a year, with inflation running at 3 or 4%, to stay, to keep up, we need to have at least 10%, which means we had to double our income every 7 years, or and so Gold, we saw Gold kiwifruit as being a way to achieve that." (A Gold kiwifruit grower)

The process of enrolment as a Gold grower was, however, not easy. To be able to grow Gold kiwifruit, the grower had to first be eligible. Zespri was able to decide whether an applicant had the capacity to produce Gold kiwifruit, was financially secure and was willing to assume the risk of growing new vines. Zespri limited the production of Gold kiwifruit to 30% of the total kiwifruit production (covering around 3,000 hectares of orchards), with projections to increase the percentage as the market grew. The selection process also resulted in the differentiation of the growers with the result that Gold kiwifruit growers were financially and operationally superior. They were the risk-takers and often more progressive in terms of technological innovation than the Green kiwifruit growers. This differentiation also reflected geographical advantages as Gold kiwifruit preferred lower altitude sites with a warmer

climate. As a result, Te Puke continued to develop as the largest kiwifruit production zone, while orchards in the central part of the North Island were excluded.

The affinity of Gold kiwifruit to the Te Puke region also influenced other actors in the actor-network. Not only does it have a better climate, the area is also supported by a large diversity of actors in the kiwifruit industry. Contract workers preferred to work with the Gold kiwifruit orchards because they got better payment for fruit-picking. It had become a strong competition between contractors to provide more skilled workers, including more exacting demands with regard to pruning and the sensitivity of the Gold kiwifruit to handling. Inexperienced seasonal workers (students, international travellers, part-time workers) were replaced by professionals.

> "Yeah, Gold gives more income than the Green, and anybody works with the Gold orchard, they get more money, because we need to pick the fruit more carefully, so people get more money for the work. So it's not counted by the hours, but by the fruit we pick." (Contractor)

The geographical advantage has created a better situation for the Gold kiwifruit growers, but not for the Green ones. With a significant price difference between Green and Gold kiwifruit, Gold growers were gaining higher returns, thus increasing their capacity to purchase more orchards from their Green neighbours. This situation was also exacerbated by the economic pressures faced by the Green kiwifruit growers. The options were either to sell the orchards or to switch to Gold kiwifruit (although this option is limited by Zespri), which often implies a deeper entanglement with debts. Kiwifruit orchards around Te Puke were increasingly managed in a very intensive production scheme. Corporate or orchard management companies managed larger orchards (more than 50 hectares of land), while individual growers still handled smaller orchards (1- 4 hectares of land). These changes, as I will explain shortly, came with a price.

Despite its advantages, the Gold kiwifruit also had impairments. In particular, the beak at the tip of the fruit has made the Gold kiwifruit harder to pick and to pack. One grower explained to me that workers could not pick the fruit in the morning because the fruit was too soft, and they had to wait for it to harden up. The beak of one fruit could also puncture the other fruit in the tray, forcing the workers to harvest and pack at a slower speed. In addition, the vines grew very prolifically rendering it harder to manage. While this latter impairment was minor

compared to greater return the Gold fruit provided, it would prove to be a major impairment when the fruit's income potential was reduced, as the subsequent section will reveal.

7. 4. Embracing the future

7. 4. 1. Psa: an invisible actor

On November 3rd, 2010, only months after Zespri and Plant & Food market-tested new varieties of kiwifruit (as mentioned in Chapter 5), a disease was detected in an orchard in Te Puke. The symptoms included spotty leaves and oozing of white and red pastes from the vines that resulted in a cane dieback. No one in the area knew what it was and no one would have predicted how severe the impact would be; no one, except several scientists and horticulturalists that have heard of, and discussed, the disease during a conference in September 2010 in Italy (Costa & Ferguson, 2011). They named it bacterial canker disease. Apparently, it had been studied since 1984. The bacteria causing this disease are called Psa, *Pseudomonas syringae* pv.*actinidiae*, and were first described by Dr Yuchi Takikawa from an isolate taken from Green kiwifruit plants in Japan. In 1992, it was also detected in Italy and, in 1994, in Korea. However, there had been no large-scale disease outbreak until February 2009 when a significant outbreak occurred in the province of Latina, the most important area of kiwifruit production in Italy. Following the event, another outbreak occurred in September 2010 in Portugal and France. The scientists and horticulturalists at the conference were, thus, eager to discuss every aspect of this disease: identification and characterization of the bacteria using PCR protocols (Mazzaglia et al., 2011), real time monitoring of the bacteria (Spinelli et al., 2011) and its epidemiology (Vanneste et al., 2011), among others. At that time, the considerable impact of its spread to New Zealand had yet to be anticipated. The bacteria were a new and previously unimaginable actor in the New Zealand kiwifruit sector. Over time, it would prove to be an invisible and resilient actor.

> "It's very serious, we don't yet know how serious, we know that the industry at least two years ago was built around two varieties, the Green and Gold, and we know that it destroyed the Gold variety, and we don't yet know the full impact on the Green variety." (Manager of a packhouse)

> "I just don't know what happens with Psa. I know it's creeping in Italy, all their vines would have it, I don't know whether we all possibly, I'm mentally prepared for less trays projection, flower bud drop, I don't know, but I know that financial costs, it was

> easy to ring-fence that to see the problem was. I don't know, I don't know how big the problem is. And I don't know how long is it, 2 – 3 years?" (Manager of a packhouse)

Like all processes of translation (Callon, 1986), the first step of enrolment for Psa was through problematization, or by other actors inquiring about its identity: what it is, where it came from, and how it spread. Having attended the Italian conference, the scientists then acted as the spokespersons for Psa. They communicated most of the information they had acquired about Psa. However, unlike the usual role of a spokesperson, they meant to betray Psa – that is, to understand the weaknesses and pitfalls of Psa so as to dissociate the bacteria from the network. In so doing, they sought evidence of the traces left by Psa. The scientists, government representatives, Zespri and growers' representatives were seeking to unravel the actors that enrolled Psa because they knew that it could not enter the network by itself. Psa is enacted by various actors.

> "I think the thing about bacteria too, is you can't see it, we don't know how it disperses and how many we've got, we don't know where they are, it's quite difficult, I mean, we know now it can survive in a drop of water for over a year quite happily, can survive inside a cane, it can sit on your shelter, but you know, we haven't managed to find a method that we can detect its presence [...] It's been very hard for us to create any sort of way of detecting, of seeing without seeing it." (An official from Kiwifruit Vine Health Incorporated)

For a crisis as serious as Psa, it was more convenient for these actors to put the spotlight on non-humans. Kiwifruit anthers, pollen and plant materials were the first to be suspected of bringing Psa to New Zealand, as some explained:

> "There's circumstantial evidence that is suggesting it could have come in from imported Chinese anthers that went to the area of Te Puke, that first, the disease was first identified in New Zealand. So, while there's circumstantial evidence, there's no proof that that is the way. We have no indication that anyone has acted illegally in the introduction of Psa to New Zealand, uhm, and it could have come in through a variety of different ways" (An official from KVH)

> "When you look at these sorts of diseases, typically they move from country to country, not on people' shoes or on a piece of equipment but on plant materials. So either it came in on pollen, [...] on graft wood that someone brought illegally, but it will be associated with plant material" (Orchard productivity manager, Zespri)

Once it entered New Zealand, the enrolment process was easily established. Three non-human actors played an important role in the negotiation process: the climate, the host (particularly Gold kiwifruit) and the Psa itself. Many hypotheses suggest that Psa originated in Asia, most likely China and Japan, where the germ plasms of *Actinidia* are found in abundance. It has lived with the vines in the wild for centuries, and possibly even in the cultivated varieties of both Green (*A.deliciosa*) and Gold kiwifruit (*A.chinensis*) for years without any significant outbreak. In 2008, the first economically important outbreak in Italy introduced the name Psa-V (virulent), showing the severety of this new type of bacteria. It impacted the Gold more severely than the Green kiwifruit (Spinelli et al., 2011), as also happened in New Zealand two years after. Through their investigation, Spinelli et al. (2011) show that the enrolment was, in part, due to a particular anatomical structure in the Gold variety named *trichome* that allowed Psa to enter the vascular tissue of the plant and protected it from the radiation of UV light and pesticide sprays. Furthermore, Vanneste et al. (2011) document that a wet and cold spring helps the Psa to proliferate and disseminate locally across orchards by creating a humid environment. A manager at Zespri referred to this as the plant disease triangle.

> "I called it disease triangle, and for a disease to have an outbreak, you need three things to happen. You need a host, and we have a very suitable host with the Hort16A. We need the pathogen, obviously, which was Psa. And then you need an environmental trigger. [...] Before 16A, we only had these two, so it never went nuts. Suddenly we introduced this, and after a couple of years this one got a lot worse with a particular environment. We think the wet winter and spring, and then that's just went, and then Psa built up so much that we couldn't just get it back under control." (Orchard productivity manager, Zespri)

The negotiation between these three actors resulted in a successful enrolment of Psa into kiwifruit orchards. But in a social context, has Psa really been enrolled to the New Zealand kiwifruit industry? Does the evidence of cane dieback, spotted leaves, plant exudates or canker in kiwifruit vines show that Psa is now an actor? From an ANT perspective, Psa-V was not yet an actor during the early stage of its infestation. To be enrolled, the negotiation process needs an equal involvement of both human and non-human actors within the kiwifruit actor-network. Psa has to be enacted such that it is associated with all actors and at the same time changes the way actors relate with others.

The enactment of Psa-V in the New Zealand kiwifruit actor-network happened soon after it was identified as a potential threat to the industry. After the first recorded infestation in November 2010, the industry responded hastily. Officials from Zespri came to the scene and isolated the area. Meetings were held to promote ways to contain the disease from spreading to other orchards. Several control measures were suggested. Growers were being notified of what Psa was and what they had to do to prevent this disease from entering their orchards. Within a month, the New Zealand Ministry of Agriculture and Forestry (MAF), in collaboration with Zespri, established a working body specifically to manage the containment of Psa, while allocating more than $50 million for research, monitoring and control programs. But these actions were unable to solve the problem. Over the next several months, the disease was spreading rapidly across the region, with Gold kiwifruit orchards being the most severely impacted.

As I mentioned in Section 7.3.4, the management of Gold kiwifruit orchards in the Bay of Plenty region has been one of the factors influencing the rapid spread of Psa. In an orchard-dense area such as Te Puke, Psa actively spread from one orchard to another. As orchards were connected within a wide area, Psa at one end of town could reach the other end of town in a very rapid sequence. The spread of Psa was further enhanced by the Rena storm[32], a weather event in March 2011 with heavy rain and wind. Using statistical data, KVH (2012a), determined that, after the event, the number of orchards infested with Psa-V had increased exponentially, reaching 239 orchards (more than 700 hectares) on June 2011 and continuing to worsen over the next eight months. The Rena storm was a pivotal event following which more growers became aware of Psa. Anxiety was increasing for everyone with the realisation that Psa could infest their orchards at any moment.

> "There was a big storm at the time of the Zespri conference and soon after the Rena grounded out there and there was a lot of northeasterly hail and rain and that sort of stuff for about a week, and that seems when it blew out of Te Puke and over to Tauranga regions. And I guess we're on the tail end of that, picked it up in November, on the 20th November I found the spotted leaves and I cut that back quite hard and watched it very closely…" (Gold kiwifruit grower)

[32] The name was taken from a wrecked container ship that caused heavy oil spill along the shoreline of Mount Maunganui. The accident happened as the result of heavy storm on Wednesday, March 21, 2011, that at the same time also impacted a lot of kiwifruit orchards in the area.

Yet, rain and wind were only able to mobilize Psa locally. To reach a wider area, it relied on another actor. In this case, infected plant materials and orchard equipment played a role in the mobilization of Psa. Contractors not only moved their tractors, boots, and tools between orchards, they also moved them to other areas of the Bay of Plenty. Growers, having to dispose of the infected canes, transported the materials as far as possible from their areas further contributing to the spread of Psa beyond the Bay of Plenty. They knew nothing of the consequences, however, making human actors, at that stage, mere intermediaries in the actor-network.

> "You've got that monoculture, and there are movements of infected materials before people realize that that block of orchard has been infected. So we were running to keep up with what the diseases have done. Not only plant materials, but also infected equipment as well as anything that could present a risk of transferring Psa to areas or properties where it doesn't exist." (An official from KVH)

> "They were cutting out massive loads of vine as you can imagine, but they had nowhere to dispose of it. So they were putting it on the back of trucks, and they were bringing them, well we heard of, I don't know how many loads come up, but they came up past good, you know, orchards with no Psa, up here, up at Manua road, and dump it out the truck there. So we were horrified about that, we both had our say about that whole thing, you know." (Gold kiwifruit grower)

The latest update of Psa statistics shows that, within two years of initial infestation, it has infected 8,487 Hectares of kiwifruit orchards, or 61% of the total in New Zealand (KVH, 2012a). Only 5 out of 17 growing regions have not yet been infected by Psa, but the spread is continuing. Greer and Saunders (2012) estimate that Psa will cost the industry between $310 and 410 million over the next five years, and even more in the 10 – 15 year period. The impact is particularly dramatic for Gold kiwifruit, as the industry has already lost six million trays of Gold in 2012 and will go down to seven million trays in the next two years (from the total production of 109.1 million trays in 2011; Zespri, 2012). One grower witnessed more and more vines being infected as evident in the number of growers who were burning the infected plant materials on their orchards.

> "I looked out my window, those are all Gold orchards over there, they were cut off Gold orchards, big Gold orchard over here, there was a Gold orchard down below me on my next door neighbor, badly affected by it. […] All we've seen for the last month, and

there is very blue and hazy, normally this time of the year, we'd be looking at Te Puke as being really clear, and really beautiful from here, but it's blue and hazy with smoke, so that's fire burning. In any one time a couple of weeks ago I could see seven fires going in orchards, so that's got to have an effect, I would've thought, on all of us." (Gold kiwifruit grower)

Psa is an actor that seeks novel relationships with other actors. As it strives to be enrolled, it also affects the way other actors relate with each other. What followed after a successful enrolment of Psa into the actor-network was a series of negotiations between actors on their effort to remain intact to the network; and these were unsettling negotiations indeed.

7. 4. 2. Unsettling negotiations

It is apparent that the enrolment of Psa elicited a distinct response from other actors in the kiwifruit actor-network, depending on their positionality within the network and the actors to which they were connected. However, for kiwifruit growers in general, the first response was frustration. Some orchardists believed that Psa infestation on their orchards was inevitable, no matter what preventative measures they were employing. One grower stated his frustration with the circumstances. He had had high hopes that the kiwifruit industry would be able to expand as a result of the new varieties. Enthusiasm and optimism had been growing. People had been going forward with their family enterprises, beginning to increase their income and maintain a good standard of living. Some growers had just started the business as they were impressed by the rapid growth of the industry, particularly with the Gold variety, over the past ten years. Some even negotiated with the bank for a loan, only to find themselves caught with debt as their orchard became infected with Psa.

Although Psa did not impact their orchards to the same extent, the Green kiwifruit growers also felt a change in their relationships with other actors due to the disease. People began to see kiwifruit orcharding in general as a risky business and it drew less interest as an ivestment opportunity. Land prices in the area dropped significantly – not only for Gold kiwifruit orchards, but also the Green ones (for the latter accerlerating a trend that had started prior to Psa). At the same time, the production costs skyrocketed due to Psa. Not only did growers have to cope with the incremental increase in fertilizer prices, but they had to apply new ways of managing their orchards. Tractors and orchard tools were no longer allowed to cross orchards. Some growers would have to purchase their own tools rather than rely on contractors. More intensive spraying was required to reduce the risk of Psa infestation. None

of these costs were compensated through an increase in orchard gate returns. They were, once again, betrayed.

> "I had spent, I bought a new tractor, and a sprayer, well not a new one, tractor and a sprayer, and employed another labour unit to drive, and so every few weeks we're out there, ten days or whatever, we're out there putting on sprays. But yeah, we increased our resources and we put capital into new machinery, so we had two sprays and our spray bill was about 3000 dolllar/month. That's just for Psa." (Green kiwifruit grower)

An important interessement device, and actor, used to dissociate Psa from the kiwifruit was copper. Copper has been used for hundreds of years to control plant diseases, even before there was such a concept as microbes. Scientists have conducted various analyses to understand how this compound acts to control bacteria. Robert Thurman and his colleagues from the University of Arizona summarized this research in a paper (Thurman et al., 1989). Copper proves to work effectively on almost all types of bacteria. At the same time, it is a contact substance that does not leave residue in crops, making it a perfect control for bacterial diseases. Unfortunately, copper control also has pitfalls. Firstly, due to its wide spectrum effect, copper damages other organisms living in the orchard, including microorganisms essential to healthy soils and, to some extent, the larger ones such as the kiwifruit vine itself. Secondly, it does not infiltrate the plants, making it harder to control the bacteria once they get inside the plant tissue. Thirdly, scientists have reported that some strains of Psa, particularly those originated from Asia, have a strong resistance to copper (Balestra et al., 2011; Lucchese et al., 2011). Thus, there was a lot of controversy among growers over copper, dividing them based on their attitudes and perspectives regarding its use.

In their desperation to eradicate Psa, growers looked for any solutions they could find from different sources. More agrochemical companies and merchants filled in the gap with their promising products. The problem emerged when the growers and Zespri had to balance between controlling Psa and complying with the export standard as stated in the GlobalGAP. Zespri's crop protection manager explained it to me, as this:

> "I say, it has been a challenge, yes, I mean, first and foremost, we need to continue to supply fruit to market that meets the requirement of our customers, so that essentially is residue-free fruits. Creating a program to enable our growers to manage Psa and meet those market requirements is a challenge. It shouldn't be a challenge for the grower to

> comply with those requirements, but it's a challenge for us to ensure that we get the highest level of control of Psa that we can" (Crop protection manager, Zespri)

To ensure that the fruits provided to the market comply with the standards, Zespri had to increase their residue testing across all growers' lines. Fruits from more than 80% of orchards were tested through multiple screening tests that could detect more than 300 different compounds. Zespri also became directly involved in the monitoring of agrochemical registration and usage of new pesticides that might provide residue risk to the fruits. The New Zealand Ministry for Primary Industries (MPI, previously known as MAF) has also taken part in the monitoring process, particularly in the utilization of streptomycin, an antibiotic commonly used to control bacterial infection.

The use of sptreptomycin is another source of conflict within the kiwifruit actor-network, as it involved more actors in the process. The beekeeping industry is an important component of the kiwifruit industry that is often left unnoticed. The bees provide pollination services for the kiwifruit flowers. By enrolling the bees to the network, the beekeeper received a huge income from kiwifruit. Over 20% of New Zealand beekeepers rely on the kiwifruit industry as their source of income. When the Psa outbreak occurred, people started to worry about the potential for bees to transport the bacteria from one orchard to another. Thus, the outbreak reduced the beekeepers' income not only because less and less orchards were operating, but also because growers were reluctant to use the beekeepers' services. At the same time, it is noteworthy that the beekeeping industry has been known as an industry sensitive to streptomycin residue. With its most prominent product, Manuka honey, being marketed across Europe as a health supplement, a residue of streptomycin is highly prohibited. Cases of some growers injecting streptomycin into the vines had invited protests from the beekeepers as to the safety of their products.

> "They know bees can carry and spread Psa around in the hives. But they're, now, they've done their study in the lab. And they know in the lab that Psa will survive in the hives for 14 days of whatever it is. But they've never been able to replicate it outside the lab. They've never been able to find Psa, haven't been able to find Psa on bee-picked pollen, yet. So they don't know […] Yeah, we've tried to tell them, but they, I have heard all sort of reasons, what causes Psa, and you can understand that some of them are very paranoid, so they're gonna come up with everything and anything to find a reason to what spreads." (Beekeeper)

> "They announced out of the blue that they were gonna use strepto-[mycin] as one of their issues. We weren't consulted on that, which is a big no-no, because for the beekeeping industry, streptomycin […] can last for over a year in honey, slowly dissipates, but nine months later it still 50% of what was in there." (Beekeeper)

The Psa outbreak had brought negative impacts, not only on growers, but also on the local community. The negativity of the situation was made mobile as it spread rapidly across the region with the help of another actor: the local newspapers. Within 18 months of the first outbreak, the local newspapers had been creating a doom-and-gloom atmosphere in the Bay of Plenty, and, to some extent, it invited more frustration and anger among the growers.

> "Yeah, I got totally fed up with the local paper […] It wasn't just the doom and gloom, it was more to do with the sensationalist and inaccurate reporting, and what I thought of was, and in fact it's evident, was deliberate staging" (Gold kiwifruit grower)

> "Yeah, the media, all they do are looking for bad news. […] It doesn't do much for our industry, you know, as growers, we really stand behind our industry, and the banks are the same, we don't want to see any bad news out there either, and Zespri doesn't either, because it'll ruin their market." (Kiwifruit grower, banker)

The negative pressure was also felt by other actors. Consultants and orchard management companies that interact with the growers on a day-to-day basis were experiencing the stressful situation. Conflict arose between neighbouring growers as one tried to maintain his vines for another season at the risk of spreading more Psa to the surrounding orchards. Some growers blamed the government either for not responding fast enough and thereby allowing the Psa infestation to worsen, or for not taking firm action against those who did not comply with the control measures. Others were exasperated with Zespri, which, they claimed, had expended too many resources investigating the disease without providing any immediate benefit to the growers. Their frustration was heightened by the fact growers, not Zespri, that assumed a huge percentage of the risk and costs of Psa. Zespri, on the other hand, would have to negotiate with the growers to retain their legitimacy to allocate resources for their marketing role. The competition between packhouses became fiercer, as they fight over lower volumes of fruits.

Frustration and conflict did not linger for very long though. A year after the initial outbreak, the human actors (kiwifruit growers and other stakeholders of the industry) were beginning to

acknowledge the changing relationships and emergence of new actors, demonstrating the resilience of the kiwifruit actor-network. The shock of the Psa infestations pushed the people to see things in a better way. Their reluctance to learn a completely new management system for another agricultural commodity coupled with the fact that the actors connected by kiwifruit provided support to continue their business, were more than enough to work their way out of the situation.

> "I think to a certain degree, after the first 12 months, the impact when they got it wasn't as severe as what would've been for those growers that got it in the first round, because they were mentally prepared for the fact that they were going to get it. Probably, and I think that made a difference in it, it appeared they were, they accepted the fact that they had it, and moved on, moved straight away to how are we going to cope with it, rather than go to a period of total grief, which I think was quite normal for people that initially got it. So they really just accepted the fact that they've got it, and made a(?) decision from there to either cut their Gold out, or and put all the new varieties in, or cut out the new variety that they've put in, and change it to something else" (Gold kiwifruit grower)

Growers began to re-negotiate their position and relationships with others. They worked actively to support one another, through growers' support groups in the local area, for instance. Communication between neighbours was rekindled and conflicts resolved. Growers' groups started to coordinate spraying, set rules in limiting the numbers of contractors and visitors that come and go in their areas. It is expected that some negotiations are bound to fail while some can prove to be successful. In Te Puke, for instance, many growers' groups weren't able to sustain themselves. They needed a different type of relationship with a network consisting of growers, packhouses, and agrochemical suppliers proving to be more durable.

However, durability is a result of negotiation among not only human actors, but involving non-human actors as well. When smaller growers were weaving their own network locally, a larger network was also being woven by representatives of actors such as Zespri, the Kiwifruit Vine Health (I will introduce this entity in the next section), Plant&Food Research, packhouses, merchants, agrochemical suppliers, growers, orchard management companies and consultants. But what made this actor-network become so durable? Was it because the actors had stronger power over others? Or was it because they reside at a larger scale? Using

ANT to address the situation, I argue that non-human actors are essential to render the network durable. A meeting room at the Plant & Food office in Te Puke has been a venue for vibrant discussions which I had the privilege to witness. Each representative communicated his/her findings and ideas around Psa: of, for instance, how Psa innoculum could be suppressed by the use of composts, or how Zespri had been able to screen new compounds for Psa control that would not compromise the quality of the fruit. Notes from the meeting were circulated among growers and other stakeholders. Psa-Bulletin, Kiwifruit Journal, and newsletters were among the interessement device that helped retain the durability of the network. One grower informed me that he felt overwhelmed by the quantity of letters and other reading materials sent to his mailbox; but he also acknowledge the value of the information and the latest updates on Psa that he acquired from those papers.

It is exceedingly evident that Psa, as it was enrolled as an actor, has also become an agent. It has the capacity to influence and alter the relationships between people. It invites conflict and frustration. Its resilience also enacts the resilience of others. It pushes actors to re-negotiate with one another for new goals and inclinations. It dissociates some actors from, but also associates others to, the network. Eventually, Psa brought the actors in the industry closer together.

> "Psa has brought our group a bit closer in the industry, our relationship with the likes of Zespri improved, people that have been long in the industry stand up, and it's really important. So people that had differences in the past stood up and the ability to work together, and I'd actually say Psa has helped bring a lot of that together, from my personal perspective, there probably had been relationships which you never really knew whether they were there or not. I think, some of those relationships now are a lot closer, better." (Director of an orchard management company)

> "I think Zespri has got closer to the growers, which they needed to do. [...] We have a closer relationship with people in Zespri. They realize that they got a role to play at growers' level, not just in the packing level. So they, they need growers to have the resources and the resilience to get some kiwifruit grow up again, otherwise Zespri would be like packhouses, would be an entity with very little supply." (Gold kiwifruit grower)

7. 4. 3. New goals, new configurations

Two years after the initial Psa infestation, the industry appears to be in a new configuration. The structure of the industry was reconfigured and relationships between existing actors altered. A new actor was enrolled for the purpose of specifically managing Psa. Psa is now seen as part of the production environment and the new normal. People are beginning to shift their orientation from eradicating Psa to managing it. Some actors have been forced to dissociate from the network, but some have found their positions strengthened. Actors also re-established OPPs to conform to new goals. Budgets have been reallocated and Psa has been identified as the main concern. The following is a narrative of how Psa is transforming the industry into these new configurations.

The transformation of the kiwifruit actor-network started less than a week after the first outbreak. On 7 November 2010, MAF and Zespri agreed to appoint a pan-industry body to specifically manage all Psa related issues. As mentioned in the preceeding section, this body was named Kiwifruit Vine Health, Inc. (KVH). This response mirrored actions taken to address other pest outbreaks in different sectors in New Zealand, such as the animal health board controlling tuberculosis in the dairy industry. It was, however, not accepted without dispute. The legitimacy of KVH was questioned because, for some people, the existing actors in the industry (Zespri, pack houses, etc.) were more than enough to handle the problem. Zespri was seen to have sufficient capacity to connect to other actors in responding to Psa. Critics of KVH argued that the establishment of the body has introduced inefficiency from a management perspective.

> "I do wonder if [KVH] has added validity. Zespri is basically capable of doing what KVH has done, so it's just another committee that we're paying for." (Kiwifruit grower)

> "Well, if we talk about technical advice, suppliers gave technical advice to growers and to the industry, Zespri gave technical advice to growers, do we need another body to give technical advice only on Psa? I think both of those things are fundamentally wrong about that statement, how can you give technical advice only on Psa? If we have a variety that's currently pretty important, I can't see how Zespri can possibly give advice on any aspect pretty much of the new variety in these days without commenting on Psa. I certainly don't see how KVH can give advice on Psa without commenting on management, so why would you need two people to do it?" (A manager at a packhouse)

> "I'm not sure that I need an independent research capability separate from Plant & Food as a research organization, separate from Zespri in managing that, and separate from what suppliers may have themselves. I'm not sure we may need another one, same as technical advice basically." (A manager at a packhouse)

Proponents of KVH beg to differ. Their defence of the organisation rests on whether Zespri, or Plant & Food, or the packhouses can legitimately do what KVH has done while remaining impartial. As a body separate from Zespri, some people hoped that KVH would take a neutral stance and work on behalf of the industry as a whole, rather than deferring to one or two actors.

> "There are some tensions between the commercial reality of Zespri and the function of KVH in terms of what their role is. The criticism is probably valid in that there may have been some duplication in tech-transfer. But I think their role in KVH is separated out from the roles of packhouses and Zespri, because they've got commercial biases, it may be a criticism if you like, but they work pretty closely with Zespri, so that we have to be careful that they are operating independently for the purpose of finding Psa. If there's something out there that is highly resistant to Psa, a vine that is totally resistant, and it's not the one that Zespri grew up here, what happens there?" (A representative of a packhouse)

Regardless of the situation, the enrolment of KVH seems to have been successful. In the months subsequent to its creation, KVH had connected to all actors within the industry, arguably even more extensively than Zespri. It positioned itself firmly as a mediator that communicates, yet translates, Psa for other actors, both humans (growers, Zespri, Plant & Food, packhouses, consultants, contractors), and non-humans (kiwifruit, plant materials, orchard equipments, new technologies). It has strategically aligned its role with the goals of others. Assessing this process from the perspective of Callon's (1986) moments of translation, the problematization occurred when all actors agreed upon a single OPP. The infected kiwifruit vines, growers with their orchards destroyed, packhouses that lost a significant volume of fruit, Zespri that was losing legitimacy, or scientists simply seeking to contribute to the scientific knowledge, wanted to know how they could better comprehend, monitor and manage Psa. KVH has rendered itself indispensable to others by setting its strategies as follows. Firstly, it has created and managed biosecurity protocols to contain the spread of Psa outside the affected regions. Secondly, it has acted as a clearing house that pools all research and innovation on Psa and disseminates the findings to all other actors.

With this, KVH has supported growers in developing new management strategies and approaches to control Psa. Thirdly, it has monitored the spread of Psa across orchards and keeps the growers informed regarding the spatial distribution of infestation. However, because betrayal often follows translation (Law, 2006), while KVH translated Psa, it also betrayed both Psa (by limiting its dispersal) and the network (by enhancing its transformation). A Zespri representative described this process:

> "Psa itself has its own organization called KVH, which manage the integration of change to the industry through that organization. So all of the relationships at the grower level, in terms of what do they need to be doing, how do they manage, all of that, the information flows back up through KVH. That being said, Zespri plays a key role in that, because we use our internal technical staff to actually support and provide a lot of the information. But it's not just us acting independently, we're in partnership with post-harvest, with growers, KVH, and we all collectively work together in the sites community to actually provide answers. So it's quite a degree of complexity down there." (Zespri's marketing division)

The second step toward KVH becoming indispensable was through interessement. KVH created several interessement devices for other actors. To associate growers to the network, KVH assisted with the disposal of plant materials, access to information and newsletters (Figure 7.2) and financial compensation for Psa detection. For scientists, KVH allocated research funding related to Psa and channels for the dissemination of the research results. For kiwifruit, KVG supplied hygiene and sanitary equipment to reduce Psa infection to the orchards. Almost all devices that KVH interposed have solidified its position in the network. However, when KVH planned to deploy its latest strategy, problems began to emerge.

In an effort to address the deteriorating effect of Psa on the kiwifruit orchards and the difficulties in controlling the spread of the disease without a coordinated action, KVH proposed a national-level protocol named the National Psa-V Pest Management Plan (NPMP). NPMP offers a highly coordinated strategy with the goal "to prevent the spread of Psa-V and minimise its impact on commercial kiwifruit production". It plans to achieve this goal by, first, dividing the orcharding areas into 'exclusion' (where there is no recorded incident of Psa-V outbreak), 'containment' (less than 35% of infected orchards) and 'recovery' zones (more than 35% of infected orchards), and, second, setting action plans based on the nature of these three zones.

Although it focuses on achieving voluntary compliance, most of the action plans are mandatory for growers, implying that KVH now has a power to penalise growers that do not comply with the regulations. As a national-level strategy, NPMP has the potential to govern a wider set of actors, including those outside the industry. It is funded through a commodity levy, meaning that growers have to pay one to two cents (depending on the variety) per tray of fruit they produce. Its binding power is stronger than that of the Biosecurity Act as no compensation will be given for any vines that are cut and burnt. It is, however, dependent on the difficult task of receiving agreement from the majority of stakeholders to the proposal before it can be submitted to MPI.

Figure 7.2. An example of guidelines made by KVH as an interessement device for growers (Source: KVH website, http://www.kvh.org.nz/)

Disputes over the legitimacy of NPMP were based on the same issue. For a lot of growers, Psa-V is a biosecurity failure and the responsibility of the government; thus, growers should not bear the costs of controlling the disease. During a controversial growers' protest meeting in the early 2012, around 60% of growers attending voted to demand "that the Government acknowledge that Psa-V is a Biosecurity failure", although only 45% voted that "the Government admit its responsibility for letting Psa-V into New Zealand and provide growers with appropriate compensation" (Collins, March 2012). One grower explained in detail a potential implication of NPMP on the industry, and particularly on the disparities between Gold and Green kiwifruit growers.

> "For now, we've been able to let the Gold growers with the bigger money carry on with their crop. What happens if the Green growers start falling over, who earn no money now; and then they walk in and say, you have to do this and you have to do that to the orchard, but didn't do that in the last 12 months to the Gold growers. There's some dangerous ground, and I think there's some very dangerous ground to tread. I agree with what [KVH] is trying to do; but I think the way this thing moves so fast, if we start putting a heavy hand on the Green growers now, this industry is gonna blow to pieces." (Gold kiwifruit grower)

The latest growers' poll on their support for NPMP conducted by KVH provided an indecisive outcome (see Figure 7.3). In total, only 50% of growers took part in the poll, although 70% of those who participated voted to support NPMP. In Te Puke (the region with the most orchards and the worst impact by Psa-V), only 31% of growers approved of the proposal. Still, KVH was hoping that the poll result would have a strong social legitimacy as it was brought to the MPI. The final decision will be pivotal to the dynamics and configuration of the actor-network for the near future.

Yet, most actors already acknowledge the transformation without the NPMP having been implemented. Actors such as contractors, beekeepers, and seasonal workers have been heavily impacted by Psa-V. Pollen producing companies were the first to fall, as the director of one from the Bay of Plenty described:

> "Back in July 2010 we won the emerging export of the year out of the Bay of Plenty export. And November 3, when Psa was announced, we went from hero to zero, essentially. Psa for the pollen business essentially wiped it out overnight. We were the first real impact of Psa, we'd just started two days into production, and Psa was

announced, then precautionary warning going out to say to growers, maybe it'd be advisable not to use pollen, because we don't know whether it's infective or not." (Director of a pollen-producing company)

	Possible Votes	% Yes	% voted
Exclusion Regions			
Kerikeri	381	95%	81%
Whangarei	151	99%	60%
Auckland	92	100%	53%
Poverty Bay	353	89%	69%
Hawkes Bay	242	95%	53%
Wanganui/Horowhenua	92	100%	14%
South Island	575	100%	71%
Total exclusion regions	**1,886**	**96%**	**66%**
Containment Regions			
Franklin	484	78%	64%
Waikato	364	100%	23%
Coromandel	165	98%	61%
Katikati	1,599	85%	52%
Tauranga West	807	69%	40%
Total containment regions	**3,420**	**82%**	**48%**
Recovery Regions			
Waihi	157	62%	50%
Tauranga East	1,109	70%	44%
Te Puke	5,569	63%	49%
Whakatane	752	95%	26%
Opotiki	1,021	94%	56%
Total recovery regions	**8,608**	**69%**	**47%**
Total all regions	**13,913**	**77%**	**50%**

Figure 7.3. Summary of NPMP growers' poll by regions (Source: KVH, 2012b)

But aside from those who are dissociated from the network, some actors are finding that their position in the network is reinforced because of Psa. Engineering businesses that provide orchard machinery and new forms of shelter, companies that specialize in trading new vines and grafting, nursery businesses, and agrochemical companies are perfect examples of such actors. In another case, Psa lowered the value of land, which became an opportunity for young people, those that are willing to take the risk of managing orchards, to fill in the age gap in the industry. Before Psa infestation, the age gap had been a pertinent issue because

high investment in the orchards often constrained young people to participate in the business, thus creating a situation where the average age of growers was 60. New ownership/management schemes, such as orchard equity partnerships or corporate-based orcharding, are expected to dominate the face of the industry in the near future. With fiercer competition between packhouses and more consolidation occurring, even the composition of packhouses will eventually change. Some of the interviews illustrate the situation.

> "Orchards have changed hands in Te Puke for a reasonable per hectare value. What you are seeing as well is probably, where the change has come about, is an organization like Seeka kiwifruit industry is leasing, I mean, it's before Psa, it continues with Psa, but probably where you see the changes is that of old growers still retain ownership, but you have a corporate business who are operating a leasing business with younger managers, younger personnel, so you're actually shifting management, not ownership, to a different age group." (Consultant)

> "And the indications are, we are going to consolidate, but there's issues with that, and it's pretty sad, because what you end up with is, the industry has basically got, it needs 70% of the industry an agreement to guide fundamental strategies. So if you get one packhouse that's over 30%, then obviously they start to control where the industry goes. So this is where the danger comes, and we're heading down that track, where we're gonna consolidate to some big guys that are swallowing up the small guys, and then getting to that level, it gets dangerous." (A representative of a packhouse)

Within Zespri, Psa has brought a new orientation in research and development. Psa dominated the thinking and strategy of the sector. Funding for projects related to sustainability practically dried up because Psa was the dominant focus. The whole of the sector was consumed by the attention that Psa drew. More research emphasis is now put on ways to manage Psa, which include spraying methods, hygiene protocols, and particularly developing new varieties that are more tolerant to Psa. This leads to the introduction of a new actor that is hoped to be the star of the transforming industry: the Gold3 variety.

7. 4. 4. Gold3 variety: a promising hope?

Just like Hort16A during the second transformation of the kiwifruit industry, Gold3 and several other new varieties were expected to be the new pot of gold at the end of the rainbow. These varieties are the results of a long negotiation between multiple actors, including Plant & Food Research, Zespri, consumers, the kiwifruit, and finally Psa. The results of this long

journey emerged only a year before the first Psa outbreak when it was hoped that the three new varieties, named ZESH004 (Green14), ZESY002 (Gold3) and ZESY003 (Gold9), would counter emerging kiwifruit varieties developed by Turner & Growers (EnzaGreen, EnzaGold, and EnzaRed) as well as other varieties from China and Italy (Ferguson, 2011). Green14 was designed as the sweeter version of Green kiwifruit. Gold3 and Gold9 were initially positioned not to substitute Hort16A, but to fill a supply gap so that Zespri Gold would have a longer marketing period. Gold3 was intended to be the early variety and Gold9, with a potentially longer shelf life, to be the late variety. After another series of negotiations, however, the relationships changed.

Although Gold9 has an exceptionally good taste, it appears to have shorter shelf life than was expected. Gold3, on the other hand, stores far better than Hort16A and Gold9, while its taste is inferior. Despite these less than ideal features, Gold3 and Gold9 varieties were assigned as a replacement of Hort16A subsequent to the Psa infestation, particularly for two reasons. Firstly, although Hort16A has good taste quality, it is a difficult plant to grow and sensitive fruit to pack. Thus, it was considered better for technical reasons to replace it with more controllable fruit with the same, or even better, taste quality. Secondly, for marketing purpose, the gold kiwifruit varieties available in the market would need to be rejuvenated by new and more attractive products, particularly as the PVR for Hort16A is coming to the end of its term.

As I mentioned in the first part of Section 8.4.1, the first Psa outbreak in New Zealand coincided with a series of market-tests and subsequent promotion to growers for the two new Gold varieties. Some growers had accepted the offer and started replacing existing Green and Gold kiwifruit orchards by grafting Gold3 or Gold9, or both to established root stock. At that point, however, it was yet to be revealed that Gold9, just like Hort16A, was very susceptible to Psa (Fraser & Parkes, 2012). As a result, people have no other current options than to put their hope in Gold3, the only Gold variety that is able to tolerate Psa. In ANT terms, Psa has played a crucial role in accelerating the enrolment of Gold3 into the actor-network.

> "Obviously Psa has changed the way we need to manage our orchards, and that includes the whole variety; but I think we were strongly focused on Gold, because the Gold growers are making a lot of money effectively before Psa. They didn't have a lot of our attention, but once Psa came along, we have to work very closely with them to try to manage the Psa. And the other thing that's happened is we needed to, fast-track, if you

like, the introduction of new varieties, because 16A, the Gold variety we had was extremely susceptible to Psa, and so the best way to manage Psa in Gold is to replace it with a less susceptible variety. So what's being called the G3 recovery pathway is really trying to get as much 16A out as quickly as possible, and [convert] to a much more [tolerant] variety." (Orchard productivity manager, Zespri)

The moment Psa was acknowledged as a serious threat, Plant & Food Research immediately included Psa resistance as a component of the screening criteria within its variety breeding program. With the time needed for the breeding program to release a new variety for commercial production, finding Gold3 to be tolerant to Psa was serendipitious and gives the industry some breathing space. However, given the uncertainty regarding the degree of long-term Psa tolerance held by Gold3 (and other future varieties), Plant & Food also increased the size of its breeding program so as to increase the chance of finding resistant varieties.

"The Gold3, as an example, is already in the market to some extent, and it seems to be more tolerant than 16A. So that's here and now. We've got a number of other cultivars which maybe two to three years behind Gold3, which would be a pretty good commercial cultivar, but hadn't been bred for Psa, which we would hope could come through and may actually be more tolerant. To start from square one and actually have resistant parents, do the crosses and so forth, it's gonna be more than 10 years before we start to see those. And so what we really need to do is to have, which we've got I hope, if you like, an interim solution, and that needs to survive probably for another 10 years until those new resistant cultivars, hopefully come through." (Business manager at Plant & Food Research)

The response of growers to the Gold3 variety was very positive. The license for growing Gold3 was already fully subscribed for 2012. In some orchards, Gold3 showed good resilience and continued healthy growth where other varieties were dying of Psa. Another advantage of Gold3 is that it requires less orchard management because it grows less vigorously than Hort16A. Not only that, Gold3 also produces perfect, appealing and heavier fruits for the market. The absence of a beak at the bottom of the fruit also makes it easier to pack. One grower gave a highly optimistic assessment of Gold3:

"The G3 has been amazing, I'm so glad that we took the risk to put that in there earlier, because going in there and seeing a relatively healthy crop with beautiful fruit and nice leaves is really uplifting, it's really good, amazing. It's been incredible, I mean it's there and it's amongst this Psa stuff. [...] And the fruit was amazing. I've never seen such

> mathematically perfect regular fruit, even if it's based along the vines. [...] Something can produce so well, so beautifully, surrounded by so much disease." (Gold kiwifruit grower)

However, as with any other actor seeking to be enrolled to the network, negotiations always invite debates and criticism. The strongest critique of the Gold3 variety involves its ability to tolerate Psa in more intensive production. A consultant (and a former scientist) who has worked with Zespri and Plant & Food for a long period of time informed me that he had witnessed the relatively good tolerance to Psa of the oldest Gold3 plants, grafted in 2006, although some vines had died or become infested with canker. He was, however, sceptical as to whether the plants' tolerance is definitely a genetic trait or merely due to the fact that the plants had not been required to carry a heavy (commericially viable) crop load, hence having enough energy to fight the disease.

Further scepticism involves the marketing side of Gold3, namely whether it will be accepted by consumers as readily as the previous Gold kiwifruit. Zespri and Plant & Food have been able to progressively produce better tasting fruit from the variety year after year. In 2011, the Gold3 variety did not produce a sweet tasting fruit sought for by the Asian market. In 2012, the taste quality has proven to be better, showing a high level of acceptability among consumers. However, even that was not enough to convince some growers. The fact that Zespri has arguably been releasing too many licenses for growers also raises concerns over the possibility of an oversupply of Gold3 fruit in the next two years.

> "So G3, there's a huge amount being grafted to, and there's a lot of Green orchardists came to graft G3 as well. I would be concerned that too many have grafted to G3 and we flood the market with G3 in a few years, which already is a risk even now with the amount of license that has been released and with the kind of crop that can be grown on G3, Zespri tell us that they can handle 50 or 60 million trays of Gold, given the fact that 30 million is a bit of a mission to sell last year, I found 50 to 60 million trays are a bit of a long shot. So there's concern amongst Gold growers that Zespri is maybe overdoing the G3, especially as there is a perception that Asian palate may not like G3 as much as 16A, so we've got to do a really good job of growing it." (Gold kiwifruit grower)

Regardless, the Gold3 variety is indeed the new hope for the industry. As many have agreed, Gold3 will eventually change the face of the New Zealand kiwifruit industry, whether it is

enrolled successfully or not. The resilience of people will be challenged by how well Gold3 performs in the next two to five years.

> "We've got high hopes in G3, it's gonna be okay, because otherwise it's gonna be an interesting looking industry, particularly when you got Green growers that make no money. For a lot of the Gold growers, this is it, if G3 fails, they're history. [...] Even if G3 is successful, I still think there will be a change in how the model works, depending on what everything looks like. There's gonna be change in how post-harvest operates, it definitely looks very different, in my view in the next 5 – 10 years." (Director of an orchard management company)

7. 5. Concluding remark: transforming kiwifruit

"Resilient communities, cities, or regions do not just return to a pre-trauma state or the status quo, but have the capacity to reinvent themselves with new relationships, modes of organization, and networks." (Gotham & Campanella, 2010:10)

The argument in this chapter has been built on two concepts: resilience and transformation. The quote from Gotham and Campanella elaborates the concept of 'transformative resilience', a developing heuristic device that seeks to analyse the relationships between transformation and resilience. For the kiwifruit industry to be resilient and durable (i.e. to maintain its basic function as the main producer of a high-class commodity), the actor-network had to undergo periods of transformation during which it increased its capacity to negotiate with, and enrol, new actors. In understanding both the concepts of resilience and transformation, I argue that negotiations are required for transformations to happen.

I developed this argument within the narratives of the kiwifruit industry with the help of two particularly resilient actors within the actor-network, namely the kiwifruit and Psa-V. Both are non-humans; yet both are able to transform the relationships between actors and influence others, humans in particular, to do many things. The former achieves such influence by providing durability and mobility (Law, 1992) to the network. However, unlike rice in Indonesia (See Chapter 7), kiwifruit does not enact multiplicity. Thus, the translation of kiwifruit within the actor-network is always followed by a transformation of the network. The Psa-V, on the other hand, acts by being resilient and fluid. By doing so, the disease helps to both accelerate transformation and build resilience within the network.

In concluding this chapter, it is evident that the dynamics of transformations (and transformative resilience) that the industry has undergone are different over time. In the 1990s, the transformation was oriented towards the industry's resilience to global political and economic shocks. The 2010s, on the other hand, saw a period of transformation that was driven by the urge to build resilience in the face of an environmental shock. In both cases, the agency of human has played a similar role – it has enhanced the system to adapt to shocks. What differs between the two transformations is the way in which resilience was enacted. I argue that this is mainly due to the agency of the non-humans (kiwifruit, Psa, and others); an important point that has often been overlooked in a similar analysis. This chapter has shown that, while the human actors were critical in ensuring that the industry was resilient, the non-human actors were particularly important in shaping the trajectories of the industry along its historical development. The next chapter will review and link resilience, historical analysis, and agency in more depth through a reflection of the case studies on the theoretical dialogue.

CHAPTER 8 WHAT IS RESILIENCE IN THE CONTEXT OF THE CASE STUDIES?

8.1. Introduction

This chapter serves as a dialogue between the three theories in this thesis (namely, resilience, food regime, and actor-network) toward a novel understanding of resilience in the context of the two case studies. It begins with the conundrum that the term resilience, despite having been widely discussed and comprehensively defined, is still often vague and subject to different interpretations. Answering one of the basic questions of this thesis: *"what would a resilient food system look like*", I argue that we need a point of reference to confidently label an agrifood system as resilient or not.

The first part of this chapter takes the bigger picture of the development of global food relations, or food regimes, as that point of reference. By assessing the behaviour and trajectories of each of the agrifood systems with regard to its position within the global food regimes, I seek to identify whether Indonesia's rice agriculture or the New Zealand kiwifruit industry shows the characteristics of a resilient agrifood system. Key concepts in resilience thinking such as adaptive cycle, panarchy and domains of attraction are particularly helpful in characterising the resilience of agrifood systems. Accordingly, the first part of the chapter proposes that resilience *is contingent on the historical development of the agrifood systems and the larger food relations at the global level*. I argue that the benefit of incorporating food regime analysis to resilience thinking comes reciprocally: that it helps to see resilience of food systems in a new, insightful way – and addresses some of the challenges raised by the critiques of food regime theory, particularly in regard to the existence of multiple trajectories and multi-stable states within the current food regime (as mentioned in Chapter 3).

However, labelling an agrifood system as resilient, or not, is only part of the question. The next part of the chapter asks how this resilience is performed at the local level. To understand this, I use key concepts such as agency, multiplicity and transformability. This second part of the chapter asserts that the way resilience is enacted within each case study depends on the interplay between components of the network, both humans and non-humans. In analysing this, I find actor-network theory to be particularly valuable in providing a new way of understanding agency, human-nature relationships and locally-bound resilience. Using the

perspective of ANT, the second part of this chapter proposes that resilience *is contingent on the locality of the agrifood systems and the socio-material relations that construct them.*

8.2. A food regime analysis of agrifood systems' resilience

A system-based approach addresses resilience through its three conceptual propositions. First, every organic system evolves and develops following a certain trajectory according to which it grows, collapses, and restructures itself to be able to reorganize in the same or a different configuration. This cyclical process is called the *adaptive cycle*. Second, a system encompasses other smaller systems, and is itself encompassed by a larger one. These different levels of systems interact with each other in a hierarchical manner. But as they do so, each system also undergoes development in its adaptive cycle; thus relationships between one system and the others depend on the phase each of these systems is experiencing. This is the concept of *panarchy*, which is distinguished from the static hierarchy concept (Holling et al., 2002b; cf. Allen & Starr, 1982). Third, the concept of a *basin of attraction* describes a state of space in which a system might reside and, to some extent, towards which a system is attracted.

To summarize these propositions, resilience is defined as the amount of disturbance a system can absorb before it shifts from one basin of attraction to another. In this sense, there are two ways of seeing resilience. A system is said to be highly resilient at a certain point when a particular amount of disturbance is not able to alter its configuration, i.e. move the system from one basin to another. However, the resilience of this system is also defined by the configuration of the basin or the way in which the basin contracts and expands at the expense of the system within it. Using a food regime-system resilience framework, this section investigates the resilience of the New Zealand kiwifruit industry and Indonesia's rice agriculture as they are situated in the global relationships of agriculture and food, through the three conceptual propositions.

8.2.1. Adaptive cycle

Holling and Gunderson's (2002) adaptive cycle consists of four development phases. The *exploitation* (r) phase is characterized by a rapid accumulation of resources and connectedness between components. Examples of the exploitation phase include exponential growth in production, an expansive market, or a fast dissemination process in terms of new

technologies or policies. It is usually followed by a slower growth of production, stagnancy, and a period of stability. This phase is called the *conservation* (K) phase, a period when, as resources deplete, a system only seeks to maintain its connectedness and decreases its growth rate. During this phase, a system becomes vulnerable to external shocks, and those shocks might lead to a system collapse where it releases its potential; thus this stage is called the *release* (Ω) phase. As the connections and complexity of the system deteriorate, the system might try to reassemble itself based on the same configuration; but more often it assembles into a different configuration that is more adaptable to the new existing environment. This phase is termed the *reorganization* (α) phase and in most cases is directly followed by the r-phase, creating a cycle of system development and succession. This pattern of development as depicted by the adaptive cycle may (or may not) apply to different agrifood systems. But the question is, will it also apply to the global relationships encompassing these systems?

As I mentioned in Chapter 2, some criticisms of the adaptive cycle concept are brought by Gotts (2007), addressing its lack of coherence when applied to global dynamics. Holling (2004) had previously suggested that patterns resembling the adaptive cycle had occurred in the modern history, including the fall of Berlin Wall in 1989 as representing a release phase and the era of the internet as a reorganization phase. However, Gotts claims that the continuous economic growth in the US post-WWII until the 1990s demonstrates an obvious exploitation phase, which occurred simultaneously with environmental degradation resembling a conservation-release phase. How can the global system experience different phases of the adaptive cycle at the same time? I argue that, in assessing seamlessly interwoven systems at the global scale, one needs to use a particular point of reference to delimit the focal system of interest. It is practically impossible to have a clear understanding of the adaptive cycle at the global scale without this reference point. This is where I posit that food regime analysis provides a very valuable insight into the adaptive cycle model and the resilience of the global (food) systems, as articulated in the following narrative.

Global food regimes

Food regime theory asserts that the modern world system has configured as at least two global regimes and is now assembling itself in a new configuration. As depicted in Figure 8.1, it is clearly shown that *the historical development of the global food relations (through*

successive periods of growth and collapse) fits perfectly with Holling et al.'s (2002) adaptive cycle.

The period of rapid growth (or *exploitation* phase) in the first food regime was characterized by the culmination of colonization and massive mobilization of resources from the colonies to the British and European empires, between 1870 and the 1890s. During this period, new technology in refrigeration promoted dramatic increases in colonies' agricultural exports, reaching a peak circa-1910 when oversupply resulted in a decrease in international prices. This was the period when the first food regime reached its climax and moved from the *exploitation* to the *conservation* phase.

In resilience thinking, the *conservation* phase relates to a period of saturated growth and resource (or capital) accumulation, as well as rigid connectivity, which decrease system resilience (although Jannsen et al., 2006 argue that there is no direct relationship between connectivity and resilience). As asserted by Friedmann and McMichael (1989), after the First World War, capital accumulation was an increasingly centralized in Britain, to which more wheat and meat were exported from the settler colonies. With a relatively stable economy compared to other countries in Europe and the US (Le Heron, 1993), Britain in 1930s sought to conserve the existing political economic regime. However, as many countries became reliant on the British market, an increased influx of commodities to the country lead to a sudden drop of the world commodity prices, bringing the first food regime into the rim of collapse. The highly centralized connections in the global food system also meant that a shock in the core country was easily spread to the peripheral countries, and *vice versa*.

As it turned out, the Great Depression and World War II finally dismantled the existing food circuits and triggered the collapse of the global system; hence a *release* phase occurred – a phase signified by the loss of stability and connectivity between actors. In the subsequent *reorganization* phase, new agricultural and international policies were being constructed in every country. Theoretically, this phase is characterized by a rich potential for new connections and ways of accumulating resources. In the rise of the second food regime, this meant the emergence of new centres of capital accumulation and modes of regulation. In Europe, the phase was characterized by a new alliance of countries collectively called the European Economic Community. In the US, the reorganization phase was marked by rapid agricultural intensification and the birth of a new agricultural policy called PL480, or the

food aid program (Friedmann & McMichael, 1989). The aggregation of these dynamics led to the global agreement on a monetary scheme through Bretton-Woods, giving birth to a new supranational organization called the International Monetary Fund (IMF).

During the next three decades, increasing connectivity between countries conformed to the *exploitation* phase of the second food regime, as the newly formed structures showed their capacity to accumulate capital. The food aid program was disseminated rapidly to third world countries in Asia, Africa, and South America, connecting new channels of food circuits. Meanwhile, European countries established the Common Agricultural Policy (CAP) in order to stabilize the European market and secure their food production, which from then was ratified by its members and implemented in their agricultural activities. At the global level, Europe and the US became two axes of power that were integrated into what Friedmann (1993) calls the 'Atlantic agro-food sector' through the livestock (soybean–maize–meat) complex.

Both the US and the EEC demonstrated a rapid establishment of their policies over two decades, but then experienced another period of stagnancy, thus conforming to the next *conservation* phase. For the US, the food aid program promoting its wheat and livestock complex to a new market had come at its own cost. In early 1970s, a sudden scarcity of wheat in the global market following a Soviet manoeuvre to buy a massive amount of grain caused the international price to sky-rocket, which was followed by the disintegration of the networks once formed by the US (Friedmann, 1993). This is the *release* phase of the second food regime. Of course, the networks did not entirely disappear, as, at the end of the 20th century, the US still maintained its trade relations with the Soviet Union, China, and many other third world countries. The centre of accumulation had shifted from a monistic centre to multiple centres, each with different food circuits.

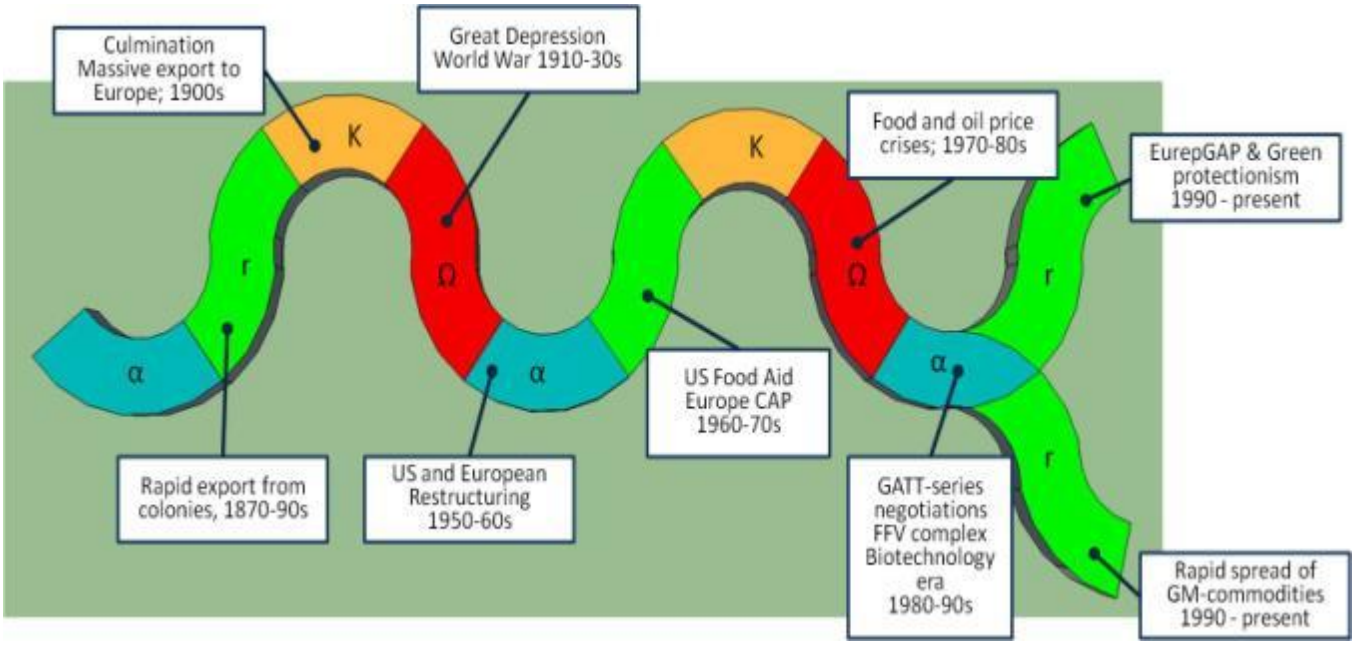

Figure 8.1. Adaptive cycles in the global food regimes; each colour strip represents phases in the cycle (Adapted from Holling & Gunderson, 2002)

The *reorganization* phase toward the third food regime was marked by a series of GATT-trade negotiation rounds with the objective of finding a new configuration that integrated most of the developed and developing countries in the world. While this series of negotiations continued even up until 2009, new circuits of food trade were already beginning to take shape in the 1980s. The first circuit was formed in the guise of the fresh fruits and vegetables (FFV) complex, connecting new agricultural countries in the tropical regions and global south to Europe, the US, and Japan in the northern hemisphere. This complex merges with fair-trade, global organic, GlobalGAP and other alternative food networks into what Campbell (2009) highlighted as the 'food from somewhere' regime. The second circuit was a mere continuation of the previous regime, connecting the US and its TNCs to developing countries in the global south. The GATT Uruguay Round would then only act as an affirmation of the existing global trajectories, resulting in agreements such as tariff reduction and sanitary and phytosanitary (SPS) measures. The *de facto* third food regime has been expanding through the rapid growth of new markets and commodities, but its formal mode of regulation has yet to be established. The WTO-related Doha Round in 2001, followed by another series of negotiations within the GATT framework, was unable to find common ground over the trade liberalization-protectionism tensions. Thus, up to the present, it is still unclear whether the third food regime has already entered the *exploitation* phase or remains

in a prolonged *reorganization* phase, particularly with the ongoing financial shocks following the 2008 World Food Crisis resulting in an ineffective global restructuring.

Walker et al. (2006) note that there are several cases where a reorganization phase is not necessarily followed by an exploitation phase:

> "Some systems with little structure and large resilience may be subject to reorganization. If the external disturbance is so large that it cannot be absorbed, even in an r phase configuration, the system becomes disordered. …. An emergent market may be resilient to price fluctuations and continue to develop, but a major currency drop or stock market collapse may destroy it." (Walker et al., 2006: 4)

In this regard, the adaptive cycle model provides a possible explanation on the current state of stability in the global food regime. A contestation between the neoliberal or 'food from nowhere' regime (McMichael, 2009) and the 'food from somewhere' regime (Campbell, 2009) interferes with the exploitation phase of the possible regime. As shown in Figure 8.1, the trajectory seems to bifurcate, each direction with its own configuration and set of food relations, but neither with a strong hegemonic power. In the end, a series of shocks, including the 2008 World Food Crisis (Rosin et al., 2012), might push the system to reorganize into either of the two opposing structures, or even into an entirely new structure.

The existence of the two global structures (and the previous regimes) is partly evident when we map the relationships onto the historical development of both the New Zealand kiwifruit industry and Indonesia's rice agriculture. As it turns out, the two local systems have undergone a similar pattern of development that can be fitted to the adaptive cycle model, and there are relationships occurring between each of the systems and the global structure encompassing them. As I will show, the two cases support the argument that there are indeed two state-spaces within the so-called third food regime that are co-existing and, to some extent, influencing the trajectories and resilience of the individual systems. The following is a reflection of such relations.

Kiwifruit industry

Throughout 100 years of its history, the New Zealand kiwifruit industry has experienced at least one period of development resembling the full adaptive cycle, and another nearly full cycle reaching a release phase after 2010. Prior to those, the pre-kiwifruit era in New Zealand

conformed to the global food regime development. This was distinguished by a rapid growth in the sheep industry depicted in Figure 8.2 as the *exploitation* phase, followed by a period of stagnant growth and collapse coinciding with the Great Depression and World War II. During these *conservation* and *release* phases, the first seed of kiwifruit was introduced to New Zealand, and within the next three decades a *reorganization* phase occurred. This latter period was characterized by experimentation and the introduction of kiwifruit into domestic and global markets.

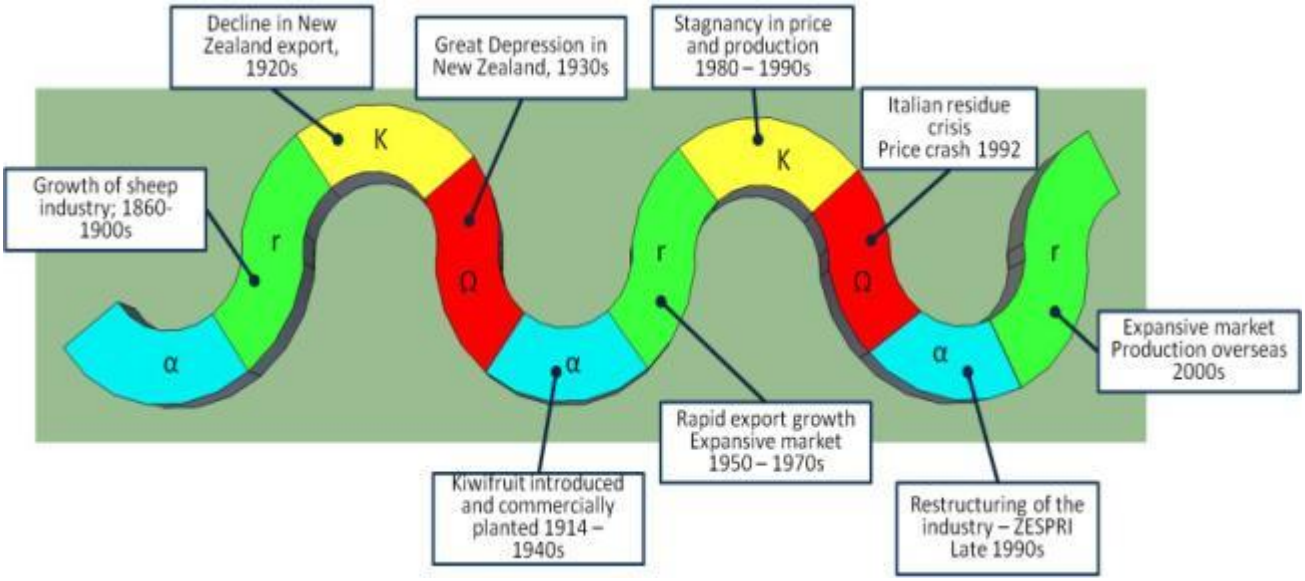

Figure 8.2. Adaptive cycles in the New Zealand kiwifruit industry

A rapid growth in the New Zealand kiwifruit industry took place from 1970 as the kiwifruit was promoted across Europe, the US, and Asia. However, simultaneous production in European countries finally caused the world market to become flooded with kiwifruit, causing a dramatic decline in kiwifruit prices in the 1980s and bringing the kiwifruit industry to its *conservation* phase. During this phase, the industry became particularly vulnerable to shocks. The sequential shocks occurring in the early 1990s finally pushed the industry to enter its first *release* phase. After a long *reorganization* phase (early to late 1990s), the kiwifruit industry in the form of ZESPRI was able to grow rapidly in terms of production, innovation, and marketing during the second *exploitation* phase.

ZESPRI has learned from a bitter experience in the 1990s that the industry was dependant on global dynamics such as price fluctuation and world economic crises. However, the kiwifruit

industry has never been highly exposed to internal disturbance. As it turned out, a decade after ZESPRI was established, the industry started to demonstrate signs of entering a *conservation* phase, rendering the industry vulnerable to shocks. In 2010, the Psa outbreak finally pushed the industry to seemingly another *release* phase.

Rice agriculture

Rice agriculture in pre-independence Indonesia developed as a form of subsistence farming. Only after 1870 did the seed of commercialization in Indonesia grow, marking this stage as a *reorganization* phase of the adaptive cycle (Figure 8.3). From then, rice agriculture displayed rapid growth in terms of the number of new farms (*sawah*) and its ability to finally export rice to Indonesia's outer islands. In the 1920s, the Dutch Ethical policy pushed for continued growth in agricultural areas, but without a significant increase in productivity. What followed was a period of decommercialization in a *release* phase that took place during World War II. Indonesia endured a long *reorganization* phase due to on-going shocks from within (revolution, political turmoil, rebellion) as well as from the outside (Dutch invasion, world price fluctuations). According to concepts developed in Walker et al. (2006), this period resembles a variant of the adaptive cycle in which reorganization is not followed by an exploitation phase, as no structure emerges from the former phase. Marks (2010) also notices this was a period hampered by a disintegrated and inefficient market in the rice agrifood system in Indonesia, a period that spanned almost four decades (1930 – late 1960s).

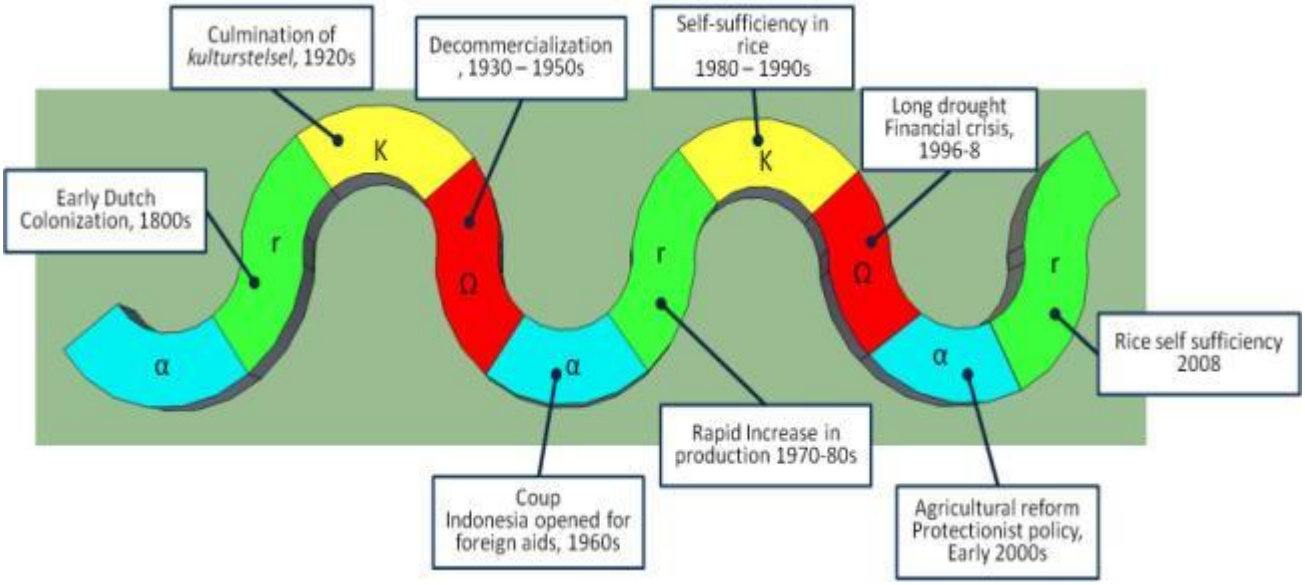

Figure 8.3. Adaptive cycles in Indonesia's rice agriculture

The new order regime led to stability in Indonesia which favoured rice agriculture, and allowed it to enter an *exploitation* phase after 1970. This phase was caused by multiple factors, namely foreign aid, the mechanization of agriculture, and Indonesia's oil wealth. In contrast to the first exploitation phase a century prior, in the 1870s, the rapid growth in this period was not characterized by an increase in production area, but instead by an increase in productivity. Several shocks were still emerging in the subsequent years, but most of them were easily absorbed by the system. From the 1980s, Indonesia experienced a period of stable growth and continued to do so for a decade, showing a resemblance to the *conservation* phase. Yet, as the system became increasingly rigid, it proved to be vulnerable to shocks such as drought and inflation, thus aligning with the situation in the kiwifruit industry during its release phase in 1992.

Agricultural reforms were enacted after this crisis in Indonesia's rice agriculture. Indonesia was pushed to liberalize its trade and open its market for international rice, but refused to do so. There has been widespread criticism from external parties, but Indonesians saw this as a source of pride, proving the government's bravery and its sense of nationalism against emerging neoliberal powers. As it turned out, through its highly protectionist policy on rice, Indonesia was able to put its agriculture back into the *exploitation* phase, and reached self-sufficiency once again in 2008. But the state of Indonesian agriculture is again being questioned (Neilson & Arifin, 2012). Its policies on self-sufficiency through Indonesia's emerging Food Estate and the new variety of GM-rice are pushing the country to grow faster. Looking at the pattern of the adaptive cycle, there is a strong possibility that the next decade will be characterized by another rapid exploitation phase, which is likely to be followed by stagnancy.

8.2.2. Panarchy

One of the benefits of merging food regime analysis with the adaptive cycle model in resilience thinking is that it acknowledges the context at the national level in which the shocks and dynamics impacting on the agrifood systems occur. The panarchy approach positions the recurring global shocks facing the systems in a patterned development, rather than as random, unrelated, and intermittently occurring events. Likewise, linking the trajectories of agrifood systems at the national level to the global dynamics through

panarchical (cross-scale) relations helps us to better understand the development of the global structures and to substantiate the proposition of multiple trajectories and multi-stable states.

The first conceptualisation of panarchy developed by Holling and others (2002b) puts an emphasis on slow changes affected by the upper scale (in the form of remembrance) and fast changes from the lower scale of the system (in the form of revolution). Further research shows that this is not necessarily the case (Armitage & Johnson, 2006; Gotts, 2007). Both scales can in fact influence the focal system in different ways, depending on the state of these scales at any given moment.

The global context set through food regime analysis helps to explain the different types of shocks and responses occurring in the two cases of agrifood systems that this thesis analyses. As I will demonstrate in the following narrative and in Figure 8.4, certain phases in the development of the kiwifruit industry and rice agriculture resulted from the direct influence of global food regimes, while other phases demonstrated a relatively subtle influence. Similarly, both systems influenced the trajectories of the global regimes to vaying extents. Here, I will show five panarchical relations that demonstrate how the global food regimes are linked to agrifood systems' resilience at the national level.

The first obvious effect of global dynamics on rice and pre-kiwifruit agricultures was the Great Depression and World War II. Although the effect was direct for New Zealand, in Indonesia it was the Japanese occupation that impeded agricultural development. This first instance of panarchical relations already counters Holling et al.'s (2002b) concept of global-to-local remembrance given that the processes in fact occurred abruptly. A rapid deteriorating effect of these events occurred coincidentally with saturated growth of both the sheep industry and rice agriculture; hence these systems only needed a modest trigger to cause a major collapse.

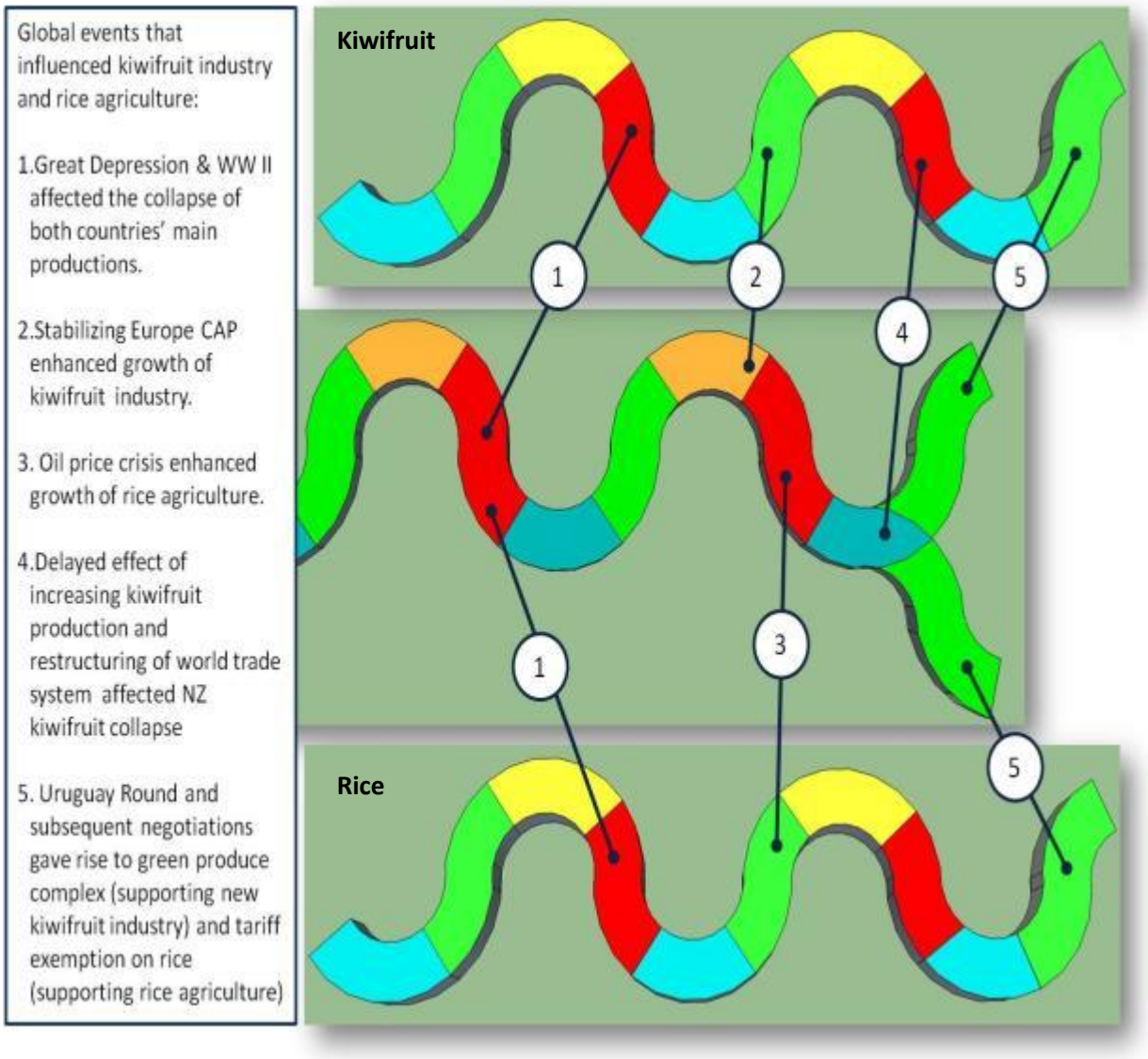

Figure 8.4. Panarchy between global food regimes with New Zealand kiwifruit and Indonesia rice agriculture

A second panarchical relation shows an enhancing, rather than the previously asserted deteriorating, effect on growth. In its early expansive market, New Zealand kiwifruit exports were oriented mainly to Europe and the US. Thus, a stable European economy supported by the EEC and CAP proved to be an enhancing factor for the kiwifruit industry's rapid growth in the 1960-70s. CAP provided favourable conditions for the acceptance of kiwifruit since the European market was already inundated by basic commodities such as wheat and dairy, and calling for diversification of its agricultural commodities to boost farmers' interest in the agricultural activities. Fortuitously, kiwifruit offered a lucrative opportunity for the future

European market. In this instance, the panarchy worked two ways. A conservation phase in Europe clearly affected New Zealand's kiwifruit industry; but at the same the industry also influenced the growth of kiwifruit production both in Europe and, eventually, worldwide. To some extent (in combination with other high quality commodity markets of the FFV complex) this situation was the template for a new set of relationships following the collapse of the second and during the reorganization towards the third food regime.

A third panarchical relation demonstrates an inverse effect between the global and the national scale. The 1973 oil price crisis, followed by the 1974-5 world food crisis, signified the collapse of the second food regime. It supposedly affected many third world countries, considering their dependency on imported foods and oil. But interestingly, this phenomenon did not affect Indonesia due to two reasons: the country's refusal to use wheat-based goods, and the discovery of its oil reserves. As a result, the global release phase conversely enhanced and prolonged the exploitation phase of rice agriculture in Indonesia.

A fourth example of the panarchical relation shows an interesting dynamic as the global influences were delayed before they finally reached the particular system. It was the same chain of events that enhanced the kiwifruit industry's rapid growth that eventually led to its collapse in 1992. The rapid increase in global kiwifruit production caused a dramatic decline in kiwifruit price in the early 1980s. But this event had only shifted New Zealand kiwifruit from an exploitation to a (premature) conservation phase. The government's measures on kiwifruit export regulation seemed to calm the storm, but in fact only delayed its collapse. The kiwifruit industry was like a bubble waiting to burst in response to even a minor shock. The collapse finally occurred a decade after the global crisis touched New Zealand – the Italian residue crisis in 1991 followed by another price crisis in 1992 pushed the industry into its release phase. It took almost a decade for the kiwifruit industry to finally reassemble itself into a more robust configuration.

Within a food regime analysis, there are two reasons for such a collapse that relate to a series of events leading to the transition between the second and third food regimes (and the bifurcation of the latter). Firstly, as mentioned in Chapter 5, the second food regime was characterized by massive state intervention policies. With the collapse of the regime, many countries, including New Zealand, started to deregulate their economy and shifted responsibility for economic regulation to trans-national entities such as the GATT and WTO.

Secondly, this emerging neoliberal scheme transformed state involvement in agricultural policies into what Campbell and Fairweather (1998) termed 'green protectionism', which focuses on sanitary measures to limit the influx of agricultural products from outside the region. The new policy orientation provided the context for the the Italian pesticide residue crisis that finally brought the kiwifruit industry into collapse.

Finally, the series of WTO-trade negotiation rounds, starting with the climax of the Uruguay Round in 1995 and followed by the Doha Round in 2001, shifted the course of both the kiwifruit industry and rice agriculture, but to ostensibly different trajectories. For the kiwifruit industry, the two major decisions of the Uruguay Round – namely tariff reduction and SPS measures – were in alignment with its trajectory subsequent to the 1990s collapse. In 1998, ZESPRI was established in order to end the government's intervention onto the kiwifruit industry. In 2001, ZESPRI had become the first corporation to comply with EurepGAP, a European retailer-based audit scheme which incorporated the SPS measures of the Uruguay Round. From this point of view, the panarchical relations between the global structure and the local food system drove this system as a passive component of the global structure.

For Indonesia, however, those series of negotiations put the country in a counter-current to the normal trends of trade liberalization. The Asian financial crisis followed by Indonesia's economic collapse forced the government to comply with IMF demands, including trade liberalization for all of its agricultural commodities. In 2001, the new Indonesian president, Abdurrahman Wahid, decided to return to the government's previous policy (although with a restructuring in BULOG). As mentioned in Chapter 5, in the Doha Round, Indonesia led other developing countries to fight for tariff reduction exemptions for several crucial products, including rice. The counterhegemonic action of these countries, in combination with the resistance of the new social movements, shapes the way in which the third food regime is manifested in its current state (McMichael, 2000; 2009).

8.2.3. Global basins of attraction

Up to this point, I have shown that there is a high degree of resonance between system-oriented resilience thinking and food regime theory when it comes to the analysis of the resilience of agrifood systems to global shocks. Both the adaptive cycle model and the concept of panarchical relations clearly show a reciprocal relationship between the global

food regimes and the smaller national level agrifood systems. In this section, I provide another narrative that substantiates the potential of theoretical merging – this time using the metaphor of the domain of attraction. This metaphor was introduced by Holling (1973); but Walker and others (2004) elaborate it further through the idea of a 'basin', of a state-space in which a system resides and that continuously attracts the system to its centre. The illustration shown in Figure 8.5 resembles a ball inside a cup.

In this theoretical merging, the global food regime is analogous to the domain of attraction. Within this domain, individual food systems are attracted to the centre of the 'food regime' basin. The resilience of the system depends both on how strongly the basin pulls systems from the threshold, and, at the same time, how strongly agents and shocks push systems closer to it. In Figure 8.5, I illustrate three stages of global food development in sequences, depicting the first food regime (Figure 8.5.a), transition to the second food regime (Figure 8.5.b), and another transition to the third food regime which consists of (at least) two state-spaces, the food from somewhere regime (characterized by the affluent-oriented FFV-complex and 'green' corporations) and the food from nowhere regime (characterized by a biotechnology-based basic commodities system) (Figure 8.5.c).

Reflecting on the case studies, the rice agrifood system during Indonesia's pre-independence era stayed within the basin of the first food regime. During the transition and as the first basin contracted, Indonesia's rice agriculture was attracted to the second food regime. Indonesian rice might not be directly involved in the US-centred food circuits, but it was clearly influenced by the regime's characteristics of state-intervention and protectionist policies. As the third food regime emerged, global economic relationships centred on neoliberalism (through WTO) tried to pull Indonesia's rice agriculture away from its current basin and towards the threshold of the new basin.

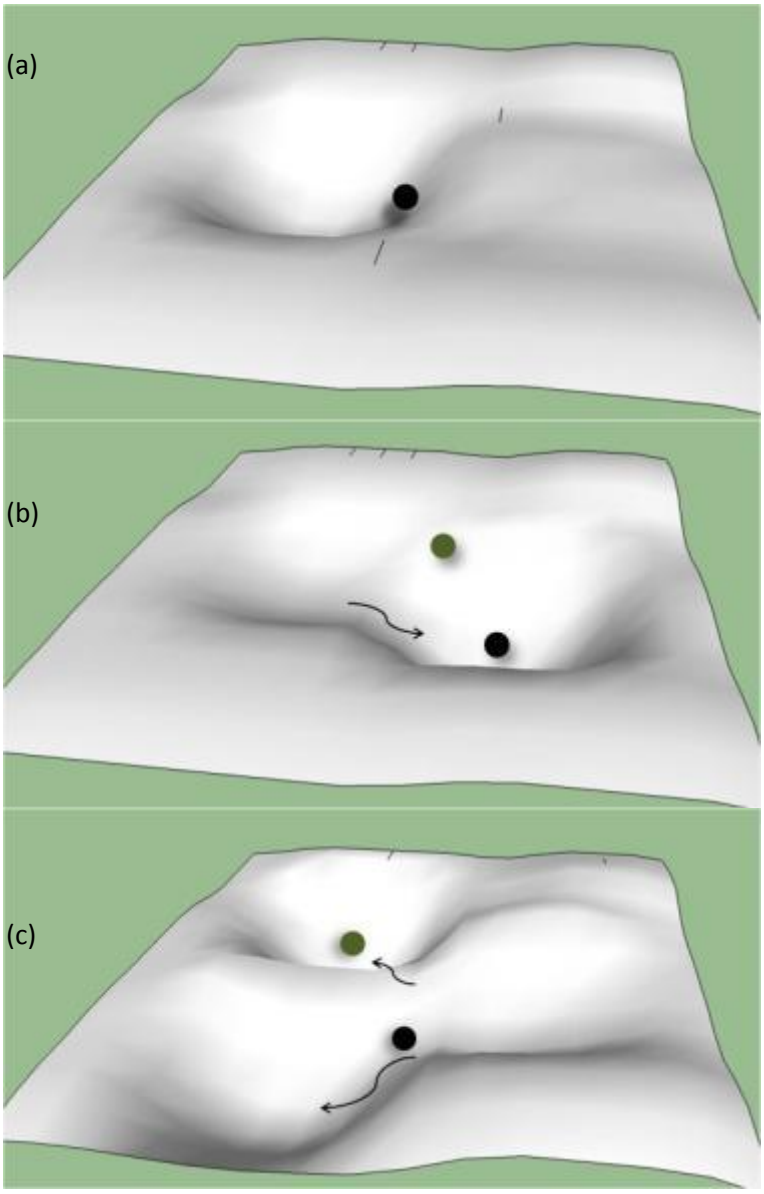

Figure 8.5. Food regimes as global basins of attraction; (a) First food regime; (b) Transition from the first to second food regimes; (c) Transition from the second to third food regimes (note two basins of attraction emerge simultaneously); black dot represents rice agriculture, green dot represents kiwifruit industry

The New Zealand kiwifruit industry demonstrates a different behaviour. During the stable state of the second food regime, the kiwifruit industry stood at the threshold of the basin. On one hand, the industry was still influenced by the existing regime, given that it continued to receive significant government support. On the other hand, the configuration of the industry fitted perfectly with the incipient third food regime, which proved to be relevant to the industry's expanding market. From the results of this research, this idea of multiple stable states seems to contradict food regime analysis that argues for the hegemony of the second

food regime, implying that there is no possibility for a local food system to exist in another basin. However, this research's analysis of the kiwifruit case shows that, although still in its initial stage, the corporate-environment food regime did co-exist with the previous state-protectionist regime, and explains why it is difficult to situate New Zealand in a particular regime during the period (Moran et al., 1996). In the end, the New Zealand kiwifruit industry has demonstrated ability to exist and integrate into the global state-space of the 21st century neoliberal food regime.

The narrative shows that there is a potential to use the concept of *domain of attraction* in a food regime analysis. The concept not only substantiates the argument of global capitalist structures (or regimes) in food regime theory, but also gives a flexibility of understanding these regimes as changing over time and potentially coexisting with other, perhaps smaller, state-spaces. Consequently, local food systems can shift from one regime to another in relation to its own behaviour and the dynamics of the regimes at a larger scale. But what does this say about the systems' resilience?

8.2.4. The value of food regime analysis

This first half of this chapter will conclude with two points of analysis. Firstly, I want to highlight how food regime analysis has given a valuable insight into the understanding of resilience of both case studies, which is not apparent in a traditional resilience thinking approach. Secondly, I will demonstrate how resilience thinking can in the same manner help to address some of the limitations of food regime theory.

As mentioned in the introduction of this chapter, system resilience can be identified by focusing on two aspects: (1) the system's ability to absorb shocks over its historical development and (2) the system's position relative to the changing stability domain/regime. This thesis demonstrates that the value of employing a food regime analysis within a system resilience framework comes in support of the two aspects mentioned. First, it offers a point of reference for a historical analysis of the system. Walker et al. (2002) has underpinned the importance of a historical profiling to identifying the periods of shocks and crises accompanying a system's capacity to be resilient or transformative. However, historical profiling *per se* is not sufficient. In the process, it is also necessary to identify the context that sets the patterns and dynamics of the system and shocks. Food regime analysis, as I argue,

reveals such context, enabling the identification of the larger state-space that influences system resilience.

The metaphor of the adaptive cycle has helped in highlighting the remarkable resilience of both systems in response to global disturbances during phases of their development. These systems show a high degree of resilience (i.e. they absorbed large amount of disturbances without altering their structure) mainly in their reorganization and exploitation phases; and this feature is consistent with Holling and others' (2002b) proposition of the three-dimensional adaptive cycle (see Figure 2.3). In their argument, a system reaches its highest degree of resilience during the exploitation and reorganization phases. One possible explanation is that at these phases, the system has a low level of connectivity, hence a higher flexibility to adjust its structure in accordance with, and conforming to the situation shaped by, the occurring disturbances. For example, the New Zealand kiwifruit industry showed its resilience as it transformed the impact caused by an emerging global audit scheme (and the rise of the 'corporate-environmental' food regime) into a favourable situation with the support of its marketing strategy, the KiwiGreen program. Similarly, in Indonesia, the 1970s oil price crisis (that signifies the fall of the second food regime) was absorbed and transformed into a competitive advantage by creating an oil-subsidized agricultural intensification scheme. In this case, the discovery of oil was not the trigger for transformation, but an innovative way that the government acted to ensure that resilience / stability was enacted.

The metaphor of adaptive cycle also hints on the difference between resilience in each development phase. For instance, in Indonesia's rice agriculture, the 1970s exploitation phase was signified by continuous and stable growth despite the emerging crisis. Resilience here is seen as the ability of the system to absorb shocks while continuing to grow. This is what Darnhofer and her colleague (2010) refer to as shock resilience. Shock resilience has become a critical point in the discussion of resilience management (Walker et al., 2002) in the implication that we can have resilience without consequences. The results of both case studies in this research illustrate that this is not necessarily true. In Indonesia, the subsidization of agriculture and intensive production seem to increase the system resilience over more than two decades (1970-1998), proving to be able to absorb environmental and economic shocks without stopping to grow. However, the build-up of shocks and increase in connectivity imply that the system is actually at a state of a collapse-waiting-to-happen, as

proven during the 1998 Asian financial crisis. Likewise, the rapid growth of the New Zealand kiwifruit industry in 1970s came to an end as the industry became saturated in growth and prone to a combination of shocks that were manifested two decades later, thus pushing the system to enter the release phase.

The second form of resilience is transformative resilience, a situation in which a system is able to reorganize into essentially the same configuration after a collapse. Transformative resilience in this sense is better than shock resilience, because it offers the potential for the system to be better equipped and adapted to a similar type of shock that can cause collapse. It, however, also involves trade-offs for policy and strategy planning. Firstly, it indicates that a release phase is an inevitable process within resilience management, a term that Holling and Gunderson (2002) refer to as a 'creative destruction'. Secondly, the end result of transformative resilience is uncertain, because it involves a wide range of possible configurations. The New Zealand kiwifruit industry has demonstrated a transformative resilience after the 1990s crisis where the industry was able to bounce back and re-emerge in a new, transformed structure that is better adapted to the particular shock. By contrast, the reorganization phase of Indonesia's rice agriculture after the 1960s hyper-inflation and 1998 financial crisis returned the system into a structure that was still prone to similar shocks, showing how transformative resilience might not necessarily work as expected.

However, the adaptive capacity of the agrifood systems is only one aspect of their resilience. In the end, overall system resilience is also determined by the dynamics of the global food regimes that encompass them. Revisiting the metaphor of 'domains of attraction' discussed in Chapter 2 (Section 2.3.1), the resilience of agrifood systems depends on three factors: resistance (R, the difficulty for a system to change), latitude (L, the amount of shock needed to move the system onto the threshold) and precariousness (Pr, its position relative to the basin's threshold). While resistance depends on characteristics of the focal system, the other two factors (precariousness and latitude) primarily relate to the extent to which the system is entangled with global food relations (i.e. how strong the shock is and whether the system is more/less precarious to a regime shift). A highly resistant system can lose its resilience if, for whatever reasons, it stays too close to the basin's threshold. Latitude depends on the 'length' of the basin, which basically means that if the regime is expanded (at its climax) or contracted (near its collapse) the latitude also increases or decreases (i.e. the system is more/less resilient). As an illustration, Indonesia's rice agriculture has a long history of

persistence, particularly because it seems to have a robust structure founded on unique social, economic and political relations (for reasons that Chapter 6 has illustrated and the next part of this chapter will elaborate). However, a collapse of the first food regime during World War II triggered the agrifood system to lose its resilience. A shock as large and influential as global economic and political restructuring (following the WWII and rise of nation-states in Asia) had clearly translated into a collapse of rice agriculture, regardless of its robustness. This shows that resilience is influenced as much by the contraction and expansion of the global regime (i.e. the latitude, L, of the basin) as by the system's resistance (R) to shift to a different state. There were also times (such as during the 1998 Asian financial crisis) during which it was highly precarious due to its configuration not conforming to the existing neoliberal regime, thus making it more susceptible to political economic shocks.

In a similar analysis, the configuration of the New Zealand kiwifruit industry seems to be more flexible (Chapter 7 for more details), showing lower resistance to a regime shift. In combination with the collapse of the second food regime in the 1970s and a transition to a new set of relationships centred on neoliberalism, the industry lost its resilience and flipped into a new stable state. After the crisis, the New Zealand kiwifruit industry restructured to align with the state-space, pulling the system deeper into the centre of the basin and, consequently, making it highly resilient.

The empirical evidence shown above substantiates the argument that food regime analysis can give new insight into system resilience analysis. In Table 8.2, I illustrate the way of analyzing resilience by understanding the historical and political economic context of global food regimes. A traditional approach of resilience analysis would fail to notice, or at least undermine, the interrelated political-economic forces and shocks at the global level. Food regime theory asserts that the dynamics at the national level are inextricably connected to the global level. Accordingly, through food regime analysis, this thesis has shown that the resilience of both Indonesia's rice agriculture and the New Zealand kiwifruit industry is deeply influenced by the global food relations.

Table 8.2. An indication of the agrifood systems' resilience as assessed with food regime analysis

Phase in agrifood systems	Indication of resilience		Shocks originated from the global food relations
	Kiwifruit industry	Rice agriculture	
1870 – 1960s			
Exploitation (r) phase		Not known	Rise of 1st FR
Conservation (K) phase		Low	Great Depression
Release (Ω) phase			World War II (Collapse of 1st FR)
Reorganization (α) phase		Low*	Emergence of 2nd FR
1960 – 1990s			
Exploitation (r) phase	High (Stable)	High (Stable)	1973 oil price crisis (Collapse of 2nd FR)
Conservation (K) phase	Low	Low	Trade liberalization
Release (Ω) phase			Emergence of EurepGAP (Transition to a new regime)
Reorganization (α) phase	High (transformative)	High (Stable)	
2000s			
Exploitation (r) phase	Low**		2008 World food crisis
Conservation (K) phase		High (Stable)	

* The low resilience is resulting from an internal political turmoil (the case of Indonesia) and an environmental shock (disease outbreak in New Zealand's kiwifruit)

What resilience thinking would add to the discourses of food regime theory is a systems understanding of the reciprocal interaction between the dynamics at the global and local levels. Panarchy helps to partially resolve the critique of global structural determinism by assigning the nation-states (and the national-level agrifood systems) a stronger role (or agency) in shaping the trajectories of the food regimes. The adaptive cycle model addresses, from a systems perspective, the failure of the third food regime to assume any dominant shape up to present. The domain of attraction gives a visualization of food regimes and the transitions in-between, while also opening the possibilities of alternate state-spaces that might co-exist at the global level. However, the relationships between food regime and panarchy analyses are mostly superficial, built on the basis of similarities of patterned trajectories alone. For instance, can we satisfactorily explain that the boom-bust cycles posited by food regime theorists occur because they are inherent properties of an adaptive system? Or can we say that the multiple trajectories of the third food regime exist because, as multiple stable states, they are necessarily so? The resilience perspective of food regime theory, at this point, is unable to satisfactorily explain why the system does what it does.

Furthermore, both a system-oriented resilience approach and food regime theory fails to explain the idiosyncratic patterns occurring within each agrifood system in relation to its resilience. Table 8.2 provides at least two examples of such a case. In 1970s and 2008, Indonesia's rice agriculture was in a situation of stable growth and high resilience despite the occurrence of a global food and fuel crisis. In 2010, the New Zealand kiwifruit industry entered a situation of low resilience during its exploitation phase, which had nothing to do with shocks transmitting from the global level. Both examples provide evidence of dynamics operating at a smaller scale that, despite far-reaching impact, seem to be obscured within a larger scale of analysis. Although system resilience contributes some understanding of agency to food regime theory, the agential capacity of the nation-states (and individual actors within them) is left unexplored in this research due to a stronger emphasis of the research purpose upon system behaviours. Accordingly, although this section has shown the way in which the global dynamics influence the systems' resilience, it still lacks the bottom-up explanation: how do local actors similarly shape the trajectories of the systems? The examples mentioned above also imply that there were deeper relational changes occurring at the local level, which were influenced by agentic (and transformative) capacity of the material objects (rice, kiwifruit and pest and bacterial disease). The next half of this chapter will provide a more detailed examination of the agency of both the humans and nonhumans inherent to each system through a combined approach of agency-oriented resilience thinking and actor-network theory.

8.3. A closer look at resilience: of agency and socio-material relations

Indeed, a system perspective is only one facet of the broad postulates formulated by resilience thinkers. At the local level, key concepts from an agency-oriented resilience framework such as shocks, social capital, functional diversity, adaptive capacity, and transformability still need to be taken into account. These features will prove to be of relevance in answering the questions arising in the conclusion of Chapter 5: how do kiwifruit growers/rice farmers, processing houses, traders, researchers, together with the commodity (kiwifruit/rice), the machine, and other human and non-human actors, develop a mechanism of resilience against imminent disturbances? Reflecting on Chapter 6 and 7, the next part of the chapter focuses on the ways in which resilience works at the local level, with emphases on the features of resilience as mentioned in Chapter 4 that may be seen to resonate with the

key concepts in actor-network theory. In the following narrative, I argue that actor-network theory can also give valuable insight to resilience thinking, particularly as a novel way of understanding agency and human-nature relationships that goes beyond the conventional, anthropocentric explanation.

8.3.1. Shocks, agency and actors' enrolment

The first valuable insight ANT offers to resilience thinking is a reconstructing of the notions of shocks, capital and agency. From a resilience perspective, pests and diseases, as well as other environmental and socio-economic crises, are considered external shocks to which the system responds and adapts. The resilience of the system is then defined as the extent of shock a system can endure before it shifts into a different configuration (Walker et al., 2004). But what does it mean in the context of both case studies? How do we measure resilience if the shock is mobilized and multiplied by the system? What will happen if the shock itself is resilient?

In contrast to resilience thinking, ANT sees phenomena without *a priori* definition of system, boundaries and external shocks. To further explain this distinction, I refer to Callon's (1986) three principles for comprehending dynamics at the local level: *free association*, *agnosticism*, and *generalised symmetry*. The first principle of free association puts the actors plainly on the landscape. Actors are free to move from one network to another, and to associate with and dissociate from other actors, providing that a successful negotiation occurs. When an actor is enrolled to a network, other actors must renegotiate their position and relationships to accommodate the incoming actor. In some cases, this may result in betrayal and the dissociation of one or more actors from the network. In other cases, the new actor is unable to enrol to the network, given the strength of the existing network's resistence to re-assembling. It is important in the regard to recognise that stability does not imply an inactive state. To the contrary, stability is the active result of continuous negotiations and contestations. Actors never stop negotiating; for if they stopped, the network would cease to exist.

The second principle of agnosticism involves avoiding any sense of sentiment or value towards or against an actor. There are no unwelcomed or 'negative' shocks, nor in the same manner 'good' or 'positive' capitals. The enrolment of Psa or brown leaf hoppers to the food systems should be seen in the same manner as the enrolment of kiwifruit to New Zealand or rice to Indonesia. The fact that the pests, diseases, climatic shocks and financial crises were

successfully enrolled to the networks shows that some actors within the network have acknowledged these so-called shocks as inherent to the system dynamics. The valuing of such actors as 'bad' is only constructed in the society once there is consensus that they have negatively impacted the system (for example, that Psa costs the industry in New Zealand millions of dollars and the brown plant hopper or financial shock creates a situation of food insecurity in Indonesia). Some actors have, however, found their position and role in the system strengthened due to the incoming shock, and some have even successfully adapted to the new configuration as what they considered to be a better situation.

This brings us to the third principle of generalised symmetry which suggests that all actors involved in building resilience, both humans and non-humans, be addressed through equal and unbiased analysis. In order for a shock to occur and the actor-network to respond, there must be a reciprocal involvement of actors within the network. This is true for pests and diseases as well as for new plant varieties or agricultural innovation. What differs between these cases is which actors respond and which do not. The introduction of new varieties of rice, for instance, involved ICRR, farmers, climate, soils, and old agricultural technologies – with controversies arising from one or two actors. In the kiwifruit industry, conflicts arose between dairy farmers as the promising new Hayward variety was introduced to the Bay of Plenty, or even between green kiwifruit growers as the Hort16A variety was enrolled. Likewise, shocks were enrolled into the network in a similar manner. Regardless of the intentionality, Psa was successfully enrolled (i.e. given a meaning) as a result of interaction not only between the non-humans (climate, the bacteria, and a suitable host), but also between the scientists, growers, pollen companies, and others.

The shock itself may be relatively small; however, it enlargens as the effect of shock is multiplied and mobilized by the network. A small occurrence of Psa symptoms in one orchard in Te Puke could have a far-reaching impact on the industry as the inoculums were mobilised across the Bay of Plenty region. A price increase in the central rice market would trigger importation of a million tonnes of rice to Indonesia and create pressures for the farmers. A rumour about a plan to import rice spread and multiplied from one trader and farmer to another to the extent that some speculated by purchasing rice for their warehouses, thus reducing the amount of rice in the market. In both cases, it was not the shock *per se* that shook the network, but the relational effect between actors that enhanced, or exacerbated, the responses.

By the time the shock is fully enrolled, it becomes part of the network. In the process, the shock gains agency. It reconfigures the relationships between actors. Both Psa in the kiwifruit industry and the brown plant hoppers in rice agriculture have proven to be resilient. They were difficult to control and always able to reappear in the network whenever new measures were employed. Yet, their resilience also influences, and is influenced by, the resilience of other actors. The rice pests have found their position in accordance with the dynamics between formulators (agrochemical companies), various types of pesticides, and extension officers in their respective efforts to remain indispensable to the network and the other actors. Without the pests, the role of the other actors would diminish. I do not mean to say that the agricultural companies *intentionally* want the pests to exist. It would be morally wrong. However, it is apparent that the existence of those companies requires reciprocity from the pests. The same is also beginning to happen in the kiwifruit industry as agrochemical companies race to find the most effective sprays to control Psa.

One thing that resilience thinkers and social scientists often fail to recognize is that resilience is enacted not only by human, but also by non-human actors in an equal manner. After Psa, stakeholders of the kiwifruit industry under the leadership of KVH established communication channels so that information from researchers was easily transferred to suppliers, consultants, and growers. The weekly meetings in particular have an important role in enhancing the monitoring and feedback mechanism, which are often seen as a key to a resilient system. However, the (human) actors would not be resilient if the scientific papers, pesticides, technology and machineries, and even meeting rooms were not involved in the process; no strong communication channel would be established and no knowledge acquired and transferred. The same understanding applies to Indonesia's rice agriculture. In the case of the traditional rice community, the support of the communal barn (*leuit si jimat*), the finger knife, and the ancient rice landraces enabled the community to establish and maintain a strong social network. These agricultural artefacts provided something more than just functionality (a knife to harvest the rice, a barn to store the harvest, etc.). They had the agentic capacity to keep the community stable and cohesive. They are examples of immutable mobiles (Law, 1992), i.e. devices that have helped to solidify the existing network for centuries.

This way of understanding the agentic capacity of non-human actors allows us to deconstruct the meaning of capital (human-made, nature, human and social) and its role in building

resilience (Walker et al., 2006). The principle of generalized symmetry (Callon, 1986) asserts that categorization of capital is not necessary. Social capital is equally built by the community and the material objects. Natural capital is more than just water, soil or crop; it is the way these actors connect to human actors in many different ways. The same holds true for other types of capital. From an ANT perspective, the significance of capital emerges from the heterogeneous associations instead of from each individual actor. In the end, this principle is relevant to our discussion because it changes the way we think about how we can build resilience through capital. Instead of seeing non-human actors as just 'passive' capital to be used by humans, we take into account their vibrancy in actively negotiating for positions and influencing the way we make decisions and take actions (Bennett, 2007). In this perspective, resilience is understood and enacted as a hybrid of actions emerging from the heterogeneous associations, rather than as the ability of humans to make use of available capital.

Once the equivalent capacity for agency of both human and non-human actors has been acknowledged, it is necessary to ask how their agency is exerted and so capacity for, or state of, resilience achieved. Although it seems that the general guidelines apply for both the New Zealand kiwifruit industry and Indonesia's rice agriculture in terms of identifying resilience through a wider acknowledgement of agency (equally for the shock, the humans and the capitals), analsyis of the two case studies has illustrated that the way in which resilience is enacted is unique to either agrifood system. As I will show in the subsequent sections, there are various assemblages of human and non-human actors in every locality that enable (and, to some extent, drive) the society to perform resilience. The possibility of association is non-exhaustive, yet some actors prefer a particular configuration of network with others as they seek stability and indispensability. Thus, there are characteristics of agency within every actor-network that are unique to itself. Social resilience is contingent on the environment in which the society lives and the material objects with whom they interact. In other words, the nature and degree of resilience within a community varies according to context. The next two sections are narratives about how rice and kiwifruit manifest resilience as agency within the respective food systems: the former through its diverse meanings, and the latter through its capacity to transform.

8.3.2. Multiplicity and functional diversity

Diversity can come in various forms. At the farm/orchard level, crop diversity (different rice/kiwifruit varieties, different crops, or production methods) is an important factor to

building resilience. At the industry level, diversity not only comes in the form of crop varieties, but also as functional and response diversity of the actors themselves. A diversity of functionally different groups/stakeholders helps increase system performance by providing a variety of expertise and resources on which the system can draw. In the event of another shock, despite executing the same functions, these diverse entities can respond differently thereby increasing the system's flexibility in adaptation to change (Walker et al., 2006).

A further type of diversity is discussed in this section in the guise of an important tenet from ANT that may be seen as aligned with the concept of diversity from a resilience perspective. The case of rice agriculture in Indonesia offers a good example of how the diversity of rice is expressed as a diversity of meanings and actions. As an actor, rice negotiates with other actors in various networks all the time, and by doing so, positions itself in different and changing roles. This creates a multiplicity of rice within Indonesia's rice agriculture that enhances resilience (Mol, 2000; cf. functional diversity posited by Walker et al., 2006), as the following narrative elaborates.

Long before its commoditization, rice has been recognised as part of Indonesians' *cultural identity*. The traditional agricultural community of Kasepuhan is a perfect example of how the resilience of a food system is enacted at the smallest scale through agro-ecosystems (King, 2008). With rice acting as the basis of Kasepuhan local knowledge, a robust network of rice and people has created a system that is sufficiently adaptive to withstand environmental shocks. In many other regions, however, the cultural meaning of rice has been significantly eroded as new modern rice varieties come into play. This is apparent at the farm level where, after the Green Revolution, rice production has been oriented towards more industrialized farming methods directly connected to the domestic, and international, rice markets. However, the deteriorating meaning of rice as cultural identity does not necessarily mean the loss of resilience. On the contrary, it appears that such shifts in meaning provide new ways in which resilience is understood and enacted. The different agencies that rice enacts promote forms of resilience that are specific to particular types of shocks.

The combination of an ever-increasing demand for rice and a new orientation for agriculture have assigned a new meaning to rice, that of *a lucrative commodity*, by which new sets of actors and relationships are being made in a different manner from rice as cultural identity. The relatively stable price of rice in the domestic market, as promoted by BULOG, performs

such agency by assembling a network of rice as a lucrative commodity. As a commodity, rice enrols additional actors to those in the cultural identity actor-network, such as agribusiness firms, research centres, markets and agricultural technology. Because it is an irreplaceable and lucrative commodity, the various actors around rice continuously adapt and negotiate in many ways so as to assure that the whole system functions as expected.

Rice is also an important *political instrument*. As discussed intensively in Chapter 6, both BULOG and RASKIN are illustrations of a successful political power play between rice, the government, the farmers and the majority of lower class society in Indonesia. Rice is recognized as having been a key foundation of social and political stability during Soeharto's authoritarian regime for 32 years (1966 – 1998). Similarly, the realisation of self-sufficiency in Indonesia that coincided with the world food crisis of 2008 (Slayton, 2008), as well as the formative regulatory moves (Fane & Warr, 2009), might be considered as much a political success as a significant agricultural achievement. It is evident from this study's observations that rice is embodied within political economic activities in Indonesia to a greater extent than any other commodity. The material and symbolic embodiment of rice, as a native plant of Southeast Asia, staple food for the population, cultural identity, and commodity for the farmers, is evidenced in its strong integration within, and influence upon, the geopolitics in the region – and *vice versa*, the political economy of rice in Indonesia solidifies the importance of rice for the resilience and sustainability of the overall agrifood system.

In regard to the multiple realities of rice, this thesis follows the discussion initiated by Mol (2002) on the multiplicity of a disease. In her account, multiplicity is never a matter of different perspectives. Multiple realities are produced by particular actor-networks that relate to each other. There can be layers of connections between the actor and others that are shaped by continuous processes of negotiation. This helps to stabilize the actor-networks, embed the multiple meaning(s) deeper within the society and render the system more resilient to potential causes of disruption, as illustrated in the case study described in Chapter 6. Multiplicity can indeed enhance resilience. However, there is no direct causal relationship between the two constructs as there is also the possibility of conflicting practices that hinder resilience overall. The manner through which multiplicity enhances resilience depends on how these realities "… dovetail together […] or include one another in complex ways" (Law, 2008: 152). From an ANT perspective, this means that networks have to be re-negotiated in order for the society to retain resilience.

8.3.3. Transformability and transformative resilience

Unlike rice in Indonesia, kiwifruit does not enact multiplicity (or does so to a lesser extent). Apart from being an export-oriented horticultural crop, the meanings of kiwifruit are limited and poorly diffused. Kiwifruit is not so well-attached to New Zealanders as rice is to Indonesians. However, the kiwifruit industry still seems to struggle for resilience at all cost. The event of 1991 Italian residue crisis accompanying the 1980s price crash (Campbell & Fairweather, 1998) provides evidence of the industry's ability to adapt to shocks and emerge stronger after the crisis. There is also an indication that the industry is able to survive from the recent Psa crisis (Greer & Saunders, 2012), thus again showing some degree of resilience. So what equips the industry to remain resilient?

It should be noted that during the development of the kiwifruit industry, transformation has been an integral part of resilience. The 1991 crisis brought about the emergence of a new marketing entity within the industry under the name of Zespri International Ltd. (Campbell & Fairweather, 1998; Kilgour et al., 2008). Likewise, the Psa crisis initiated a reorganization of the industry through the establishment of Kiwifruit Vine Health Inc. (KVH) and a reorientation of the industry's focus to include vine and orchard health (Greer & Saunders, 2012). It is, then, arguable that to be resilient, it also needs the capacity for renewal, reorganization and transformation (Berkes et al., 2003). But how can a system become resilient and transformative at the same time? The following is my interpretation of how the New Zealand kiwifruit industry demonstrates its resilience through its transformability.

For the kiwifruit industry to be resilient and durable (i.e. still maintaining its basic function as the main producer of a high-value commodity), the actor-network had to undergo periods of transformation during which it increased its capacity to negotiate with, enrol, and exclude actors. I argue that negotiations are required for transformations to happen, based on the agency of two particularly resilient actors within the actor-network, namely the kiwifruit and Psa-V. Both are non-humans; yet both demonstrate the capacity to transform the relationships between actors and influence others, humans in particular, to do many things (Latour. 2005). Kiwifruit provides durability and mobility (Law, 1992) to the network. Psa, on the other hand, acts by being resilient and fluid (de Laet & Mol, 2000). By doing so, Psa helps not only to accelerate transformation, but also build resilience within the actor-network.

Adopting Michael Callon's (1986) four moments of translation (*problematisation*, *interessement*, *enrolment* and *mobilisation*), I propose that the transformative resilience within the New Zealand kiwifruit industry in response to Psa can be understood by analysing the process through what I called 'moments of transformation' (*enrolment, translation, stabilisation*, and *alignment*). For a transformation to happen, the stable network of the kiwifruit industry needs to be disrupted. Psa acts as such an agent when it is enrolled to the network. After the process of enrolment, Psa translates the way actors perceive both the disease and the practices of producing kiwifruit. The situation, most often, raises disputes and conflicts between actors. Actors need to stabilise the network in order to resolve those conflicts. The process involves the enrolment of a new actor that can act as the new centre of calculation (Latour, 1987). In this case, the Kiwifruit Vine Health Inc. (KVH) appears as such a centre. Resolution then requires actors to accept Psa as part of the network, and readjust their positions and actions with regard to it. This is the process of *alignment*. In the end, the process of transformation is a necessary step to be taken by the actors so as to maintain their resilience in the face of Psa.

Was Psa the actor that accomplished all of this? Although excerpts from the interviews demonstrate that this is the case, I argue that the acts of resilience, adaptation and transformation are a collective action of all actors in the network. As actor-network theorists would assert, what is known as Psa is not the bacteria *per se*. Psa is the epitome of that collective action. The meaning of Psa within the society comes from the process of assembling the society (Latour, 2005) from actors such as scientists, bacteria, kiwifruit, wind and rain, growers, Zespri, sprays, and newsletters. Just like Pasteur's bacteria (Latour, 1988), Psa helps to render the social structure, relationships and resilience visible. And just like kiwifruit, Psa is an agent that brings transformation in the industry through the reassembling of new connections, goals, and configurations. The results of the negotiation processes are uncertain. There is no pattern, no future projections. We can, however, define each actor's goals, problems, and identity to enrol the actors to, or dissociate them from, the network – so as to remain resilient and transformative.

8.3.4. The value of actor-network theory

To summarize, one might ask, how does the ANT perspective contribute something new and valuable to the understanding of resilience in the case studies? The value, I suggest, is three-fold. Firstly, ANT blurs the divide between society and nature. Despite the extent to which

the concept of Social-Ecological System (SES) has been used, the traditional resilience framework still assumes that there is a divide between the social and the natural systems (Westley et al., 2002; Kinzig, 2012). Accordingly, it sometimes becomes unclear where the driving force for resilience comes from. If a SES shows to be resilient, is it because the society is able to enact resilience? Or is it the ecological system that provides the basis for this resilience mechanism to happen? This divide also constrains our understanding of shock and capital. Shock is often considered as external, negative, destructive, and something to be overcome. Psa in the kiwifruit sector and brown plant hoppers in the rice sector are such examples. On the other hand, any form of capital (physical, natural, or human-made) is positive, internal, and constructive. However, as the narrative in this section (and in Chapter 6 and 7 in details) demonstrates, these are not necessarily the case. Using ANT, we shift from a focus on the magnitude of a shock and the amount of capital (thus measurability of the natural components), to that on the alignment between actors in the network. I argue that it is important to identify and analyse the involvement of each actor in the enrolment, multiplication, and mobilisation of both the shock and the capital within the network. In order to do so, one needs to strip away all the anthropocentric assumptions and put all actors in a symmetrical position.

This relates to the second value, which involves broadening our view of agency. ANT asserts that agency should be seen not as solely a property of humans, but as originating from the relationality between (human and non-human) actors. It allows us to see more clearly without the pre-assumption that individuals can purposively adapt to shocks by using their wide range of capital. The pitfall of the more conventional assumption is that it treats non-humans as passive objects at the disposal of humans, while in fact non-humans act as vibrant agents that also exert power and influence resilience. The case of Psa shows that the resilience of the industry is limited to the extent that they know how to control the disease. As the outbreak becomes less controllable and more incomprehensible, it hampers the adaptive capacity of the human actors. In the case of pest outbreak in rice agriculture, what builds resilience is not necessarily the volition of humans. As discussed extensively in Chapter 6, the human actors do not seem to purposively work together to build resilience, nor do they have any intention of achieving such a state. Each actor seeks to remain indispensable to others through many examples of negotiations: agrochemical companies looking to increase the sale of their pesticide, banks securing their investments, farmers struggling to survive, or pests

opportunistically benefitting from their pesticide-tolerance. It is the actors' engagement with the network through their various roles that in fact makes the network stable and robust. This shows that agency and resilience is less about intentionality and coordination than it is about relationality and assemblages (Latour, 2005).

Lastly, ANT locates resilience in the locality. Within an ANT perspective, resilience always occurs and is enacted at the local level. This means that, in contrast to the discussions of building social or farm resilience (Folke et al., 2003; Buikstra et al., 2010; Darnhofer et al., 2010), there are no general prescriptions or criteria for a resilient food system. Indonesia's rice agriculture and the New Zealand kiwifruit industry, at times, have proven to be resilient food systems – but they perform resilience differently. In the broad context of Indonesia's food systems, in order to promote resilience, Indonesian society embraces the multiplicity of rice and nurtures these meanings in a balanced way. This means appreciating practices of rice agriculture as a cultural identity while also bringing forth the commercial side of rice production for various growing areas. By contrast, the New Zealand government (as represented by MPI) and the kiwifruit industry (as represented by Zespri and KVH) have prepared for another round of transformation within the industry as a pathway to build resilience and remain sustainable. Either resilience mechanism is unique to the particular agrifood system. Although the general principle may apply, it is only through the specific actors within the localities that the resilience of those agrifood systems can be enacted.

This being said, the latter value described above has also become a limitation of ANT. It captures the dynamics and relationships *a priori*, without any pre-determined definition of resilience. The notion of resilience, thus, becomes subject to the values and norms of the society that embraces it. For the New Zealand kiwifruit industry in particular, resilience becomes an imagery toward which the (human) actors progress. It has become a new catchphrase among the actors that is used to build their optimism post-Psa crisis. For Indonesia's rice agriculture, resilience has not come to the attention of the society because they have already exerted resilience inadvertently. Resilience relates to the complexity of the actor-network that has been woven through various goals and meanings. As the goals dovetail with each other, the actor-network becomes stabilised; rice agriculture is resilient through its quasi-stability. When resilience is brought to a larger scale, it loses its meaning and significance to the local food systems. Resilience at the national level in Indonesia is not the same as resilience at the local, community level; in fact, the former often obscures the

vulnerability of the community (see Neilson & Arifin, 2012). So how should we compensate for this limitation?

8.4. Concluding remark

This chapter has taken an optimistic view on the resilience of the two agrifood systems. Due to their complexity, I argue that both Indonesia's rice agriculture and the New Zealand kiwifruit industy have maintained a degree of resilience in the face of various shocks. Both systems share similarities in terms of their alignment with global food relations. This implies that they are not only influenced by similar types of global shocks, but accordingly behave to some extent in a similar way. Adopting a protectionist policy in the 1970s or trade liberalization in the 1990s were forms of adaptive measures taken by both Indonesia and New Zealand in response to global shocks, but also in accordance with the global configuration. However, the contrasting features of the two agrifood systems (e.g. domestic cf. export-oriented, cultural cf. professionally managed, labour cf. technology intensive) also contribute to the unique ways in which the two systems perform resilience. Multiplicity is the way of Indonesia's rice agriculture to perform resilience, as transformability and fluidity are with the New Zealand kiwifruit industry. Although some general patterns apply, I argue that agrifood systems in different parts of the world demonstrate their own ways of performing resilience in the face of shocks. In the next chapter, I will conclude with a broader view of what a resilient agrifood system looks like, along with some general remarks on the value of employing resilience thinking, food regime theory and actor-network theory in a joint theoretical framework for assessing and performing agrifood resilience.

PART IV: SYNTHESIS

CHAPTER 9 CONCLUSIONS

"The future is moving so quickly that you can't anticipate it. We have put a tremendous emphasis on quick response instead of planning. We will continue to be surprised, but we won't be surprised that we are surprised. We will anticipate the surprise." (Yogesh Malhotra, 1999, as cited in Folke et al., 2002:11)

9. 1. Resilience of agrifood systems: a synthesis

Studies on the resilience of agrifood systems involve a dilemma. On one hand, the analysis of resilience is usually limited to a particular shock or geographic locality where the social and ecological relationships are most obvious (Yorque et al., 2002), such as the farm level (Darnhofer et al., 2010) or catchment area (Allison & Hobbs, 2004). One possible reason is because by the time the studies deal with wider and more complex relations, the meaning and mechanism of resilience likely become vague. On the other hand, complexity ensures that each agrifood system is distinct from others. One cannot compartmentalize agrifood solely into the farm level or consumption level, as these are closely intertwined. Because of this, a resilience framework alone is not sufficient to capture this complexity. This dilemma becomes the rationale for incorporating other approaches that have extensively dealt with the complexity of agrifood systems.

I have chosen to incorporate food regime theory and actor-network theory to resilience thinking in this thesis in an attempt to mitigate this dilemma. The objective is simple. The more we can unravel the complexity, the better equipped we are in anticipating surprises, from both the global and local levels. Each approach has its advantages and limitations; neither is sufficient to address the complexity. In the subsequent sections, I will summarize implications of each theory for resilience thinking, and follow with a synthesis of resilience from the two approaches. Although the synthesis comes from my reflection of the case studies, I extend the discussion by making more general claims as to the applicability of this framework to other agrifood systems.

9. 1. 1. Resilience from a food regime perspective

From a food regime perspective, resilience of an agrifood system can be defined as *the dynamic of an agrifood system to remain viable in the face of political economic forces of the global food relations*. Food regime analysis requires us to shift our point of focus some

distance from the system of interest. By situating the system within its state-space, as offered by food regime theory, we can underpin, in a more structural way, the state of resilience a system is in at a particular moment, the development phase the system is undergoing and the types of external shocks the system is facing. Resilience is shaped through the historical development of both the particular system as well as the larger state-space (food regimes) within which it resides. The global food regimes not only challenge the system through shocks and crises, but also influence the way the system responds and adapts to those crises. Understanding this helps us to identify *when* and *where* a system is said to be highly resilient (or not) and be prepared for such a situation. Of course, there are always variations in the development patterns of each agrifood system, which do not necessarily conform to the dynamics at the global level. Smaller scale variables, such as pest outbreaks, local policies or regional climate, can also influence the system dynamic in conjunction with larger scale variables. That is why we also need a local perspective of resilience.

9. 1. 2. Resilience from an actor-network perspective

From actor-network perspective, resilience may be defined as *a continuous assembling of actor-networks through negotiations between actors so as to maintain the socially-established meaning and function of the network*. Actor-network theory offers a closer look at how resilience is enacted at a particular moment and the active processes that lead to that moment. It does so by rendering agency visible as relationality. This means that the crops, food, pests and diseases, climate and technology have an equal importance to the humans. Resilience is always *in the making* and enacted locally. It is an active and continuous negotiation between actors (the human, the 'shock' and the 'capital'), which together performs agency. The relationships mapped using actor-network theory show the extent of involvement of various actors in the network. This brings a consequence that any policy employed to increase the system resilience will have an impact on the actors within it through different manners.

9. 1. 3. What would a resilient agrifood system look like?

Returning to the narrative in Chapter 1, resilience is about preparing for uncertainties, which means maintaining some flexibility to adapt to changes and shocks. With regard to the two perspectives, I propose that a resilient agrifood system can be characterised by two things. Firstly, a resilient agrifood system should have the capacity to adapt to the changing

variables, from the global to local scale. It should be noted that resilience is expressed differently throughout time, and one cannot say an agrifood system is resilient; rather one might say an agrifood system has the capacity to be resilient in a particular temporal context. The agrifood system should be able to position itself strategically within evolving global political economic regimes. This does not necessarily mean that the individual agrifood system must conform to the global structure no matter how unsustainable it is (although that is one way of seeing resilience; see Holling, 2004 on capitalism and Holling et al., 2002b on mal-adaptive systems). This also means that the system as an entity and the components of the system as agents should create spaces for the growth (and contestation) of an alternative stable state (or a more sustainable food regime) and be responsive to the cross-scale feedback loops that might reinforce or compromise their position.

Secondly, in order to do so, a resilient agrifood system should be able to maintain its function and identity for the interest of the people within the system/network. Actors, both humans and non-humans, should be able to relate to each other and fluently express their goals in a way that ensures successful negotiations and a stable network. A resilient agrifood system should pivot around a crop or food that is also resilient, or at least drives the rest of the actors to be resilient. This implies that there should be strong connections between food/crop, people and nature, which reduce the potential of betrayal/dissociation between the actors. The process of constructing a resilient network, thus, requires a long and effortful pathway. Enrolling a new crop or commodity to a network is not a way to build resilience, no matter how productive the crop would be. I posit that an agrifood system that nurtures the human-food relations within multiple dimensions (not only in an economic context, but also a part of the social, cultural and political relations) will be more likely to maintain its resilience amidst various changes.

Incorporating the two approaches into a resilience framework can also provide a practical insight to unmask some possible false attempts to build agrifood resilience. For example, a productionist endeavour to achieve national food security through ‘landgrabs’, such as the Merauke Integrated Food and Energy Estate (MIFEE) in the eastern part of Indonesia (Neilson & Arifin, 2012), will unlikely be resilient, particularly for two reasons. At the global scale (through food regime analysis), the issue of landgrabbing has been fiercely resisted by a counterhegemonic movements such as La Via Campesina (McMichael, 2009). Although it may seem to fit into the neoliberal regime, the structure of the state-space itself stands on a

shaky ground, and a contracting regime is likely to render the position of the agrifood system precarious. At the local level (through an actor-network approach), the introduction of a new agricultural practice into a region within which the actors (the community and ecosystem) have never had any connection with the commodity before would require a long and effortful negotiation between actors and be subject to betrayal and dissociation of the network (such as the case of scallops; see Callon, 1986), thus reducing its resilience.

On the other hand, constructing domestic-oriented organic agriculture in a developing nation like Indonesia may not necessarily build into a resilient agrifood system, although theoretically organic practices do relate to resilience (Altieri, 2002; King, 2008). Through a food regime analysis, we can identify the way in which Indonesia is situated within a global crossroad between trade liberalization, agricultural intensification, and state protectionism – leaving less space for the growth of alternative food networks. Likewise, organic products come in a fragile position amidst the 'conventional agriculture' actor-network (farmers, agrochemical companies, pests, etc.), thus rendering it more vulnerable to shocks. Of course, not being resilient does not mean that it is something bad. In fact, transformation is often needed to escape from an undesirable state (Walker et al., 2004). One thing that we can take from this understanding of resilience is that in order to build a sustainable and resilient agrifood system, we have to actively create a space, both globally and locally, that would favour the existence of the desirable system and thus become a new stability domain for such a system.

9. 2. A constructive dialogue between three theories

The analysis in Chapter 8 has clearly shown how food regime and actor-network theories offer valuable insights to a novel understanding of the resilience of agrifood systems. But what is the significance of the joint theoretical framework for the social theories? As discussed in Chapter 4, food regime theory and actor-network theory are situated in different paradigms. Debates emerging between the two theories are often brought by the deconstructing nature of each towards the other. A structuralist approach such as food regime theory undermines the role of individual agency, let alone material agency. A post-structuralist (or post-human) approach such as actor-network theory refutes the deterministic idea of structure, pattern and predictability. The two theories both address power relations

within the agrifood chain, but in entirely different ways (see Friedmann & McMichael, 1989; cf. Busch & Juska, 1997). So, is there still any hope of a theoretical dialogue?

Throughout this thesis, I have argued that there is, after all, huge potential for such theoretical merging, in which each theory complements the limitations of the others. Instead of focusing on the contradictions, I have shown through the case studies that using the two theories in conjunction can provide a wider understanding of the dynamics within agrifood systems. This chapter posits that one of the two key points is to shift the focus of the analysis from the hegemonic power of capitalism, stability or relational agency, to the notion of uncertainty.

Since the early development of resilience thinking, uncertainty has always been one of its major tenets (Holling et al., 2002). As mentioned in Chapter 1, the complexity of our current world is imperative to a shift in understanding of sustainability from predicting the future to preparing for uncertainties. The same holds true for the current discourse in food regime theory (Campbell, 2009; McMichael, 2009) and debates around food system failure in general (Rosin et al., 2012). Campbell (2009) highlights the uncertainty of the future food systems amidst the contestation between two global regimes and suggests the opening of spaces for the growth of alternative systems. Within ANT, there is also a shift of focus from strategic negotiations between actors (Callon, 1986) to multiplicity and contingency of relations (Mol, 2000; Latour, 2005). This shift involves similar implications for the understanding of network, from that of stabilized linkages into the form of assemblages (Latour, 2005; referring to Deleuze & Guattari, 1987). Seeing the third food regime from a post-1998 ANT perspective (Law & Hassard, 1998) enables us to build an alternative explanation for the de-stabilization and re-assembling of the current regime. Conversely, food regime analysis provides a shape for the 'amorphous' global actors (Friedland, 2001) that ANT leaves unexplored. Thus, global, institutional entities such as transnational corporations, the WTO and even global capitalism are actors (or, to use Krarup and Blok's (2011) term, quasi-actants) to the same extent as farmers, crops and pests. The principle idea of these new politics of uncertainty (Moran, 2011) is to identify as many actors and unravel as many possible relationships – at both the global and local levels – as we can with the objective of enabling resilience or transformation and helping to anticipate surprises (Yorque et al., 2002; Folke et al., 2003).

Another key point that might constructively link the two social theories (and potentially resilience thinking) is putting 'food' back at the centre of analysis. Even without referring to ANT's conception of material agency, many prominent studies within the political economy of food have already put strong attention on the centrality of food and the power relations circulating around it (see, for instance, Mintz, 1985 on sugar; Friedmann, 1993 on wheat; Dixon, 2002 on chicken). Although political economic discourses still play a central role, the literature also offers, perhaps inadvertently, some sense of the materiality and agency of vibrant matter (such as shown in Bennett, 2007). For instance, there would be no hegemonic power if not for the durability of the grains that facilitates their transport over long distances (Friedmann, 1993) or for the ability of sugar to stimulate human physiology in the context of a growing working class society (Mintz, 1985). This materiality remains relevant for food as it is currently manifested through its multiplicity as fuel, finance, feedstuff or source of social-political movements (McMichael, 2000). Food, thus, can embody a politics of perpetuation and resilience (such as the case of rice and wheat; Friedmann, 1993), or renewal and transformation (such high-value and organic food as kiwifruit).

A last point relates to the three important tensions within the social studies of agriculture and food, which repeatedly were manifest in the previous chapters. Here, I want to highlight how the joint theoretical framework has bridged the dichotomies between global and local, structure and agency, as well as society and nature. Firstly, a link between global food relations and local actions (and consequently between structure and agency) is represented by the notion of panarchy. Panarchical relations provide a space of merging for a food regime and actor-network theory based on its basic premise: the dynamic of the focal system is shaped by both the encompassing structure and the agency of the local actors (see Figure 4.1 and 9.1 below). In terms of the society-nature dichotomy, Campbell's (2009) and Friedmann's (2005) concern with the relevance of ecology in times when environmental repercussion has become a major driving force for transformation is clearly accommodated by resilience thinking's Social-Ecological Systems (SESs) (Walker et al., 2004). The notion illustrates two distinct systems that, although separated, function interdependently. However, actor-network theory goes further by asserting that even the boundaries between the two systems are vague when seen as heterogeneous networks (Law, 1992). In this sense, nature (or food, water, disease, or climate as parts thereof) can and does intertwine with society in many ways, regardless of the attachment of these parts to the ecosystem. The two case studies

have shown that these conceptual linkages between and within the three dichotomies do have an empirical value in understanding whether and how a system is resilient. In the end, the conceptual framework constructed through a dialogue between the three theories has proven to be valuable, without which our understanding of the resilience of agrifood systems would be less satisfactory.

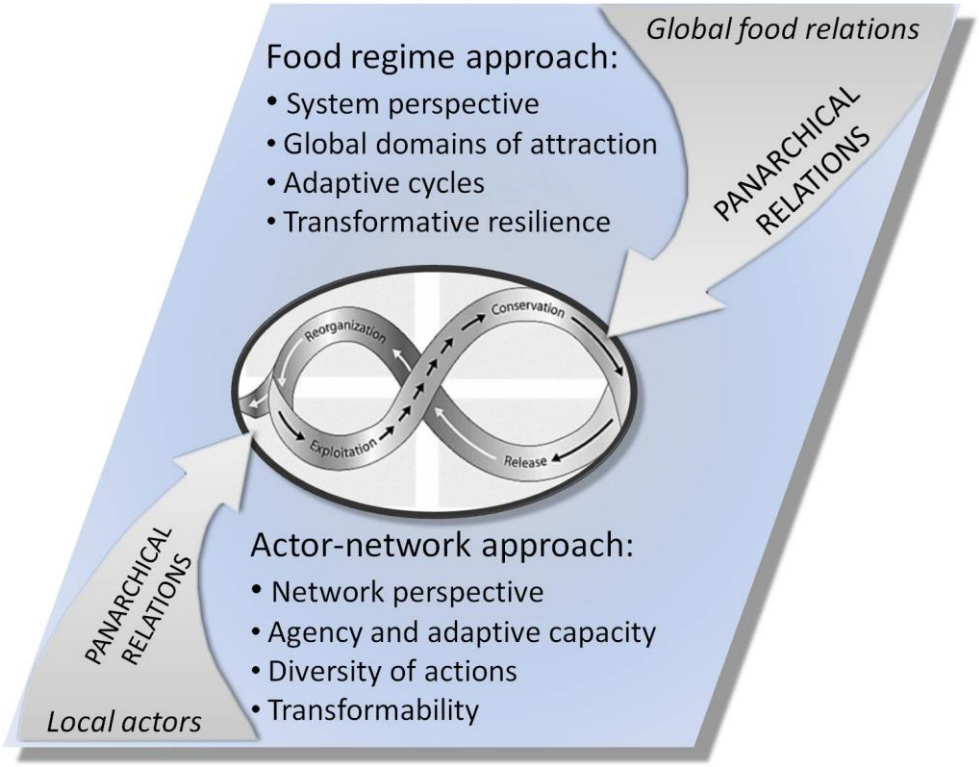

Figure 9.1. A two-way approach in assessing the resilience of agrifood systems (see also Figure 4.1)

9. 3. Future ontological journey

The last section in this chapter opens a space for another, perhaps deeper, question. What should we look for afterwards? One of the main findings of the thesis is that each agrifood system is unique to its locality. Resilience is enacted or accomplished differently in each system in context with its locality and temporal situation and circumstances. A combination of factors, from the assemblages and interactions of the local actors to the continually shifting global relations, sets and perpetually shifts the context for specific resilience in every agrifood system. Context, I argue, becomes the key principle to understand this complexity. One can examine, for example, the differences between the resilience performed in an agrifood system in sub-Saharan Africa (Challinor et al., 2007) and on the Indo-Gangetic plain

(Aggarwal et al., 2004) as both face similar issues of climate change. Will rice agriculture in other Southeast Asian countries (e.g. Thavat, 2011) show similar features with that in Indonesia? Or will similar indispensable crops such as maize in Central America also enhance the resilience of those societies? In the end, the value of this conceptual approach lies on the continued attention to the emergent nature of resilience within changing contexts – between global and local scales, social and ecological systems and structure and agents. Thus, case studies of Indonesia and New Zealand offer an illustration of resilience specific to those agrifood systems at particular moments in their development. The dual approach to resilience demonstrated in this thesis provides insight to the unique features in every agrifood system, taking into account the contextual factors of locality and temporalities. In this manner, this dual approach to resilience enriches the emerging theorisation of resilience especially as relevant to diverse agrifood systems in different parts of the world.

I suggest that the application of the research framework to other agrifood systems has the potential to reveal resilience mechanisms as being more complex than the sum of shocks and system properties alone. This finding reinforces the understanding that local, regional and global contexts are necessary to assess whether (and the extent to which) an agrifood system is resilient. This thesis has elaborated a model and set of considerations that provide a more effective means of considering and accomodating context within the understanding of and planning towards a greater capacity for agrifood system resilience.

The theoretical framework, however, is not the ultimate endpoint; this thesis encountered findings that do not necessarily fit to the theoretical framework. For example, processes of market creations in both cases might better reflect an assemblage (due to its precarious and de-stabilizing nature), to which assemblage thinking (Deleuze & Guattari, 1987; Lewis et al., 2013) offers a relevant framework. Likewise, the ethical positioning of the human actors in negotiating for strategies is better addressed by conventions theory (Boltanski & Thevenot, 2006; Rosin, 2006). This thesis has been a reflection of my ontological journey so far, in which I engaged with, and learned from, different perspectives and ways of thinking that were previously unfamiliar to me. Given that such journeys are commonly experienced (Law & Urry, 2005; Campbell & Rosin, 2011), I argue that in developing the concept of resilience and sustainability – for various different (and changing) contexts, both in theoretical and practical senses – it is essential to experiment with new approaches and perspectives (or more

specifically social theories) that may offer a more comprehensive understanding of the system in question.

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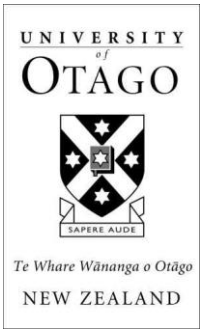
APPENDIX 1: Example of Information Sheet and Informed Consent Form

[Reference Number *as allocated upon approval by the Ethics Committee*]

[*Date*]



"IDENTIFYING THE RESILIENCE OF NEW ZEALAND KIWIFRUIT INDUSTRY IN THE FACE OF INCOMING PSA DISEASE"

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

This project aims to investigate the way New Zealand's kiwifruit industry as a collaboration of different stakeholders (growers, pack houses, ZESPRI™, workers, etc.) perceive and respond to the prevailing Psa disease. This project is being undertaken as part of the requirements for the degree of PhD at the University of Otago. This work has been funded by the University of Otago.

What Type of Participants are being sought?

Participants will be representatives from all stakeholders involved in New Zealand's kiwifruit industry, and particularly in the management of Psa disease.

The research project is expected to provide benefits for you and for New Zealand's kiwifruit industry in general in the form of information and evaluation to assist industry stakeholders in decision making and policy development in relation to Psa management.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to participate in an interview. This will require personal involvement from you, and will take between 1-3 hours. The interview will be informal and discuss aspects of the kiwifruit industry and the Psa infestation. The general line of questioning will include:

- What were the set of relationships in the industry like before Psa-infestation, and how did they function?
- How do you perceive, and engage with, Psa?
- How do you communicate to, and interact with, different stakeholders with regard to this shock?
- Are there any new stakeholders emerging and how are relationships with these new stakeholders being shaped?

However, this project involves an open-questioning technique; thus the precise nature of the questions which will be asked have not been determined in advance, but will rather depend on the way in which the interview develops. Consequently, although the University of Otago Human Ethics Committee is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used.

In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s) and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

Participants will be audio-taped and transcripts of the interview will be written up by the interviewer. Transcripts of your interview will be made available to yourself to check over. Transcripts will be used to ascertain how Psa affects the behaviour of stakeholders in the kiwifruit industry.

You may be contacted for a second meeting after the interview data is transcribed, so that you can review the interview transcripts for any false assumptions that the interviewer has made, or for any changes you want to make to your statements.

The data collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

You are most welcome to request a copy of the results of the project should you wish.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand). Every attempt will be made to preserve your anonymity.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Angga Dwiartama (Student)	and/or	Hugh Campbell
CSAFE, Department of Geography		Department of Sociology, Gender, and Social Work
(03) 479-8294		(03) 479-8749
dwian039@student.otago.ac.nz		hugh.campbell@otago.ac.nz

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

[Reference Number *as allocated upon approval by the Ethics Committee*]
[Date]

"IDENTIFYING THE RESILIENCE OF NEW ZEALAND KIWIFRUIT INDUSTRY IN THE FACE OF INCOMING PSA DISEASE"

CONSENT FORM FOR

PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. Personal identifying information, including any audio recordings, will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which they will be destroyed;

4. This project involves an open-questioning technique. The general line of questioning includes how I perceive and adapt to Psa, as well as the way I interact with different stakeholders regarding such matter. The precise nature of the questions which will be asked have not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable I may decline to answer any particular question(s) and/or may withdraw from the project without any disadvantage of any kind;

5. This research is a part of the ARGOS Research Project that is affiliated with ZESPRI™.

6. Publications arising from this work may use selected quotations or narratives from my interview to illustrate the findings. Quotations will be identified only by my specific role in the industry (e.g. growers, workers, pack houses, etc.).

7. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) and ARGOS Research report repositories, but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

....
(Signature of participant) (Date)

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.