Private sector adaptive capacity to climate change impacts in the food system: food security implications for South Africa and Brazil

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Abstract

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Achieving food security under climate change is one of the biggest challenges of the 21st century. The challenge becomes even greater when contextualised within our current limited understanding of how the food system functions as a complex, adaptive socio-ecological system, with food security as one of its outcomes. Adding climate change into this already complex and uncertain mix creates a 'wicked problem' that must be solved through the development of adaptive food governance. The thesis has 4 key aims:

1. To move beyond an understanding of food security that is dependent solely on agricultural production, and therefore the reliance of future food security predictions on production data based on climate model inputs.

2. To ground the theoretical aspects of complex adaptive systems with empirical data from multi-level case studies.

3. To investigate the potential role of the private sector in food system futures.

4. To analyse food system dynamics across scales and levels.

In order to realise these aims, a complex adaptive system (CAS) approach within the GECAFS food system framework is employed to multilevel case studies in South Africa and Brazil. Particular emphasis is placed on the role of the private sector and how these vital actors, comprising a powerful component of the global food system, can be mobilised towards building adaptive capacity for a more resilient food system. Critically, the private sector is often left out of academic discussions on adaptation, which tend to focus more on civil society and governmental capacity to adapt. This thesis provides novel insight into how the power of the private sector can be harnessed to build adaptive capacity.

The findings of the thesis showed that applying CAS to issues of governance has three important implications:

The first is that in a complex system, it is critical to maintain diversity. This can translate into appreciating a multiplicity of viewpoints in order to reflect a range of decision-making options. This finding makes the case for closer synergy between the public and private sectors around areas like product development and distribution that includes an emphasis on enhancing food security under climate change. In the developing country context, the inclusion of smallholders and local entrepreneurs is also vital for building adaptive capacity. In this sense, it is possible for business to help achieve development goals by developing the capacity of those most vulnerable to socio-economic and environmental shocks.

Secondly, adapting to climate change and other environmental and economic pressures will require a shift in mind-set that embraces the uncertainty of the future: 'managing for uncertainty rather than against it'. This entails a shift in governance mindset away from linear thinking to a decision-making paradigm that is more flexible to deal with unexpected shocks.

The third implication for governance is the need to understand the complex interplay of multiple interlinking processes and drivers that function across many levels and sometimes have exponential positive feedbacks in the food system. Adaptive governance is an iterative process, but as more is learnt and information is retained in the system, the ideal is that the beneficial processes that lower inequality and increase food security will start to be reinforced over those that entrench the current inequality in the food system.

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Figure 1: Advertising chickens in Mpumalanga, South Africa

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Acronyms

ACSA	Accumulated Credit and Savings Association
ACTESA	Alliance for Commodity Trade in Eastern and Southern Africa
AEZ	Agro-Ecological Zones
AHDSS	Agincourt Health and Demographic Study Site
BLS	Basic Linked System
BOVESPA	Bolsa de Valores de São Paulo (Brazilian Stock Exchange)
CAS	Complex Adaptive System
CAWMA	Comprehensive Assessment of Water Management in Agriculture
CEO	Chief Executive Officer
COMESA	Common Market for Eastern and Southern Africa
CONAMA	Conselho Nacional do Meio Ambiente (Environment National Council)
COP	Conference of the Parties (to the Kyoto Protocol)
CSER	Corporate Social and Environmental Responsibility
CTT	Causal Texture Theory
DOA	Department of Agriculture (South Africa)
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)
ENSO	El Niño Southern Oscillation
ESSP	Earth System Science Partnership
ETHOS	Instituto Ethos de Empresas e Responsabilidade Social
FAO	Food and Agriculture Organisation

FARM	Future Agricultural Resources Model
FDI	Foreign Direct Investment
FEWS NET	Famine Early Warning Systems Network
GDP	Gross Domestic Product
GEAR	Growth, Employment and Redistribution Program
GEC	Global Environmental Change
GECAFS	Global Environmental Change and Food Systems
GEO4	Global Environmental Outlook, volume 4
GMT	Global Mean Temperature
GRI	Global Reporting Initiative
GTAP	Global Trade Analysis Project Model
GLZ	Generalized Linear Model
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Access Scale
IAASTD	International Assessment of Agricultural knowledge, Science and Technology for Development
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
IFS	International Simulation Model
IFSS	Integrated Food Security Strategy
IIASA	International Institute for Applied Systems Analysis
IBGC	Instituto Brasileira de Governança Corporativa (Brazilian Institute of Corporate Governance)
IMF	International Monetary Fund
IPCC	International Panel on Climate Change
JSE	Johannesburg Stock Exchange
MA	Millennium Ecosystem Assessment
MDG	Millennium Development Goal
NAMC	National Agricultural Marketing Council (South Africa)
NEMA	National Environmental Management Act (South Africa)
NGO	Non-governmental Organisation
NGP	New Growth Path
NWA	National Water Act (South Africa)
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development

PROGER	Programa de Geração de Emprego, Trabalho e Renda (Employment and Income Generation Programme)
PROGRAMA MODER-FROTA	Programa de Modernização da Frota de Máquinas e Equipamentos Agrícolas (Programme to Modernise the Fleet of Agricultural Machines and Equipment)
PROMAF	Projeto de Modernização da Administração Financeira (Programme to Modernise Financial Administration)
REDD+	Reduced Emission from Deforestation and Forest Degradation
RDP	Reconstruction and Development Programme
SAB	South African Breweries
SAP	Structural Adjustment Programme
SBSTA	Subsidiary Body for Scientific and Technological Advice
SES	Socio-Ecological System (Please note that only in **Chapter 4**, SES refers to socioeconomic status)
SRL	Sustainable Rural Livelihoods
SSA	Sub-Saharan Africa
SWOPSIM	Static World Policy Simulation Model
UNFCCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture
WBCSD	World Business Council of Sustainable Development
WHO	World Health Organisation
WFP	World Food Programme
WTO	World Trade Organisation

Chapter 1

Modelling approaches in the Food System

1.1 Introduction

The food system and its ability to provide food security have become headline news over the past few years. In 2011, the Economist published a Special Report on Food: "Enough to go around?" on 24th February and the Financial Times ran a 'World Food' special report on Friday 14th October. The link between the food system and climate change has also recently been acknowledged internationally. At the recent Conference of the Parties to the Kyoto Protocol (COP 17), the UNFCCC (United Nations Framework Convention on Climate Change) adopted a decision on agriculture for the first time (although agriculture has still not been formally included in the decision-making process due to objections from various countries) and the SBSTA (Subsidiary Body for Scientific and Technological Advice) officially put agriculture on its agenda. Despite this albeit slow progress at the international level, the focus on the linkages between food security and climate change remains heavily biased towards agriculture- as shown in the FAO's new emphasis on 'climate-smart agriculture' as the key to promoting food security and development whilst simultaneously addressing environmental concerns[1]. This has reinforced modelling as the

[1]See `http://www.fao.org/climatechange/climatesmart/en/` for more information.

primary method for assessing food security under climate change.

This thesis aims to shed some light on the complexity of the whole food system, which often makes tackling issues of food security difficult- especially when the issue of climate change is included. Coming to terms with this uncertainty is critical if the food system is to adapt to a future made even more uncertain by climate change. Furthermore, this 'coming to terms' can only effectively occur if the food governance system itself becomes adaptive. Using case studies from different levels of the food system, this thesis cuts through these issues in order to start answering the question of how the food system could adapt so as to provide food security under climate change.

1.1.1 The problem of an increasingly globalised and complex food system

The global food system is complex, not least because it amalgamates the global economic and financial systems with environmental systems comprising the natural resource base on which agriculture is dependent. Even this mode of analysis fails to consider the socio-political, cultural and legal aspects of food as a necessity for human life and its concomitant understanding as a human right. Eakin *et al.* (2010) capture these tensions as conflicting notions of food as a commodity, as a human right and as an ecosystem service. Understanding the food system as an entity in which human and natural systems interact, Ericksen (2008*b*) suggests that food systems can best be conceptualised as socio-ecological systems (SESs): "co-evolved [systems], with mutually dependent and interacting social and ecological components and highly uncertain and unpredictable outcomes" (Ericksen, 2008*b*: 237). There are multiple constructions around food for its production, transformation, distribution, consumption and regulation. This further emphasises that we are not dealing with simple, linear processes as understood through a conventional supply chain. Rather than a simple chain from production through to consumption, the current food system is a network, consisting of feedbacks and nonlinear relationships defined by concentrations of power and resources across different scales and levels. The evolution of the food system from simple, traditional practices to a globalised super-system complicates its governance, which has been developed and implemented for a linear, less complicated system. On top of this complexity, further challenges are presented by non-linear global environmental changes that are currently being experienced by the Earth's system: from climate change through to natural resource depletion and pollution, these changes require action or their mismanagement could spell disaster in the

long-term (Rockström *et al.*, 2009).

As researchers, we are becoming aware of the problems faced in trying to conceptualise this complexity in a manageable, yet still relevant manner. Breaking out of paradigms is not easy: the food security discourse is a prime example of how embedded ontologies and practices inform the formulation of the research agenda and thus how research is conducted without regard for more relevant alternatives. Deep-rooted disciplinary approaches can also be problematic as they are often not holistic. Climate change modellers, economists, soil scientists and development specialists all have relevant contributions to make to food system studies, but can find it difficult to bring their expertise together in a meaningful way. Often left out of the academic debate are those that are shaping the system themselves- the individual smallholder farmers and entrepreneurs, large agribusiness multinationals, retailers, commercial farmers and wholesalers, and countless other actors.

One of the biggest current challenges is ascertaining the effect that climate change is going to have on the ability of the food system to deliver secure outcomes in the future. The most common method of answering this question is through the development of models. The next section of this chapter aims to assess critically the utility of models in aiding our understanding of the food system and its ability to provide food security under climate change. It demonstrates what models can show us and how they have contributed substantially to our knowledge of the food system, but also where there are significant gaps in our knowledge that models cannot fill. These gaps are mainly around issues of complexity and uncertainty about the future that are inherent in our global food system. Figure 1.1 illustrates how conducting research on the future of the food system under climate change is currently carried out: models from different disciplines are combined under various assumptions of how they relate to each other in the context of the food system in order to provide an output of future predictions of crop production and food prices within a certain degree of certainty. Unfortunately, regardless of how apt the initial models are, there is a loss of information regarding their assumptions and their measurement of certainty as soon as they are combined across disciplines not least because they are often designed to function at different spatial and temporal scales (Cash *et al.*, 2006). On top of this is the fact that the food system comprises more than the economy, climate and crop responses, which can be quantified and modelled (Ericksen *et al.*, 2010). This 'black box' of other elements is arguably more important to try to understand and is why modelling is not always a particularly useful tool for decision-making. An alternative approach that incorporates these issues can be found in complex adaptive systems theory, which is discussed with reference to the global food system in the

latter part of this chapter. The implications of complex system characteristics highlight the inadequacy of models and linear thinking, the need to combine qualitative data to complement quantitative data and the importance of a multiplicity of perspectives (Berkes *et al.*, 2003: 5).

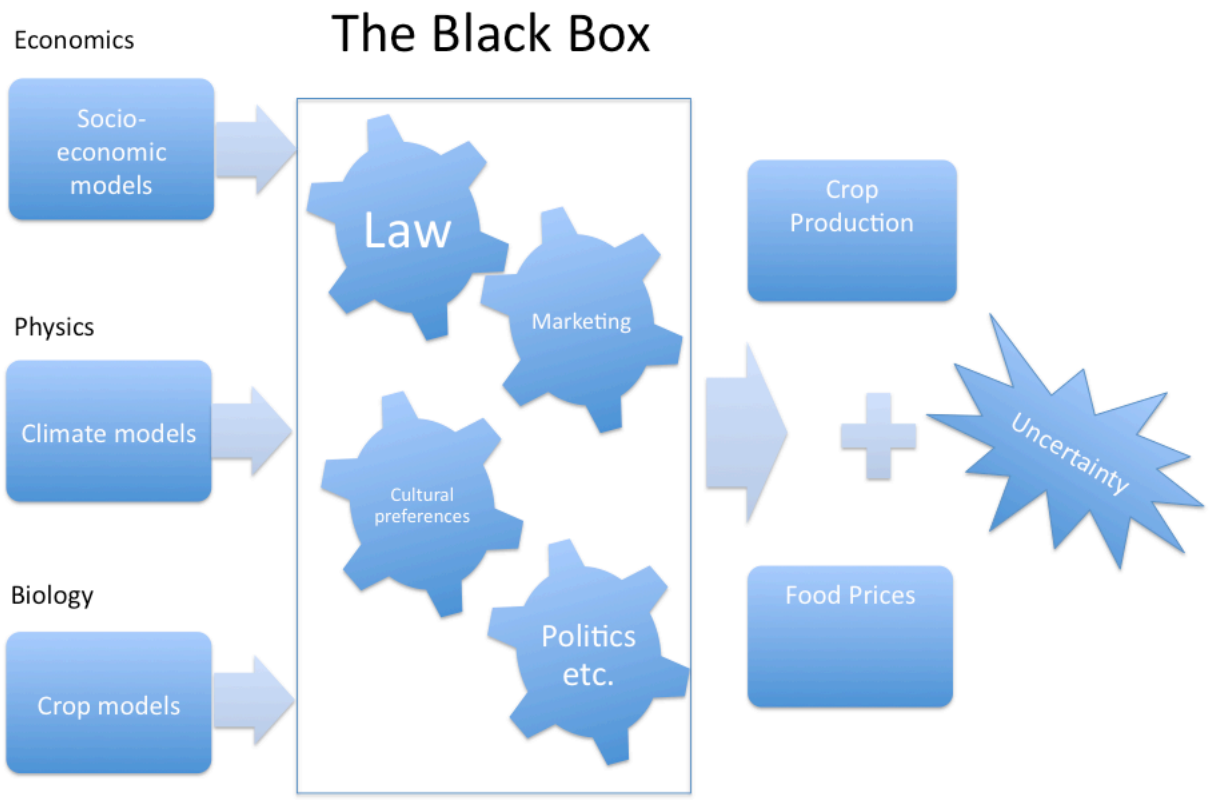

Figure 1.1: Current conceptualisation of modelling the food system under climate change. (Source: Author's own)

1.1.2 Thesis aims and key questions

This thesis has four key aims that are set out below together with the thesis chapters that deal with them.

1. To move beyond an understanding of food security that is dependent solely on agricultural production, and therefore the reliance of future food security predictions on production data based on climate model inputs. *Chapters 1,3 and 5*

2. To ground the theoretical aspects of complex adaptive systems with empirical data from multi-level case studies. *Chapters 2, 3 and 4*

3. To investigate the potential role of the private sector in food system futures. *Chapters 3,4, and 5*

4. To analyse food system dynamics across scales and levels. *Chapters 5 and 6*

In order to achieve these aims, the thesis has 8 key questions that together go towards achieving these aims. These are also set out below with reference to the chapters that answer them.

1. How is our current understanding of food security under climate change aided/constrained by models? *Chapters 1 and 5 (Section 5.1)*

2. How does a complex adaptive systems (CAS) approach complement our current understanding of food system futures? *Chapters 1 and 2*

3. What role does the private sector play in achieving food security across scales and levels? *Chapters 3 and 5*

4. What evidence from the private sector shows that the food system is complex and adaptive? *Chapter 4*

5. What are the implications of these findings for adaptive food governance? *Chapters 4 and 5*

6. What mechanisms for adaptive food governance can be identified in the food system? *Chapters 3 and 5*

7. What are the drivers of adaptation across scales and levels in the food system? *Chapter 6, but drawing from evidence in Chapters 3,4 and 5*

8. What broader conclusions about food system futures can be drawn from this analysis? *Chapter 6*

The remainder of this chapter is divided into four sections. The next section (*Section 1.2*) provides the analysis for aim 1 - *To move beyond an understanding of food security that is dependent solely on agricultural production, and therefore the reliance of future food security predictions on production data based on climate model inputs* by answering key question 1- *How is our current understanding of food security under climate change aided/constrained by models?* As such, it briefly introduces modelling as a tool for understanding questions of climate change and its impacts on food production. It describes the usefulness of models as explanatory tools in science where uncertainty and assumptions are understood versus their application to decision-making where they are valued for their predictive value. This section focuses on the challenges associated with integrating climate change models with economic models where it reaches the conclusion that although individually they can be useful, scale mismatch can make it problematic for them to be combined in a realistic reflection of reality. It offers a critique of a conceptual bias towards approaching the food system through the use of models, which lays the foundation for the following section that deals with key question 2- *How does a CAS approach complement our current understanding of food system futures?*

In *Section 1.3* the concept of the food system as the unit of analysis for discussing food security is introduced. It shifts the focus away from a preoccupation with agricultural production to take other elements of the food system (e.g. pricing, distribution) into account. It is arguably feedbacks from other parts of the food system that drive production because farmers respond more to economic drivers like prices than to environmental conditions (Liverman, 1986) (this is further elaborated in **Chapter 5**, *Section 5.1*). In this section, the food system approach is taken back to its roots in socio-ecological and complex adaptive systems thinking and I propose these as better conceptual tools through which to come to terms with the complexity and uncertainty in the food system under climate change. The research agenda for the rest of the thesis is then outlined.

The fourth section (*Section 1.4*) provides an overview of the methods used in the study and the rationale behind the two-country comparison and the final section (*Section 1.5*) outlines the remainder of the thesis.

1.2 Models and modelling

"Mathematics proves, science struggles merely to describe" (Smith, 2007: 159). However, we still rely on science's predictive powers that allow us to see into the future. This stems

from an underlying belief in a set of physical laws governing natural processes like the weather and tides (Lorenz, 1995). Models fulfil both a predictive and an explanatory role. When it comes to climate change, adaptation requires detailed projections of future climate variability mainly at the regional scale; notwithstanding nonlinearity and chaos, the only tools that we have for understanding the climate system lies in the inelegance of mathematical models (Collins, 2007). This section is concerned with describing chaotic models because they "force us to accept that some of our goals are unreachable given the awkward properties of non-linear systems" such as the climate and economy, but that the insight that we gain through understanding how these systems do (or do not) work extends beyond science and equips the climate modeller to explain the current limit of our knowledge (Smith, 2007: 159).

Models can be divided along many lines, but probably the most useful classification is between linear models and non-linear models. Linear models are by far the most prominent (e.g. general linear models used in statistics), but there is an increasing recognition that nature is seldom linear and predictable, rather that it demonstrates relationships with a disproportionate response between states, i.e. non-linear. Processes in ecology, economics and epidemiology are dominated by nonlinear phenomena and uncertainty (Berkes *et al.*, 2003). These systems require non-linear models, which can either be stochastic or deterministic. Stochastic models are subject to random external factors whereas in deterministic models, the initial state determines all future states under iteration (Lorenz, 1995). Deterministic non-linear models can be either periodic or chaotic. As climate models are chaotic, for the purposes of this section, I will discuss the implications of forecasting in chaotic, dynamic systems. Non-linearity, complexity and fractality have been grouped under the term 'chaos' although they are not all strictly the same; they are related concepts (Lorenz, 1995).

A mathematical dynamic chaotic system is deterministic, non-linear and has sensitive dependence i.e. it is sensitive to initial conditions- see 'the butterfly effect' first published by Lorenz (1979). Being chaotic does not mean that a system is unpredictable; rather it means that uncertainty needs to be dealt with in a different way to how it has been dealt with so far in statistics, which has co-evolved with linear thinking (Smith, 2007). Understanding and communicating how uncertainty is handled in models is critical if decisions are to be made based on their outputs (Slingo *et al.*, 2005). This is especially true for long-term forecasts because uncertainty in non-linear models grows as we predict further into the future (Smith *et al.*, 1999). How this uncertainty is understood and dealt with in chaos theory has important implications for how we understand climate and

economic models; and also highlights the limitations of what we can usefully forecast.

There is a fundamental difference between mathematical dynamical systems, which consist solely of an iteration of numbers and physical dynamical systems, which are representations of the real world consisting of noisy measurements (noise here refers to the difference between what is observed and the 'true' value- if such a value exists), although both are essentially numerical. When dealing with the climate or the economy, we are dealing with 'real-world' systems, the models of which will always contain noise and which will always contain an element of uncertainty. Identifying and then quantifying that uncertainty is the challenge. In terms of climate change models, Hawkins and Sutton (2009) provide a good overview of uncertainty, noting three sources: the internal variability of the climate system (i.e. natural climate fluctuations without radiative forcing), model uncertainty (how different models simulate different changes in climate in response to the same radiative forcing) and scenario uncertainty (the uncertainty of future emissions resulting in uncertainty in future radiative forcing). They show that over small spatial scales and shorter time scales (10-20 years), internal variability contributes the most to uncertainty, but that over many decades and over regional and larger scales, model and scenario uncertainty are the dominant sources of uncertainty. It is uncertainty of the latter category that has implications for adaptation.

How we measure this uncertainty is of key concern. The mainstay of measuring model error in statistics is by using least squares; a good fit model has a minimal distance between the forecast and the target. This holds under conditions where the model is linear and observational noise has a bell-shaped distribution. However, these conditions do not hold for non-linear model parameters and so more non-traditional methods must be sought. Some alternatives include Lyapunov exponents, however these can be extremely difficult and time-consuming to measure and are limited to infinitesimal uncertainties (see Ziehmann *et al.*, 2000). Another option is to ground climate models in historical data through backcasting, which is essential if we are to quantify changes in certain phenomena of interest (Smith, 2002). This is not a perfect solution for a lack of future observational data, but at least it provides some idea as to the utility of the model.

Ensemble forecasts have been presented as the best solution for handling all three types of uncertainty (see Collins, 2007; Tebaldi and Knutti, 2007; Frame *et al.*, 2007 for an in-depth discussion from Bayesian and frequentist perspectives). These consist of a collection of iterations either with different initial states, different parameter values or a different model design. For decision-making purposes, ensembles that explore uncertainty could provide a lower bound on the maximum range of uncertainty (Stainforth *et al.*,

2007). In physical systems, there are no perfect models and in their absence, there can be no perfect ensemble and therefore no accountable forecast scheme (Smith, 2007). However, moving from an understanding of models as surrogates for reality to using them to tease out useful relationships between observable phenomena and things we want to forecast is a significant step that has been made in the climate modelling community (Allen, 2003).

Ensemble forecasts of alternatives consistent with current knowledge can inform decisions, but climate modelling also contains the 'what if' of the changing parameter value of CO_2, which changes the attractor value of the model and adds another source of uncertainty (Smith, 2007). The system and the model have different attractors, which are generally defined by the dynamics of the system over long periods of time (durations similar to the time it takes the system to return near to the same point in state space, which for the earth's atmosphere has been estimated to be longer than the lifetime of the planet- see van den Dool in Smith, 2002). Under constant forcing, uncertainty in the initial condition would result in increasing uncertainty over time and the ensemble of initial states will therefore spread out over "the attractor" (Smith, 2002: 2490). Under transient forcing, there would be no attractor; a perfect ensemble would spread out over time, but not be attracted to any fixed point (Smith, 2002). "Climate is therefore always a distribution" (Smith, 2002: 2490), but only large ensembles of Global Climate Models (GCM) predictions (as opposed to simpler energy balance models or earth system models of intermediate complexity) sampling the widest possible range of uncertainties can provide a reliable specification of spread of possible regional changes in climate (Murphy *et al.*, 2004).

The key point of this brief discussion is that there is a trade-off to be made between the traditional approach to climate modelling, which has been to run ever-more complicated models yielding a single 'best guess' and running ensembles of much simpler modes taking into account different initial conditions (to deal with 'chaos'), different parameterisations and parameter values (model tuning) and different model structures (to cope with model error) (Smith, 2002). Statistics is impotent to deal with pattern complexity, especially in social structures (Hayek, 1999). However, given the discussion, although it is less able to provide us with certainty, examining the distribution of ensemble models can provide us with an idea of the sensitivity of the system and a lower bound on how much trust to place in the results (Smith, 2002).

Climate model ensembles display a huge diversity, suggesting a large uncertainty in the future of the 'real' climate and also question how our current climate models can downscale to the regional level, which is what would be of most value for decision-making.

Furthermore, statistics with any economic interest cannot be computed because statistics calculates uncertainty in the mean, but says nothing about the likelihood of actual day-to-day variation, which is where economic returns lie (Smith, 2002). At the same time, however, recognising these constraints is extremely important in generating useful models and recognising the limits of their explicative powers. Rather than providing cut-and-dried answers, understanding how uncertainty arises in chaotic systems reinforces the fact that difficult decisions about climate change will need to be made despite this uncertainty and that neither this nor 'imperfect' models provide an excuse for inaction. Frame *et al.* (2007) advocate for moving from overconfident science that aims to make robust claims with tight error bars towards a more 'underconfident' science that errs on the side of caution so as not spuriously to exclude possible 'true' values of future climate.

The next section provides a brief review of climate-crop models; what they have shown us, but also how they have been extended beyond their usefulness through an over-reliance on their predictive power (especially when combined with economic models), rather than for their explanatory usefulness.

1.2.1 A brief review of climate-crop models

One of the most widely used tools for assessing the relationship between climate change and food production are climate crop models. These aim to assess the relationship between climate variables and crop production or yield and can therefore be used to project possible future crop systems under different scenarios. Climate crop models involve in their simplest form, a climate model, which produces the climate input variables (temperature and precipitation) for a crop model that defines the relationship of these inputs with the final output of crop yield or production within a set of parameters. However, the first major challenge is that climate models and crop models were designed separately and function at different scales. This leads to scale mismatch. Traditional crop models were originally designed for use at the field level, at a high spatial resolution where lots of input variables and parameters are known or can be directly measured, making the crop model very specific. On the other hand, climate models operate mainly at the global scale (e.g. Global Circulation Models (GCMs) and Atmosphere-Ocean GCMs (AOGCMs)) and sometimes at the regional scale (Regional Circulation Models (RegCMs)). This disparity can either be ignored and dealt with through post-processing (e.g. through a weather generator or by applying climate model outputs to observed climate) or solved through downscaling *ab initio*, but in both cases it means that the traditional suite of crop models

for field-scale simulations are not all suitable for regional climate crop projections under climate change and so models with low input data must be designed or selected for (Challinor *et al.*, 2009). Challinor *et al.* (2009) present a good review of alternatives for coping with this scale mismatch with an emphasis on large area modelling. They suggest that although increased computer power makes higher resolution models more feasible, this is still only useful for large-area models and is beyond the scope of traditional crop models. Challinor *et al.* (2007: 385) point out:

> "The spatial scale of a crop model is related to its complexity: a crop model should be sufficiently complex to capture the response of the crop to the environment whilst minimising the number of parameters that cannot be directly estimated from data. The greater the number of unconstrained parameters, the greater the risk of reproducing observed yields without correctly representing the processes involved. Thus, efforts to predict crop productivity using large-scale data inevitably involves some sort of simplification in model input data and/or the way in which the growth is simulated".

1.2.2 The challenge of integrating climate-crop and economic models

Food security research is concerned with more than the potential impacts of climate change on food production alone. One of the responses has been to develop integrated socio-economic-biophysical models. Slingo *et al.* (2005) identify the need to understand socio-economic responses to climate-crop interactions as a major gap in the literature. When compared with the variety of biophysical modelling approaches, there has been a substantial lack of variety in economic models since the 1990s. This is even more apparent when the assumptions underlying these models are made explicit.

In the combined socio-economic and biophysical models there is far less variation in the types of models and assumptions used. Table 1.1 provides a list of the most widely cited climate-crop models that incorporate an economic model.

Table 1.1: A non-exhaustive list of integrated global climate-crop and socio-economic models from 1994

IIASA's Basic Linked System	IFPRI's IMPACT	Cross-sectional Ricardian model	SWOPSIM	FARM (extension of GTAP)
Rosenzweig and Parry 1994	Nelson *et al.* 2009	Kurukulasuriya *et al.* 2006	Reilly *et al.* 1994	Darwin 2004
Adams *et al.* 1995				
Fischer *et al.* 2002				
Parry *et al.* 2004				
Fischer *et al.* 2005				

Kurukulasuriya *et al.* (2006) use a cross-sectional approach estimating how farms' net revenues are affected by climate change as compared with current mean temperature. This is an econometric approach based on survey data conducted in eleven African countries, however they do not use a crop model to calculate the impact on production as the focus is on land revenues rather than on prices. The SWOPSIM (Static World Policy Simulation) model is a static, partial equilibrium model that does not take into account interaction with other sectors (Reilly *et al.*, 1994). FARM (Future Agricultural Resources Model) is an aggregation and extension of the 1990 GTAP (Global Trade Analysis Project model), which is a general equilibrium model (Darwin, 2004). The major limitation of this model is its high level of aggregation of the world into 8 regions where the 'Rest-of-World' is an aggregation of the former Soviet Union, Mongolia, eastern and northern Europe, Greenland, western and southern Asia, Latin America and Africa (Darwin, 2004).

By far the dominant model has been the BLS (Basic Linked System) model developed by IIASA to complement the FAO/IIASA Agro-ecological zones (AEZ) climate-crop model. The BLS is a dynamic, general equilibrium model that divides the world into 34 components with 9 agricultural sectors and 1 other coarsely aggregated sector (Fischer *et al.*, 2005). International prices are computed to equalise global demand with supply each year, therefore in scenarios with production shortfalls projected due to future climate change, international prices rise, providing incentives for the reallocation of resources and causing consumers to react accordingly; in a one year iteration, only demand changes with price so that buffer stocks can be adjusted for short-term responses to changes in production; this leaves the production marketed in the following year to be affected by the change in relative prices (Fischer *et al.*, 2002). The IPCC's fourth assessment report (Easterling *et al.*, 2007) relied solely on the IIASA model to formulate the fifth chapter on Food, Fibre and Forest Products that dealt with food security. Its conclusion was that global trade was predicted to be able to compensate for production disparities resulting from the projected shift of suitable land for crop cultivation from the tropics to more temperate regions. Recent responses around global food price increases demonstrate that this may not in fact be the case.

The most recent contribution has been IFPRI's Impact model (Rosegrant *et al.*, 2008; Nelson *et al.*, 2009). This is a partial equilibrium model where food prices are determined annually at levels that clear international markets (i.e. the assumption that the quantity supplied equals the quantity demanded). It divides the world into 115 food production units (FPUs) that are linked through linear and non-linear equations of trade relations. Growth in production is determined by crop and input prices, exogenous rates of pro-

ductivity growth and area expansion, investment in irrigation and water availability and demand (for 4 commodity categories: food, feed, biofuels and 'other') is a function of prices, income and population growth (see Nelson *et al.*, 2009). This model is definitely the most comprehensive to date, especially because of its inclusion of the hydrological cycle. However, it makes similar economic assumptions as the BLS model, which is problematic as they inherently assume system equilibrium through clearing markets. All integrated models are therefore still based in traditional, linear economic thinking. This is arguably because complexity economics has not yet reached a stage where it is widely applied to commodity price markets, but it means that the assumptions in these models do not necessarily reflect what happens in reality.

Schmidhuber and Tubiello (2007) note that the reliance on IIASA's AEZ and BLS model framework has important implications for uncertainty because the robustness of their assessments depends on these underlying models. This is even more problematic since these studies all rely on a liberalised global trade regime where shortfalls in one country can be offset by imports from others. As the Doha round and recent trade restrictions imposed after the 2009 food price crisis has shown, this is not guaranteed (Nelson *et al.*, 2009). Basing all integrated models on assumptions of liberal markets and a global increase in GDP is therefore flawed. Long-term economic predictions are of themselves problematic because if we cannot predict food prices into next year, the reliability of projections in 2030, 2050 and 2080 is even lower. This does not undermine the utility of models that aim to incorporate socio-economic factors into biophysical models of the impact of climate change on crops; however, the reliance that is placed on these results is not commensurate with the information that they can actually provide. This is despite sensitivity studies like that of Liverman (1986) that warned of using global models with annual time-steps (like the International Simulation Model- IFS) without fully understanding their assumptions about the food system.[2]

1.2.3 Model limitations

Understanding the limitations of these models is critical for studying food security because it enables us to think more critically of current research approaches and thus develop new methods that focus more on the entire food system and incorporate uncertainty in a

[2]Liverman (1986) ran a sensitivity analysis of the International Simulation Model (IFS) where climate was included as a yield factor in the agriculture sub-model. The analysis showed that the IFS was particularly sensitive to changes in crop yield as a surrogate for climate, but that it responded better to slow climatic changes than to rapid, abrupt changes like drought.

manner that assists in decision-making rather than making unreliable predictions. This section provides two main critiques of how food security under climate change has been modelled so far. The first remains within the modelling paradigm, but questions how uncertainty is dealt with in socio-economic models. The second focuses on an understanding of the food system as a complex socio-ecological system, which requires a more holistic approach in order to capture its complexity. It is argued that climate change adaptation calls for new mechanisms through which we can break open the 'black box' between food production (where the models are focussed) and food consumption (where food security is ultimately determined).

The first critique is relatively straightforward in that it simply calls for a similar discussion of how uncertainty is handled in climate change models to be applied to their economic counterparts, especially if they are combined into one integrated super-model. The climate and economy can both be classified as chaotic systems as they both suffer from the same characteristics of sensitivity to initial conditions and non-linear dynamics (Smith, 2007). This is still a contested issue. Most climate scientists agree that the climate is a chaotic system whereas many economists still do not accept the non-linearity of the economy. This has important implications for how innovations in researching the relationship between the climate and the economy (as embodied in food security studies) are undertaken. In this thesis, however, the economy is accepted as a chaotic system with all the assumptions this implies (this argument is expanded in **Chapter 2**). Therefore, I argue that the discussions around uncertainty at the beginning of this paper apply equally to the economic components of food system models as they do to the biophysical elements of climate models. In fact, as Hayek (1999) points out, all we can hope to get out of an analysis of the economy are general mechanisms rather than specific predictions. Here, he refers to the economy as a social structure consisting of a large number of distinct elements following a pattern determined by the different behaviour of different actors that cannot be classified into the same statistical collective (Hayek, 1999).

A similar choice exists as to whether to create ensembles of simple models or to focus on generating the first best guess from a complicated model. The evidence is that the literature has chosen to focus more effort on the latter, i.e. building increasingly complicated models that necessitate more and more assumptions. Inasmuch as these models can provide us with a better understanding of how the food system could function under certain conditions they are useful, but when it comes to using them as forecasts, a discussion on how much trust we can place in them is important. Arguably, building ensemble models of both climate and economic systems in order to model the food system

is probably unfeasible not least because of the computer power that it would require (see the climateprediction.net project that uses the computer power of volunteers to run climate model iterations in order to establish the accuracy of climate predictions up to 2100). However, this does not mean that we must then only focus on 'perfecting' the complicated models, but should look for alternative ways of understanding how uncertainty could play out from the socio-economic perspective as well as from the bio-physical aspect of food system models. Increasing our knowledge of our own ignorance is arguably a significant pursuit in its own right and a loss in the degree of falsifiability [or predictability] of our claims is the price we pay for advancing the field of complex phenomena (Hayek, 1999).

This leads to the final, major concern of how useful results from models really are when trying to understand the food system as a whole. Although knowing long-term trends of food prices (the most common model output) is useful, it provides little value to a study of food security and more importantly how to adapt to the variability and uncertainty that is expected from the global climate into the future. What is needed is an understanding of the volatility and uncertainty of future climate impacts on the food system. Similarly, these models evaluate a very narrow set of production (and price) indicators, but do not trace impacts through to other food system activities (Wood *et al.*, 2010). The weight given to these model frameworks is evident in their inclusion in major international assessments focussing on food supply; the IFPRI IMPACT model provided inputs for the Millennium Ecosystem Assessment (MA, 2005), Global Environmental Outlook (GEO4, 2004) and International Assessment of Agricultural knowledge, Science and Technology for Development (IAASTD) documents and the IIASA GAEZ-BLS model was used in the IPCC Fourth Assessment Report (Easterling *et al.*, 2007) and the Comprehensive Assessment of Water Management in Agriculture (CAWMA 2007) (Wood *et al.*, 2010). Their utility in terms of understanding the food system is not commensurate because they leave out large elements of the food system necessary for food security outcomes by focussing instead on economics and land use (Ericksen *et al.*, 2010). Schmidhuber and Tubiello (2007) admit to the narrow focus of these integrated assessment models. Indeed, it can be said that there has been a conceptual bias towards using models as the only tools for understanding climate change impacts on food security since the 1980s despite their limitations being openly discussed (Liverman, 1986).

A simple focus on production impacts and macroeconomics is clearly insufficient when discussing the nuances of food security into the future and so alternative methods need to be sought. However, dealing with all the complexity of the food system is also not a feasible proposition as the interactions and feedbacks are numerous. Ericksen *et al*

(2010) recommend a systems analysts' approach by looking at patterns and typologies that can be used to organise a holistic framework of analysis. The GECAFS[3] food system framework (Ericksen, 2008*b*) is just one such typology that forms the backbone of the Food Security and Global Environmental Change synthesis report (see Ingram, 2011 for more background on the framework and how it has been applied). It is this new approach that is substantiated below and that is used throughout the rest of the thesis as an alternative to the traditional, linear modelling approach to climate change impacts on food security.

1.2.4 The food system as a complex, adaptive socio-ecological system

Socio-ecological systems (SES) are the complex combination of social (e.g. economic, political, legal etc) and ecological systems. This complexity is created not just through interactions of interdependent variables across scales and levels (Ramalingam *et al.*, 2008; Thompson and Scoones, 2009), but also through multiple feedbacks and thresholds present in the system at large. Feedbacks are inherent processes in coupled socio-ecological systems and they happen when actors respond to change, often having unintended negative consequences especially at different levels (Ericksen *et al.*, 2010). Ericksen (2008*a*) argues that the food system is a prime example of an SES because it exhibits just these characteristics. For example, feedbacks in the food system include impacts on ecosystem stocks and services from food system activities (like production and distribution) and social feedbacks include people's responses to shocks by drawing down their assets beyond critical thresholds and falling into the poverty trap (Ericksen *et al.*, 2010). Since most policy is not designed for the surprises inherent in complex systems, these unanticipated feedbacks create challenges for policy (Gunderson, 2003). Furthermore, as discussed above, the food system is dependent on two chaotic systems: the climate and the economy. Uncertain changes in these systems into the future add to the complexity of studying the future of the food system. In order to make effective decisions regarding the food system and in particular if we are to adapt to the projected changes that will impact it into the future, we require new tools and methods of understanding how it works.

When dealing with complex systems, it is necessary to break out of the traditional understanding that quantitative prediction is possible (though difficult and data intensive), to an understanding that some systems are inherently unpredictable and not tending to-

[3]Global Environmental Change and Food Systems group, a subsidiary of the Earth Systems Science Partnership (ESSP)

wards equilibrium (Berkes *et al.*, 2003). This impacts the type of data that we need in order fill in the gaps that nonlinearity leaves behind. Qualitative data (e.g. from methods that do not require a quantitative output, e.g. participant observation or key informant interviews) can be useful in choosing between the suite of possible 'correct' model solutions (Berkes *et al.*, 2003) and needs to be encouraged in conjunction with quantitative methods. Another useful mechanism for dealing with the uncertainty of the future is through the formulation of scenarios. These are particularly necessary in complex systems like the food system, which "exhibit turbulent behaviour, extreme sensitivity to initial conditions and branching behaviours at critical thresholds" (Wood *et al.*, 2010: 49).

There has been a geographical critique that quantitative models from the global change discourse are inappropriate or unsuccessful in predicting social or human trends for a variety of reasons: that they do not adequately capture power dynamics, that the local environment is more salient, or that the economy is only seen through a capitalist lens (See Liverman 1994). Although the usefulness of models is not disputed, their limitations need to be recognised. Models are very useful for their *explanatory* value because in the absence of being able to perform actual experiments in the real world, models allow researchers to adjust variables and their relationships allowing for a better understanding of how the system could work. However, their *predictive* value (i.e. that their representation of the world can project reliable future states) is not useful in systems that have high complexity and uncertainty and therefore they provide only supplementary value for envisioning the future. Chaotic dynamical systems like the climate and the economy are especially problematic because their different measurements of uncertainty make decision-making difficult. When dealing with the food system, which comprises both these chaotic systems, new mechanisms need to be identified and tested in order to further our understanding of its complex nature in the future. However, alternatives to quantitative modelling are few and far between and this is likely why we still have a conceptual bias towards modelling as the research solution to complexity in the food system. The key conclusion from this section is that models of chaotic and complex systems are useful for their *explanatory* value, but not for their *predictive* value due to their non-linear character about which certain assumptions must be made and uncertainty calculated. As mentioned, the first aim of this thesis is to move beyond models for understanding the food system and to use a different approach, embedded in socio-ecological systems thinking, which is outlined below.

Socio-ecological systems thinking has been an important development in how we study complex systems problems, however, thus far most of the work has focussed on natural

resource management (see for example Folke, 2006; Walker *et al.*, 2002; Ostrom, 2009). There is great potential in bringing a socio-ecological systems perspective to work in the food system and Ericksen (2008*b*) has provided a framework for how this can be achieved. Although socio-ecological systems are often difficult and confusing spaces in which to work, simplifying the research agenda will not be beneficial in the long run. It is therefore time to take stock of our conceptualisations in order to do consistently meaningful research that will contribute towards building global adaptive capacity to the future shocks we are likely (but not certain!) to face. With this in mind, this thesis aims to utilise the GECAFS food system framework outlined below to address questions aimed at understanding the multi-level interactions within the food system that determine food security.

1.3 The Research agenda

1.3.1 The GECAFS food system framework and Double Exposure

There are three main challenges to researching the food system holistically: the complexity of the system, its inherent uncertainty and the multiple scales and levels across which interactions and feedback loops occur. Wilbanks and Kates (1999) argue that there is a problem of perspective when focussing on only one scale or level of analysis in global change studies and Cash *et al.* (2006) discuss the multi-level dynamics at play within socio-ecological systems (SES). Ericksen (2008*b*) proposes an iterative framework that addresses some of these challenges, recognising that there will always be uncertainty. This framework takes into account the coupled social and ecological drivers of change that affect food system outcomes (e.g. food security) by impacting the processes and activities (e.g. production, processing, packaging, distribution, retail and consumption) that the food system undertakes (Figure 1.2). The critical contribution of this framework is that it treats the food system as multi-scale and multi-level. Despite the system's complexity, using case studies strategically can help us to understand critical processes in the food system and how to govern them adaptively (Ericksen, 2008*b*).

Applying a socio-ecological systems (SES) approach to food systems changes the scale of analysis from the household level (e.g. Liverman, 1994; Eakin, 2005; Misselhorn, 2005) to one integrated across different spatial and temporal levels, taking into account feed-

backs and cross-scale interactions (Ericksen, 2008*a*), thereby incorporating the complexity inherent in food systems. Ericksen (2008*b*) proposes an iterative framework where Global Environmental Change (GEC) drivers interact with changes in socio-economic drivers to impact food system activities and outcomes where the subsequent environmental and socioeconomic feedbacks then impact the initial drivers again (Figure 1.2). The relationship between food security outcomes (stability of availability, access and utilisation) and the global change drivers can be analysed through food system activities like food production, processing and packaging, distribution and retail or consumption (Ericksen, 2008*b*). This framework complements the double exposure framework outlined by O'Brien and Leichenko (2000) as it incorporates the interactions between environmental change and socio-economic drivers. The other key aspect of this framework is that it provides a means of understanding the system at multiple scales and levels. By using this framework in the study, macro-scale changes can be linked to local concerns of livelihoods and food security with a focus on the adaptive capacity that the private sector brings to food systems. This is critical for addressing aim 4- *To analyse food system dynamics across scales and levels* with reference to empirical examples (as required by aim 2). In **Chapter 6**, the multi-level case studies provided in **Chapters 3** (local level), **4** (national level) and **5** (regional level or two country comparison) will be brought together in order to show that it is possible, though challenging, and beneficial to do empirical work within a socio-ecological system that operates across levels and scales.

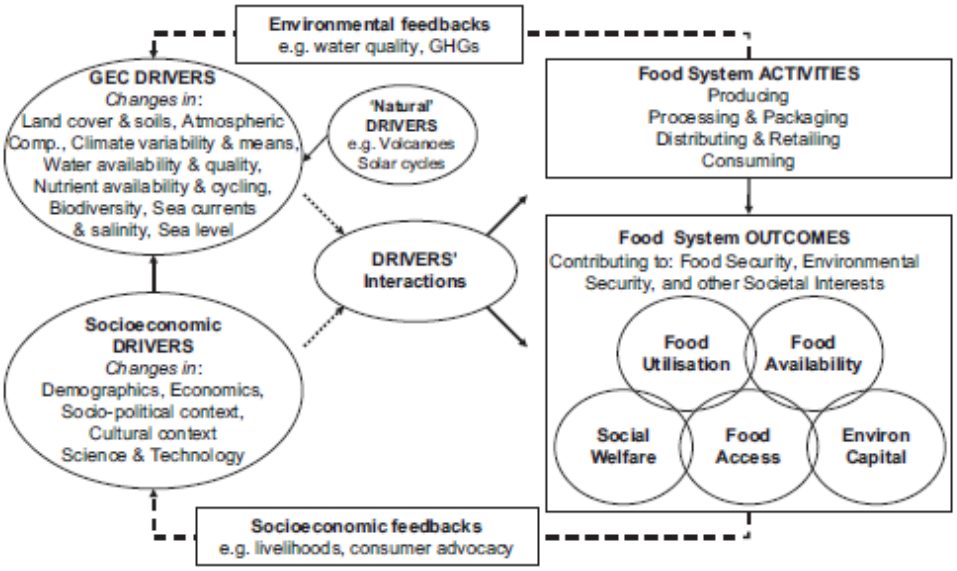

Figure 1.2: Food systems and their drivers (Source: Ericksen, 2008*b*: 239)

Double exposure is "a metaphor for cases in which a particular region, sector and social group, or ecological area is simultaneously confronted by exposure to both global environmental change (GEC) and globalization" (Leichenko and O'Brien, 2008: 9). The GECAFS framework can be used to identify the synergistic effects of GEC and globalisation and then to determine the implications of these synergies on regions' vulnerability to these processes. Double exposure provides a means of analysing the multiple global change processes that impact areas in a dynamic way, which allows for analysis at different spatial and temporal scales whilst including contextual factors and feedbacks. There are three different pathways of double exposure, each focussing on changes within a section of the framework (Leichenko and O'Brien, 2008). Outcome double exposure focuses on the consequences resulting from global change processes acting together on exposure units. Context double exposure highlights the new conditions that are created by global change processes which may change the contextual environment in which the exposure unit exists, thereby increasing vulnerability to shocks and stresses by affecting exposure as well as response capacity. Feedback double exposure stresses the temporal linkages between the two global change processes, emphasising the dynamic quality of their interactions and the effects that responses from either contextual changes or outcomes can have on these processes themselves.

These global change processes acting individually, synergistically and even antagonistically create uneven outcomes or 'winners' and 'losers' (O'Brien and Leichenko, 2000; Kates, 2000; Adger *et al.*, 2003). The impacts of climate change within the context of globalisation provide a perfect illustration of this (see Figure 1.3). As mentioned above, global climate model findings highlight the global inequalities of climate change impacts: Fischer *et al.* (2002) found that whilst developed countries are likely to benefit from climate change due to increased productivity, the developing world is likely to face negative consequences from a decrease in productive capacity. In order to understand fully the affects on food security, it is imperative to contextualise the impact of (and vulnerabilities to) climate change within current socio-economic and political trends, and in particular market uncertainties. The double exposure framework within the wider GECAFS food system framework provides the tool through which to do just this.

1.3.2 Background to the case studies

Using the GECAFS framework in combination with an appreciation of the effects of double exposure, this study links macro-scale changes to local concerns of livelihoods

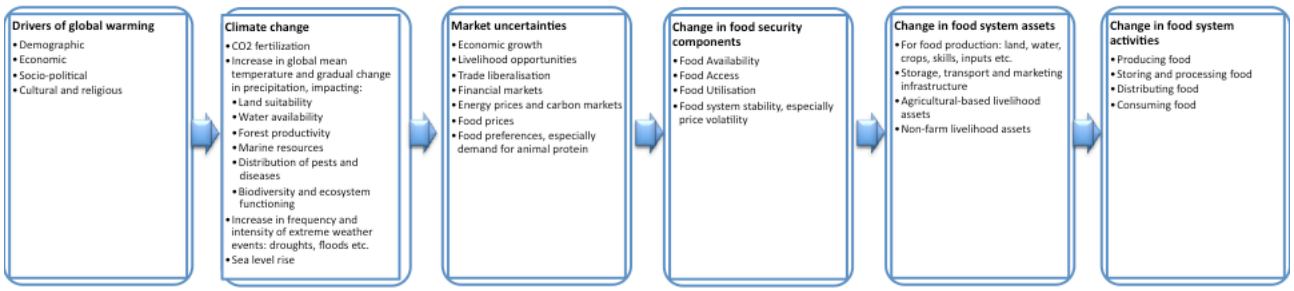

Figure 1.3: The drivers of global warming lead to climate change, which in the context of market uncertainties results in changes in the food system (Adapted from FAO 2007)

and food security with a focus on the adaptive capacity that the private sector brings to food systems. One of the key problems identified in doing research on the food system is how to address the difficulties that arise from the mismatch between environmental and societal processes occurring at different levels. The thesis therefore grounds this theoretical discussion with examples of three case studies, each focusing on a different level in the food system. Although these are not necessarily nested studies because by nature different questions need to be answered at different levels in the food system, the central theme is how a complex adaptive system approach can identify how to build adaptive capacity in the food system under the uncertain impacts of climate change. Furthermore, the emphasis that a systems approach involves a multitude of perspectives in any analysis lends itself to a multi-level approach as different voices come into focus at different levels.

The meso-scale has been posited as a useful level of analysis for the food system (Ericksen and Ingram, 2009). I have therefore identified two countries on which to focus the study and then to build downwards from there. Using two countries means that the study is comparable outside of a single country context and it allows for extending the analysis into the regions in which the countries are located. This will enable conclusions to be drawn on trends that could be more globally relevant versus more locally specific trends that are not necessarily scalable. The two countries that I have chosen are South Africa and Brazil because of the different impacts that they are predicted to face under climate change, particularly in the agricultural sector (see Easterling *et al.* 2007). Furthermore, interesting comparisons can be drawn from an analysis of how globalisation processes have played out differently in these two countries; both in terms of economic policy and in the different structure and historical role of private sector actors in their respective

food systems. There is also a good body of work on food security that has already been done in these countries upon which this thesis can build.

Africa is projected to be the worst hit region because climate change will add stress and uncertainty to crop production in areas that are already vulnerable to climate variability (Slingo *et al.*, 2005) as well as to environmental, socio-economic and political instability (Homer-Dixon, 1994; Peet and Watts, 1996; Swatuk, 2002; Challinor *et al.*, 2007). Trade liberalisation is another area where there is an ongoing discussion about winners and losers. The argument that liberalisation will result in positive net gains does not mean that it will make everyone better off, but rather that changes in the distribution of income will create winners and losers (Stiglitz and Charlton, 2005). Identifying winners and losers resulting from the joint effects of climate change, economic policy and market change processes at different scales is a vital step in understanding equity issues within the food system network. Studying these global processes together will aid in developing policies that close rather than widen the gap between countries facing different combinations of impacts from these global processes. Food security as an equity issue is a key component of such development strategies as it links environmental processes to issues of poverty, economic growth and human rights, such as the right to food (Eakin *et al.*, 2010).

The current trade regimes faced by the two regions are extremely important for understanding food security impacts. Stevens *et al.* (2003) describe food security as a dynamic concept where the stability and reliability of access to food over a period of time is guaranteed, which is difficult to ensure within the volatility of the global market. The global level impact of trade liberalisation on an individual's access to food is one of the examples of multi-scalar interactions in the food system. Food access is largely determined by purchasing power (of individuals), which is conditional on economic growth, income and resource distribution (within nation States) (FAO, 2003). Most macro analyses focus on the impacts of trade liberalisation on food security by causing direct changes in relative commodity prices (e.g. between tradable and non-tradable goods), domestic production and imports (Stevens *et al.*, 2003). Indirect effects are felt through shifts in these direct impacts that differentially affect geographical areas and social groups associated with one product over another. There are two types of differential impacts: those that result in absolute gains and losses where some gain (e.g. producers) whilst other lose (e.g. consumers) and those that result in absolute gains and relative losses where only some of the potential beneficiaries can actually take advantage of the change, resulting in increasing income disparities within the same group (Stevens *et al.*, 2003). For example, a study by Chilowa (1998) on the impact of agricultural liberalisation in Malawi showed that policy

packages that focussed on promoting market and price mechanisms rather than addressing production constraints and non-economic barriers to growth had had a negative impact on food security. These policies resulted in creating 'winners and losers': the losers were mainly the smallholder farmers that are net food buyers, located in remote areas or low-income earners in urban or semi-urban areas and the winners were smallholder farmers that are net food sellers, private and institutional traders and the state marketing agency.

These results further emphasises the need to understand the equity issues of liberalisation and other macro-economic policies below the national scale, especially when dealing with groups that are vulnerable because they are often lost in aggregate data. Understanding the link between how changes in food prices and agricultural productivity translate into changes in the poor's access to assets, (which impacts food security and livelihood strategies) is vital in inter-scalar analyses (Imber *et al.*, 2003). In this study, this relationship is teased out in **Chapter 3** with the subsequent chapters discussing contextual double exposure to macro-level processes that affect the governance decisions of different actors in the food system.

1.3.2.1 The Private sector focus

Despite their importance, studies on the capacity of the private sector to adapt, or the necessity of this, are largely missing in the literature. I argue that companies are strategically equipped to deal with the issue of climate change impacts in the food system and have great incentives to do so. An analysis at the level of private companies also allows for the issue of scale to be incorporated because many of these entities can be described as 'boundary organisations' that operate between different scales or functional levels (Cash and Moser, 2000). The third aim of the thesis is therefore *to investigate the potential role of the private sector in food system futures.* The private sector provides a good primary focal point for the study and as such each of the case studies in **Chapters 3, 4 and 5** all centre on the role of these actors in their respective levels of the food system. This is also why key questions 3- *What role does the private sector play in achieving food security across scales and levels?* and 4- *What evidence from the private sector shows that the food system is complex and adaptive?* both explicitly focus on the private sector. However, no entity acts in isolation in a complex system and so it is necessary to develop how the interactions between different actors play out at different levels of the system and how these interactions feed back into and influence other levels (leading back to aim 4- *to analyse food system dynamics across scales and levels*). This multi-level interaction is what lies

at the heart of developing adaptive food governance and so key questions 5- *What are the implications of these findings for adaptive food governance?* and 6- *What mechanisms for adaptive food governance can be identified in the food system?* are dedicated to drawing out the role of private sector actors within this wider idea of governance. **Chapter 4** is the core chapter that discusses these 'messy' governance issues whilst practical examples are offered in **Chapter 5**.

Due to their role in the food system, food companies are vital structures in the food value chain. At the same time, they bridge the multi-scalar and multi-level arenas in which the food system operates. These different roles are also often played by different arms of the same company, making these large companies immensely powerful (Figure 1.4). For example, their procurement policy affects what crops are lucrative and from where they are sourced. This is often based on which producers can meet their requisite quality and safety standards and is therefore largely biased against smallholders who do not have the capital base either to meet the standards or to have the standards certified (Reardon *et al.*, 2003; Arda, 2007). Having such disproportionate power over procurement means that all the risk of agricultural production (not just in terms of ensuring a productive harvest, but the investment required to operate at scale) falls on the farmers themselves and not on agribusiness that contracts out of risk (Pollan, 2007; Patel, 2007). On the other end of the scale, they also determine what type of food products finally reach consumers and who those consumers are, based on their location within the company's distribution network. It is clear then that the process of building an adaptive and equitable food system that can deliver food security will need to focus a lot of attention on the role of the private sector and what it can contribute to an adaptive food governance. Furthermore, the large amounts of capital in these transnational ventures and their incentives to maintain a system in which they can continue to profit, provides the perfect opportunity for interrogating how private sector actors can contribute to the overall adaptive capacity of the food system.

Considering the size of the private sector in the food system, it is necessary to focus on a specific group and so for the purposes of this study, the main focus will be on retailers and in particular supermarkets. Within the food system, supermarkets play an important role in facilitating the process of globalisation and likewise in creating winners and losers. Their role in food policy in the developing world (and in particular emerging economies that are already considerably integrated into the global economy) is extremely important: They are a vehicle for the transmission from developed to developing countries of new technologies (e.g. for lowering transaction costs across the supply chain), new

Figure 1.4: A "corporate view" of the world food system: Sales of top 10 companies (in billions US dollars), 2004 and 2006 (Source: von Braun, 2008)

taste preferences, their power over suppliers (in terms of standards, payments and what products they will actually buy) and scarce resources (the food product itself) thereby reinforcing structural transformations in the food system (Timmer, 2009). The elephant in the room is therefore the question of how to leverage their transformative power for the public good by ensuring food security and not just as part of a greenwashing exercise in an expansive business plan. This discussion requires drawing on discussions from the corporate governance literature and the social and environmental responsibility discourse, which at its heart questions the fundamental role of business to maximise profit. A discussion on adaptive food governance needs to tackle what incentivises the private sector to provide such social (and environmental) goods.

1.4 Overview of Methods and Data collection

This study embodies Scoones (2005: 13) "hybrid methodological approach" in practice as each paper required a different method of data collection, although they all fit within the broader food system and double exposure frameworks. A complex systems approach requires the input of both quantitative and qualitative data and so this study makes use of both.

1.4.1 Quantitative data

All the data referring to climate change data are based on climatic modelling as described in *Section 1.2*. The livelihoods data described in **Chapter 3** are based on data from ques-

tionnaires that can be found in Appendix B. Finally, the data for the econometric analysis on Brazil in **Chapter 5**, *Section 5.1* comes from national and international databases: Production (Instituto Brasileiro de Geografia e Estatística, Pesquisa Agrícola Municipal— IBGE/PAM); Domestic price (Fundação Getúlio Vargas, Agroanalysos); International price (International Monetary Fund, International Financial Statistics— IMF/IFS) and Import/Export data (FAOSTAT). This is further elaborated in the chapter.

1.4.2 Qualitative data

A key feature of this thesis is the combination of quantitative and qualitative data in order to paint a better picture of the food system. Therefore, complementing the numbers are data from one-on-one interviews. This process tried to echo the call from CAS theory for an inclusive array of relevant stakeholders being involved. Although the scope of the project did not allow for a great number of interviews to be conducted, there is a wide range of views presented through the three substantive chapters.

Semi-structured interviews[4] were conducted with five different members from the private sector in South Africa: one person who heads corporate sustainability at a prominent food processing company, the CEO of a carbon neutral wine estate, the sustainability head of a retailer, the senior manager of sustainable development and the divisional director of fresh produce at another retailer. From the public sector, there was a roundtable discussion with various members of the South African Department of Agriculture (DOA) including the head of food security, another member of the food security directorate and three members from the disaster risk management directorate: one from the climate change sub-directorate, one from policy and implementation and one from the disaster and recovery unit. The head of corporate sustainability at the food processing company was also the former director general of the department of agriculture and so she could provide many insights as to the relationship between the public and private sectors in South Africa. Finally, an interview was conducted with an agricultural economist who was the former chairperson of the National Agricultural Marketing Council (NAMC) in South Africa. These interviews form the primary data for the material in **Chapter 4 and 5**, *Section 5.3*. In order to embed the discussion on South Africa within a regional perspective (see **Chapter 6**), I also conducted some research in Mozambique. Here, semi-structured interviews were held with a researcher from Michigan State University

[4]Please see Appendix A for a full list of the interviews.

working on food security, the country head of an NGO, Technoserve, that deals with finding business solutions to poverty and a researcher with FEWS NET.

Unfortunately, gaining access to businesses in Brazil proved to be a big challenge and despite working in collaboration with academics from the Getúlio Vargas Foundation in Rio de Janeiro, we were unable to secure interviews with the Brazilian counterparts of those who were interviewed in South Africa. However, I did still interview three Brazilian academics working on different aspects of the food system and sustainability issues: one from the University of Campinas, one from the University of São Paolo and the other from the Rural Federal University of Rio de Janeiro. Although the original plan had been to do a comparative study between the two countries, this was no longer possible and so a 'flexibility of response' was required. Instead of using data from interviews, my colleagues and I referred to company reports, websites and magazine articles in order to get information on food businesses in Brazil. These are described in **Chapter 5**, *Section 5.2*.

The methodological approach was left deliberately open-ended and the scope of the interviews was broadly defined although a list of questions was usually sent to interviewees beforehand so that they were aware of the general thrust of the discussion. This approach was also applied to the local level study (described further in **Chapter 3**) when interviews with shop owners followed the format of short discussions that complemented the quantitative data that was already available from questionnaires. Broadly defining the problem under discussion left it open to the discussants to raise what they thought were the most relevant points thereby not pre-emptively reducing the focus of the study and risking "doing violence to precisely the complexity and diversity, which many livelihoods manifest- in themselves, in their relationship with the physical environment and with each other" (Chambers and Conway, 1991: 81)

1.5 Thesis structure and paper outlines

This thesis consists of six chapters and incorporates four academic articles that have been published or accepted to relevant peer-reviewed journals. As such, the thesis meets the requirements for a thesis by papers. The thesis itself is divided into two parts: the introduction, literature review and conclusion chapters (**Chapter 1, 2 and 6**) form the 'bridging material' linking the three empirical chapters (**Chapters 3, 4 and 5**).

Section 1.2 of this introductory chapter is based on the following paper, which at the

time of submission was under review at the journal 'Geoforum':

Pereira, L.M., "Modelling the food system under climate change."

This paper sets out the rationale behind the thesis through a critique of our conceptual bias towards employing a modelling approach to understanding the linkages between food security and climate change. It suggests using the more holistic socio-ecological systems framework that makes use of both quantitative and qualitative data and provides a better way of translating the concept of uncertainty to a variety of different audiences. The case studies that form the empirical parts of the thesis were developed around this socio-ecological systems approach. In conjunction with the literature review in **Chapter 2**, these two chapters cover aim 1- *To move beyond an understanding of food security that is dependent solely on agricultural production, and therefore the reliance of future food security predictions on production data based on climate model inputs* and its associated key questions 1- *How is our current understanding of food security under climate change aided/constrained by models?* and 2- *How does a CAS approach complement our current understanding of food system futures?*

The three empirical chapters are briefly described below. They were designed to focus on three different levels of the food system, starting locally and working upwards to the regional level. In **Chapter 3** the food system dynamics at the local level in South Africa are studied, whilst governance at the national level in South Africa is covered in **Chapter 4** and a regional overview of the South Africa and Brazilian food systems, emphasising the private sector, is provided in **Chapter 5**. When combined, the findings in all three empirical chapters are used to achieve aims 2- *To ground the theoretical aspects of CAS with empirical data from multi-level case studies* and 3- *To investigate the potential role of the private sector in food system futures.*

The three case studies are divided as follows:

The objective in **Chapter 3** is to answer key questions 3- *What role does the private sector play in achieving food security across scales and levels?* and 6- *What mechanisms for adaptive food governance can be identified in the food system?*. It is based on the following paper, which at the time of submission was under review at the journal 'Development Policy Review':

Pereira, L.M., Cuneo, N.C. and Twine, W.C. "Food and Cash: Understanding the role of the private sector in rural food security"

The paper focuses on the local level and how adaptive capacity can be built within local food systems through increased integration between different stakeholders. Most of the literature on the role of retail on food security refers to urban areas (and conversely,

production studies are focussed on rural areas) and so in this paper my co-authors and I look at the flipside- i.e. what role retail plays in rural food security strategies and how by integrating rural areas with their urban supply, supermarkets have swopped the traditional role of rural area as food source to one reliant on food being brought in. The paper provides the general context of the food security situation in Agincourt, South Africa. It is framed within a sustainable livelihoods framework and includes a discussion of the political changes in South Africa under the government's new growth path policy, thereby linking it to the findings in **Chapter 4**.

The objective in **Chapter 4** is to answer key questions 4- *What evidence from the private sector shows that the food system is complex and adaptive?* and 5- *What are the implications of these findings for adaptive food governance?* It is based on the following paper, which was accepted for publication in January 2012 by the journal 'Food security':

Pereira, L. and Ruysenaar, S. (2012). "Moving from Traditional Government to New Adaptive governance: the changing face of food security responses in South Africa". Food Security, vol. 4, no. 1, pp. 41–58.

The paper applies a complex adaptive systems approach to discussing governance issues in the South African food system and in particular what trends in the private sector can be applied more broadly to governance across the system by including different actors. The main question in this chapter is how to build more flexible and sustainable governance structures that can respond to an uncertain future and also be more inclusive of multiple stakeholders. By focussing on the role of the private sector in adaptation to climate change my co-author and I aim to extend the adaptation discussion from local level projects involving NGOs or increasing the institutional capacity of regional and state actors, to a more holistic approach where all actors within the system have the capacity to adapt themselves or to aid adaptation processes elsewhere. The role of the state in promoting adaptation and the impact that globalisation will have on governance and decision-making at this level has been discussed by Eakin and Lemos (2006) and there are also numerous reports and projects on local level adaptive strategies and livelihood practices (Eakin, 2005; Misselhorn, 2005; Ziervogel *et al.*, 2008). However, the interplay between local level governance processes, the role of the state and governance processes in the private sector has not been analysed from a complex adaptive systems perspective. This governance nexus is discussed here.

The objective in **Chapter 5** is to answer key questions 5- *What are the implications of these findings for adaptive food governance?* and 6- *What mechanisms for adaptive food governance can be identified in the food system?* In order to answer these, it has

three thrusts. The first is concerned with macro-economic modelling and identifying the limitations of this method for understanding how the food system provides food security through a quantitative analysis on Brazil. It is based on the following conference paper:

Pereira, L. and Chiarini, T. (2010) "Understanding macroeconomic processes in the food system under climate change: a study of food prices in Brazil". Presented at the Global Business and Technology Association Annual Conference, Kruger National Park, 5-9th July 2010.

The second part interrogates private sector approaches to environmental change in the food system at a regional level in Brazil and South Africa and is based on the following paper, which at the time of submission was under review at the Brazilian journal, 'Revista de Gestão Social e Ambiental"

Pereira, L.M., Fontoura, Y. and Fontoura, C.F. "Strategic corporate shifts towards adaptive good governance under environmental change: a comparison between South African and Brazilian Retailers".

This paper looks at the possible implications of various approaches for adaptation and what role there is for adaptive governance by specifically discussing corporate social responsibility initiatives undertaken within the food sector in South Africa and Brazil.

The final section uses qualitative data from interviews to identify where the private sector can most contribute to building the adaptive capacity of the food system to climate change.

Chapter 6 is the final chapter with the aim of bringing all the multi-level case studies together and thus *to analyse food system dynamics across scales and levels* (aim 4). By bringing together the conclusions reached in **Chapter 3, 4 and 5** and embedding these within the modelling critique and alternative framework offered by CAS and socio-ecological systems that were introduced in **Chapter 1 and 2**, key questions 7- *What are the drivers of adaptation across scales and levels in the food system?* and 8- *What broader conclusions about food system futures can be drawn from this analysis?* are answered in this final chapter.

The next chapter (**Chapter 2**) shows where and how the thesis' CAS framework fits into and complements the many disciplinary approaches that this study cuts across. It also provides a background of the food security challenge that is discussed in the empirical chapters.

Chapter 2

Key concepts and theoretical perspectives

Homer-Dixon (2006) argues that with the increasing complexity of our global society, the tight coupling of essential nodes (e.g. financial markets), and increased efficiency leading to rigidity rather than resilience, we have extended the growth phase of our adaptive cycle with the result that a 'social earthquake' (e.g. a terrorist bombing of a Saudi oil pipeline) could lead to a global societal collapse more catastrophic than renewal. Building adaptive capacity would therefore entail allowing for "breakdown in the natural function of our societies in a way that doesn't produce catastrophic collapse, but instead leads to healthy renewal" (Homer-Dixon, 2006: 289). He advocates a three-pronged approach for building system resilience: reducing the strength of the underlying forces (e.g. population increase, climate change), whilst at the same time cultivating a 'prospective mind' that allows us to become comfortable with change, surprise and the 'essential transience of things' and finally to lose some efficiency and productivity in our critical systems to allow for redundancy, loosely coupled nodes and a build-up of stocks rather than just-in-time production (Homer-Dixon, 2006: 281-283). This requires a reconceptualisation of how we govern the Earth's system in all its complexity, cross-scale and cross-level dynamics. According to Cash *et al.* (2006), the three common challenges faced by society

in doing this lie in overcoming ignorance, mismatch and plurality across scales.[1] New forms of governance are needed that take into account the complexity, uncertainty and dynamism of socio-ecological systems- an analysis that is applicable to challenges in the food system. The concept of 'governance' is further elaborated on in **Chapter 4**, but it refers to governance across a range of levels- from individual behaviour change right through to reform of supra-national structures like the WTO and WBCSD. The aim of this chapter is to interrogate the concepts proposed by the literature within the context of complex adaptive systems (CAS) theory in which they are embedded.

This chapter lays out the various theoretical perspectives and key concepts that are referred to throughout this study (see Figure 2.1). The common denominator is that they can all be traced back to the same origins of complex adaptive systems (CAS) thinking, but have been remodelled for their application to different disciplinary problems. Where applicable, this chapter aims to discuss these origins, how these theoretical concepts were incorporated into different disciplines in order to provide novel explanatory and exploratory ideas to complex problems and then how they can be brought back together in order to discuss the complexity of the food system. The outline of the chapter begins with a brief discussion of the term 'food security' and how this is inextricably linked to the idea of the 'food system.' Following this is a section defining the contested terms 'resilience', 'vulnerability' and 'adaptive capacity' as they are used in this study. The idea of the food system being a socio-ecological system (introduced in **Chapter 1**) is then discussed with further reference to CAS and complexity economics. How complexity theory has been applied to corporate governance through the idea of 'turbulence' is then introduced followed by a brief discussion of 'adaptive food governance.' The papers that form **Chapters 4 and 5** deal more fully with how governance terminology has evolved and its relevance to ensuring food security. Finally, this chapter finishes with a discussion of sustainable livelihoods theory and how this ties into notions of complexity in the food system as it is employed in **Chapter 3**.

[1]Briefly these refer to: ignorance of the complexity of human-environment interactions, which therefore leads to a lack of decision-making that takes into account cross-level and cross-scale interactions, a mismatch between human actions and ecological systems (e.g. the jurisdictional authority of an institution may not be conterminous with an environmental problem) and plurality refers to the reluctance to acknowledge that there are a multiplicity of characterisations of cross-level and cross-scale challenges and therefore a variety of possible solutions (Cash *et al.*, 2006).

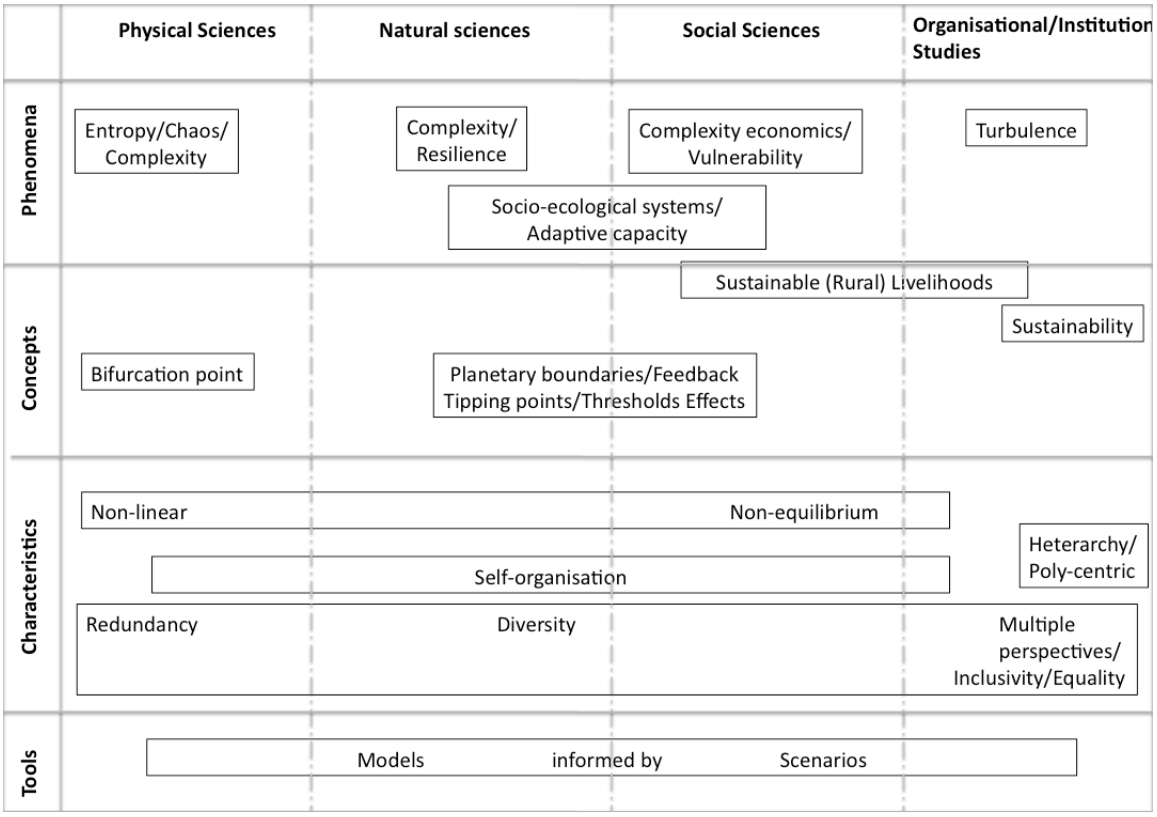

Figure 2.1: Outline of the main theoretical ideas referred to in this chapter as they relate to each other between disciplines. Some (e.g. self-organisation) are referred to in all disciplines, others refer to a similar idea that has different terms in different disciplines (e.g. complexity and turbulence) and some share concepts between disciplines (e.g. tipping points). (Source: Author's own)

2.1 A brief history of food security

At the world food summit in Rome in 1996, the participants agreed that "food security exists when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996: 2). However, this is not the only definition and over time food security has been constructed in many ways, with the result that different elements of it have been emphasised by different institutions, individuals and organisations. Research still focuses heavily on food production[2] whereas many aid agencies, for example,

[2]The historical emphasis on food production which led to the establishment of the Rothamstead Experimental Station in 1843 (arguably the world's oldest agricultural research station) has continued to the present day with the 2011 Foresight report calling for research into 'sustainable intensification' of the food production system that can meet the food requirements of 9 billion people without negative

now recognise the importance of economic and political factors too. The World Food Programme (WFP) no longer only provides aid in the form of food, but also has a cash and voucher scheme in areas where there is sufficient food available, but people cannot afford to buy it, collapsing the local market and resulting in severe knock-on effects for people's livelihoods (WFP, 2011).

The origins of the term 'food security' lie in the idea of national self-sufficiency where the main goal was to produce sufficient food internally in order to decrease reliance on the international food market. This productionist view of food security was premised upon the Malthusian idea that population would outstrip food production, making supply the key area of focus, which necessarily resulted in many interventionist and protectionist policies in the agriculture sector. Heavy and unsustainable subsidisation was introduced such that "cropping patterns were distorted, domestic trade was repressed and consumer preferences were altered" (Stevens *et al.*, 2003: 1). At the same time, the Green Revolution resulted in food production more than doubling over the 40-year period from its beginnings in Mexico in 1945 (Borlaug, 2000). Despite the huge increase in agricultural production resulting in more than sufficient world food stocks to feed the global population, there were still instances of food insecurity particularly in Africa and South-East Asia (From famine data in Devereux, 2000).

As a result, in the 1980s a shift occurred towards a focus on world food stocks and import stabilisation as contributors to national food security; the self-reliance rather than self-sufficiency approach to food security. At the same time, Sen's (1981) entitlement approach spurred a pivotal shift in understanding food security as access to food mediated through various means. First within the practitioner community and then later within the governmental sphere, it shifted the scale of food security analysis from the state level to that of the individual and his or her entitlements. After the entitlement approach, it was "usual to define food security as a problem of access to food, with food production at best a route to entitlement either directly for food producers or indirectly by driving market prices down for consumers" (Maxwell, 2001: 17).

Sen's (1981) entitlements theory stated that food security was not simply a production-based issue (i.e. affected by shocks like droughts resulting in famine), but that production together with trade, labour and transfers were all possible sources of food. This shifted the focus of achieving food security goals from increasing national production to ensuring that there was sufficient food available at the national level. The idea could be equated to

environmental consequences (Ingram, 2011).

commercial and concessional food imports. This 'self-reliance' understanding of national food security thus became dominant. As opposed to the self-sufficiency strategy, where sufficient domestic production to meet consumption does not necessarily guarantee equal access to this food by all households, the self-reliance model means that the sources of food are determined by international trade patterns with the risks and benefits associated with this system (FAO, 2003). Under the food reliance regime, national food security strategies shifted from increasing domestic agricultural production to generating sufficient foreign exchange to import the requisite quantity of food, hopefully also resulting in a more diverse mix of foodstuffs being available in the country, which could improve nutritional quality too. However, this still did not address the crux of Sen's argument which was that individuals' food security was not only determined by the availability of food, but also by their ability to afford it and that this was more often the constraining factor, especially during famines (Sen, 1981).

The critical aspect of a self-reliance strategy is that a country must be able to afford food imports in the global market and it is on this point that the self-reliance strategy often fails, as it did during the 2007-2008 global food price crisis when prices of staple foods more than doubled in some cases (FAO, 2008*b*). Financial constraints can limit the role in which imports can fill the gap between production and consumption, particularly if commodity prices are low, which may limit export earning potential. The United States Department of Agriculture (USDA) reports that a 1 percent increase in imports requires a 1.3-2 percent increase in foreign exchange (FAO, 2003: 6). Food import capacity (the ratio of food imports to total export value) is very high for Sub-Saharan Africa (1.99) and Small Island Developing Countries, but smaller for larger economies like India (0.05) (Valdés and McCalla, 1999) reinforcing this inequality. The instability of world markets is transferred to countries via the import price of cereals. The aggregate impact on food security therefore depends on cereal imports as a share of: total imports, the price elasticity of imports and the ability of a country to finance imports via export earnings (FAO, 2003). The role of exports as well as foreign exchange in ensuring food security is therefore of utmost importance for food security concerns under the self-reliance strategy and impacts on these factors will indirectly affect on food security. Von Braun and Diaz-Bonilla (2008) provide an in-depth discussion on the costs and benefits of deregulation and liberalisation of agri-food markets and their impact on food security.

The 'self-reliance' interpretation of food security has not been anymore successful in achieving global food security aims (such as the first Millennium Development Goal (MDG) of halving global hunger by 2015) than the self-sufficiency approach. There are

presently over 1 billion undernourished people worldwide, over 98 percent of which live in the developing world. Sub-Saharan Africa accounts for the highest proportion of undernourished people, at 30 percent (FAO, 2010). It is now recognised that food security is the outcome of a complex articulation of multiple factors interacting across multiple levels and therefore requires a research agenda that understands this (Ericksen *et al.*, 2010). Given the changing character of the food system, Maxwell and Slater (2003) call for the discovery of a 'new food policy.' This policy must take into account transformations in the food system that affect not only traditional understandings of food as a nutrient supply, but as "an expression of who a person is, where they belong, and what they are worth" (Dowler in Maxwell and Slater, 2003: 541). Getting past traditional notions of supply and demand of food as a commodity is not easily achieved, but the systems approach proposed by the GECAFS group is a good starting point. Food systems comprise a complex set of interlinked activities and outcomes of the commodity chain of production through to consumption. Food security is integrally associated with the food systems that either succeed in achieving this security, or fail to do so, and in order to be effective, food policy is similarly dependent on how the system functions.

Using the FAO's definition, food security can be divided into three elements: food availability, food access and food utilisation that are outcomes from a set of activities and processes in the food system. Schmidhuber and Tubiello (2007) introduced the concept of stability of these outcomes so as to take into account temporal elements of food security, such as volatile markets, and to differentiate between chronic food insecurity, (which is ongoing), and transitory food insecurity, (which is caused by a sudden shock). The GECAFS framework is formulated around these three outcomes of food security whilst understanding the food system as a socio-ecological system with biophysical as well as socio-economic drivers of change. Conceptualising the food system as a socio-ecological system (SES) has roots in systems thinking and complexity theory. Therefore, the next two sections elaborate further on these bodies of thought in order to provide a substantial grounding for applying them to the issues raised in this thesis.

2.2 Resilience, Vulnerability and Adaptive capacity

The terms vulnerability, resilience and adaptive capacity are closely linked to the literature emerging from CAS theory. They are historically contested terms in the social and natural sciences and so it is necessary for them to be clearly defined in this study.

2.2.1 Resilience

The term 'resilience' originates in the ecological literature with the work of Holling (1973) and has continued to develop from a focus on multi-stable states of ecological systems to incorporating nested cycles of adaptive change and finally to transformations that can move across scales (Young *et al.*, 2006). Holling *et al.* (2002) define resilience as the buffering capacity of a system that enables it to absorb perturbations or alternatively as the amount of disturbance that a system can maintain before it undergoes structural changes (Adger, 2000). Resilience is an emergent property of the system and therefore cannot be predicted or understood by looking at individual component parts (Holling, 1986). It is therefore necessary to measure resilience holistically so that the emergent characteristics of the system become evident. Ericksen (2008*a*) suggests applying this ecological term to food systems in their guise as coupled socio-ecological systems because it allows for management options: resilient systems can learn and respond to impacts and feedbacks. In order to enhance food security outcomes and environmental services, Ericksen *et al.* (2010) stress the need for managing for resilient food systems, transforming them in some cases and above all making them adaptive to multiple shocks and stresses.

Homer-Dixon expands further on how to build resilience in critical systems. He defines resilience as a system's capacity to absorb large disturbances without changing its fundamental nature, which he says can be done in two main ways: by building functional redundancy and building up stocks (Homer-Dixon, 2006). Redundancy requires trading some efficiency and productivity gains for increasing resilience to shocks. This can mean doubling up key systemic functions by replicating and dispersing critical nodes thereby making highly connected hubs less vulnerable to shocks. The example he gives is the contingency plans put in place by some financial firms after the World Trade Centre bomb in 1993 which entailed setting up data centres in Connecticut and Maryland. The result was that despite the 9/11 terrorist attack destroying NASDAQ headquarters, the redundant centres remained connected, displaying a system that was so resilient that according to some officials they could have started trading again within hours of the attacks (Homer-Dixon, 2006). The second example, which is directly related to the food system, is the need to move from "just-in-time production" that increases vulnerability to cascading failures to a system that encourages the build-up of stocks and inventories that can be drawn on during times of interrupted supply (Homer-Dixon, 2006: 284). In the food security literature, there has been an increased focus on the need to improve grain storage facilities in rural areas to act as a buffer in years of low productivity (see Ziervogel and Ericksen,

2010).

2.2.2 Vulnerability

The literature relating to vulnerability is vast and unconsolidated and has been made more so by the socio-ecological systems approach that links the social concept of vulnerability with the natural science idea of resilience research. Young *et al.* (2006) define vulnerability in the ecological sense as the situation where a system is neither robust nor resilient enough to survive without structural changes. In such cases they argue that the system must either adapt or go extinct. They refer to adaptation as the process of structural change in response to an external disturbance and adaptability as the system's capacity to adapt to future changes (Young *et al.*, 2006). Climate change research has emphasised a vulnerability-led rather than an impacts-led approach. This approach typically includes the underlying socio-economic and institutional factors determining people's responses and ability to cope with climate hazards rather than focussing on detailed scientific information relating to climatic changes, which are inherently uncertain (Brooks *et al.*, 2005). The IPCC (2007a: 21) fourth assessment report defines vulnerability as:

> "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes ... it is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity"

where adaptive capacity is

> "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."

The social sciences have two camps that define vulnerability differently. The disaster management/hazards community defines vulnerability relative to a specific shock that then produces a negative outcome (e.g. a disaster). Whereas the food security/development community defines vulnerability more as an outcome of human welfare relative to a range of potentially harmful perturbations (Bohle *et al.*, 1994). These two different epistemological positions on vulnerability are classified by O'Brien *et al.* (2004b) as 'vulnerability as outcome' and 'contextual vulnerability.' Dilley and Boudreau (2001)

trace the divergence of the food security and natural hazards definition of vulnerability to the 1980s move towards incorporating socio-economic and political causalities into food security discourse. Sen's (1981) paper on entitlements (and understanding hunger as a lack of access rather than production) resulted in a shift from emphasising natural causes of famine to societal ones with authors "invok(ing) the word 'vulnerability' to refer to the complex web of socio-economic determinants outlined by Sen" (Dilley and Boudreau, 2001: 233). Downing (1992) defines vulnerability in relation to a consequence rather than in relation a cause, which presupposed a negative outcome. Chambers (1989) refers to vulnerability as a combination of an exogenous exposure to risks, shocks and stress and an endogenous element of defencelessness as a lack of means to cope. In the food security literature, although environmental stresses can contribute to food insecurity, it has been argued that they only act together within contextual socio-economic, political and institutional factors that act as drivers changing vulnerability (Ericksen, 2008*a*). Using this approach on a local scale, household vulnerability to food insecurity can be said to occur through a failure in one of three entitlements: food availability (including distribution), access to food (affordability and markets) and utilisation of food (Maxwell, 2001). Although the entitlement approach to vulnerability has been criticised for underplaying ecological or physical risk, it does highlight inequalities that cause and result from vulnerabilities (Adger, 2006).

Despite their critique of an outcome-based definition of vulnerability, in their Tanzanian case study, Dilley and Boudreau (2001) admit that there is a limitation to the hazards approach in that whilst the assessment identifies shocks that threaten households and the characteristics of these households, it does not explain why the households were vulnerable to the shock in the first place. This is a severe limitation when the aim of a vulnerability assessment is to identify and implement *ex ante* coping mechanisms (i.e. increasing resilience by building adaptive capacity) and this requires in-depth knowledge of the underlying reasons as to why a group may be vulnerable. Lovendal and Knowles (2007) argue that by defining vulnerability in terms of an unfavourable outcome allows a minimum welfare threshold in terms of food security to be defined. They therefore define vulnerability relative to the negative outcome of food insecurity. The ontology informing this logic is that because vulnerability is linked to the uncertainty of events, everyone is in a state of potential vulnerability and so it can be conceptualised as a continuum where the greater the probability of becoming food insecure, the more vulnerable one is (Lovendal and Knowles, 2007). This allows for a dynamic concept of food insecurity vulnerability as a state that people are constantly moving in and out of.

Although the hazards definition of vulnerability cannot wholly be transported into a food security discourse, Dilley and Boudreau (2001) do make an important point regarding the need to define vulnerability to 'what.' These stressors (external perturbations that cause stress) can be factors embedded in society (i.e. socio-political context), in the natural environment (e.g. changes in climate) or from their interaction and feedback (Misselhorn *et al.*, 2010). In order to decrease food insecurity, it is necessary to have an appreciation of what the stresses and changes are that threaten food systems as well as the mechanisms through which they generate vulnerability (Misselhorn *et al.*, 2010). Drivers of change have complex characteristics, which in turn shape the types of vulnerability they could produce, including: their temporal and spatial scale dynamics, extremes, varying levels of predictability, tipping points, change and reversibility as well as the ability to adapt (Misselhorn *et al.*, 2010). It is therefore not necessary to exclude adaptive capacity from a risk-approach to understanding vulnerability.

Adger (2006: 268) provides such a definition where vulnerability is "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt." By this definition, the adaptive capacity of systems to respond to stresses becomes the vital means through which to reduce vulnerability. Indeed, this flexible compromise between the two competing definitions is how vulnerability will usually be understood in this study unless otherwise explicitly stated: "dynamic vulnerability is the extent to which environmental and economic changes influence the capacity of regions, sectors, ecosystems and social groups to respond to various types of natural and socio-economic shocks." (Leichenko and O'Brien, 2002: 3). As well as incorporating notions of inherent vulnerability, this definition also considers the global drivers of change that have multi-level impacts whilst leaving open the mechanisms through which coping responses occur.

2.2.3 Adaptive capacity

The capacity to adapt to these stressors forms the central theme around which this study is based: identifying adaptive capacity in the food system to impacts from climate change. Adaptive capacity can be defined as "the ability or capacity of a system to modify or change its characteristics or behaviour so as to cope with existing or anticipated external stress" (Adger *et al.*, 2004: 34). Extending this, reductions in social vulnerability (Liverman, 1994) due to the realisation of adaptive capacity within a system, are termed adaptations

(Adger *et al.*, 2004).[3]

Adaptive capacity is the property that reduces vulnerabilities in the system making it more resilient. This system resilience comprises, amongst other things, entitlements like economic access to food. Hence, a failure in these entitlements will result in an increase in vulnerability (Sen, 1981; Maxwell, 2001). The food system's ability to undergo the requisite changes to maintain its resilience under future impacts will include its ability a) to adjust to a change, b) to buffer potential damages limiting its ability to provide food security, and c) to take advantage of opportunities offered by this change (adapted from IPCC 2007).

Anderies *et al.* (2004) make an interesting point that it is necessary to recognise both the designed and self-organising components of an SES: the concepts of 'resilience' and 'adaptive capacity' are more descriptively useful than practically applicable to active design: how does one actually design for adaptive capacity? They prefer to use the concept of robustness, often used in engineering, which emphasises the cost-benefit trade-offs associated with designing for unpredictable perturbations (Anderies *et al.*, 2004). However, the authors themselves acknowledge the difficulty of applying an engineering concept to SES, which are self-organising and exist in high uncertainty. Therefore, for the purposes of this study, the concept of adaptive capacity is more relevant than that of robustness because it allows for transformation and flexibility- the opposite of robustness.

This study looks at the adaptive capacity of private sector actors as structural components of the food system. As food system structures, I argue that their capacity to adapt to climate change is critical to the overall adaptive capacity of the food system. The research aims to identify elements of adaptive capacity within the private sector of the food system that will enable it to cope with future climate change stresses and thus fulfil its role of providing food security at the individual level.

2.3 Complex adaptive systems theory

The food system is a complex interaction of actors and their activities with food security as its 'complex outcome' (Ericksen *et al.*, 2010). It is therefore fair to argue that the food system, as a socio-ecological system, is also a complex adaptive system (CAS). CAS theory

[3]Adaptive capacity can be thought of in the sense of remaining in an adaptive cycle of collapse and renewal, which infers a backloop of recovery that bounces the system back and retains its essential function. However, recent work on *transformations* can be thought of as actively bouncing the system forward- into a more desirable state. This does not maintain the system's resilience, as it changes its essential function, but it is arguable an adaptive process.

has become an increasingly important area of interdisciplinary research and leading groups working on it are the Santa Fe institute and the Resilience Alliance. However, much of this work remains in the realm of the theoretical, mathematical or applied to ecological systems at the local level. Although conceptually CAS theory makes sense, it is difficult to find practical case examples of it being employed to assess adaptive capacity across levels (See for example Resilience Alliance case study examples[4]). This could be attributed to the increased plurality of factors operating at higher levels of organisation and therefore a loss in ability to attribute causation in any particular direction. It could also be due to the difficulty of attributing characteristics to social systems that emerge from the system itself rather than from the mindful action of the human actors within the system. For example, one area where CAS theory has been strongly advocated, but where its plurality and lack of coherence has proved problematic, is in the study of social systems like organisations. Results of such studies have shown that during their development, organisations tend towards equilibrium and stability rather than novelty or dynamism and that power differentials and other psycho-sociological factors are more relevant than those relating to adaptive behaviour, self-organisation or emergence (Houchin and MacLean, 2005). As social organisations, the food businesses that provide the case studies for this thesis are used to illustrate that practically this 'tendency towards equilibrium' needs to be overcome through a change in governance in order to respond to complex and uncertain future environments or 'turbulence.' This governance challenge is dealt with in particular in **Chapters 4 and 5** as they cover the second aim of the thesis, which is to ground CAS theory using empirical examples.

That being said, although organisational studies offer only one example of a critique of the practicality of research based in CAS theory, it makes a relevant point that came through during this study. CAS theory seemed to be the most logical means of tying together the thesis across different levels due to recurrent themes of emergence, complexity and uncertainty, but from a theoretical perspective it proved difficult to piece together bits of the theory since they had evolved in different disciplines. The main critique levelled at CAS theory lies in this lack of coherence around the terminology associated with complexity (quite often it conflates chaos with complexity) and therefore the plurality of definitions associated with it (Morel and Ramanujam, 1999). Although flexibility is desirable, it becomes problematic when there is a need to tie the different definitions together again as was the case in this study. The remaining sections are therefore an attempt to

[4] `http://www.resalliance.org/index.php/case_studies`

reconcile some of these contradictions and explicitly to state what interpretation of CAS theory was applied in this study because despite these critiques, it still provided the most coherent theory around which to organise the thesis.

2.3.1 Complex adaptive systems

There are 6 main attributes of complex adaptive systems that are not present in simple systems and which lead to their complexity: nonlinearity, uncertainty, emergence, self-organisation, scale and adaptive renewal cycles. Each is briefly introduced below.

- **Nonlinearity** is demonstrated through disproportionate relationships between system states over time. Confusion between chaotic and complex models can arise at this point because all nonlinear models produce multiple solutions/equilibria/stability domains each of which may have their own threshold effects. According to Berkes *et al.* (2003), complex systems organise around one or several possible equilibrium states/attractors and when conditions change, the system's feedback loops tend to maintain its current state, but if it is at a threshold, the system could change rapidly and flip: this process is rarely predictable and forms the cornerstone of maintaining resilience.

- **Uncertainty** then arises precisely from the inability to predict which of the multiple states will occur. (In chaotic systems, this is related to initial conditions where the slightest change in the starting point can lead to a fundamentally different outcome).

- **Emergence** is when a system's properties emerge from the interaction of its components. This means that merely understanding the individual components themselves is insufficient for understanding the behaviour of the entire system.

- **Self-organisation** means that open systems will reorganise at critical points of instability. The process of self-organisation after a disturbance will draw from temporal and spatial scales above and below it (Folke, 2006). Self-organisation is the process through which 'order arises from chaos' (Prigogine and Stengers, 1985). Much of Ilya Prigogine's work on complexity is based on the property that a system self-organises into order (a dissipative structure) at a bifurcation point, which can occur due to feedbacks from a subsystem (see below on panarchy).

- **Scale**: complex systems are never just one system, but a nested set of systems or 'panarchy' (Gunderson and Holling, 2002). When coupled, they create feedbacks

and therefore need to be analysed simultaneously at different scales. But, it can be problematic to analyse social and ecological systems together as they often operate across different temporal, spatial and other scales (Young *et al.*, 2006).

- **Adaptive renewal cycles**: Linked to issues of scale is the concept of a dynamic panarchy that Gunderson and Holling (2002) refer to as an adaptive renewal cycle. Cyclic change is an essential characteristic of all SESs (Berkes *et al.*, 2003) and all systems undergo slow processes of exploitation and conservation followed by rapid change and 'release' after which the system reorganises (Holling, 2001). This illustrates the dynamic balance between change and memory and between disturbance and diversity in CASs (Berkes *et al.*, 2003). Schumpeter's (1943) reference to 'creative destruction' echoes this exact process within the bounds of the economic system under capitalism.[5]

Berkes *et al.* (2003) highlight three implications of accepting the characteristics of complex systems. The first is to recognise the inadequacy of models and linear thinking perspectives: there is a key difference between viewing quantitative prediction as difficult and data intensive (most scientists understand the fundamental constraints of their models) versus understanding a system as not equilibrium-centred, but inherently unpredictable and complex and therefore requiring different analytical tools. The second is that the lack of one 'correct' numerical solution requires complementary qualitative description. This implies an appropriate role for both quantitative and qualitative data. Finally, due to the multiplicity of scales, and levels across which CAS function, there is not one 'correct' all-encompassing perspective. This requires broad-based participation in the management of complex systems. Holling (1986) calls for a 'science of surprise' that views notions of control and prediction critically.

Further to its introduction in chapter one, below is a brief description of how complexity has contributed to a new understanding of economics. The usefulness of CAS theory is evident in its ability to bridge the natural and social sciences: its applicability to economic theory is one such important development.

[5]"The opening up of new markets, foreign or domestic, and the original development from the craft shop and factory to such concerns as US Steel illustrate the same process of industrial mutation- if I may use that biological term- that incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one. The process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in." (Schumpeter, 1943: 83).

2.3.2 Complexity economics

The story of science over the 20th century was one of loss of certainty: from being defined by its power to predict and a clear subject/object distinction, "science after science lost its innocence" (Arthur, 1999: 31). Economics as a discipline relied on physics for its initial mathematical development, but as physics developed in line with an increased understanding of the physical environment, economics failed to remould the assumptions upon which it was formulated and maintained that the economy is a closed system tending towards equilibrium (Beinhocker, 1997).[6] It therefore kept its certainty. This in part can be attributed to Friedman's (1962) well-known description of economic methodology that as long as your results are correct, it does not matter what you put in.[7] However, as his contemporary Hayek pointed out, increasing our knowledge of complex systems often comes at a cost of decreasing our ability to predict and that this is evident in the study of the economy (Hayek, 1999).[8]

However, the change that took place in the physical sciences over the past century is starting to filter into economics. Arthur (1999) argues that there are major pockets of uncertainty in economics and that in response, economics is opening itself up to a less mechanistic and more organic approach that recognises the economy not as a machine, but as a collection of agents: "once assumptions of perfect rationality, perfect information and homogeneity are removed, expectations of individuals become 'fugitive'- predictions become unstable" (Arthur, 1999: 40). This has led to innovative research around recognising the complex nature of the economy and the development of complexity economics, spearheaded by the Santa Fe institute (see Anderson *et al.*, 1988; Arthur *et al.*, 1997; Blume and Durlauf, 2006). They essentially provide a new mathematics for understanding the economy, which is similar to the revolution that took place in scientific thinking over the discovery of chaos and complex system phenomena (E.g. Gleick, 1996; Stewart, 1990; Prigogine, 1997). Even econometrics, which is based mainly on identifying the

[6]He calculates that if the economic system were indeed tending to equilibrium, this would take approximately $4.5X10^{18}$ years (Beinhocker, 2007: 63)

[7]The counterargument put forward by the logical-empiricist school is that scientific theories are there not to make predictions, but for their explanatory powers and that prediction should be used to differentiate two competing explanations.

[8]Beinhocker (2007) provides an in-depth discussion on what he refers to as traditional economics from its foundations in classical economics as pioneered by Adam Smith's concept of human self-interest, through the Marginalist era where Walras introduced mathematics to calculate the equilibrium point of markets and Pareto's efficiency to the neoclassical synthesis that led to Samuelson's replacement of utility with preference and Arrow and Debreu's general equilibrium theory that combined all of the above with a set of general assumptions: "rational self-interest operating in competitive markets would drive the economy to its optimal point" (Beinhocker, 2007: 38).

statistical relationships between variables, would be profoundly affected if the economy were to be recognised as a chaotic or complex system because (as mentioned in **Chapter 1**) current statistics are based upon linear relationships that are unsuitable when applied to non-linear systems. A reanalysis of how the economy is understood, modelled and explained could therefore have a profound impact on how society interacts with the market.

Arthur *et al.* (1997) have identified 5 features of the economy that present problems for the traditional mathematics used in economics:

1. There is dispersed interaction between multiple agents over time and space.

2. No global entity controls these interactions.

3. The economy comprises cross-cutting agents that interact across many levels and the system constantly adapts through revising their behaviours, actions, strategies and products.

4. Ongoing, perpetual novelty results from the continuous creation of new niches to be exploited. The evolutionary idea of punctuated equilibrium- that change happens suddenly and rapidly in-between long periods of stasis- captures this idea of continuous, yet often rapid, periods of change. Long-term survival therefore requires continuous adaptation rather than the competitive advantage prescribed by traditional economics (Beinhocker, 2007). This reinforces the concept of 'creative destruction' (Schumpeter, 1943)

5. This continuous novelty means that the economy always operates far from any equilibrium. This departure from equilibrium entails two departures from the classical model: equilibrium analysis is replaced by evolutionary analysis where behaviour persistently responds to constant incentives and secondly, the competitive-equilibrium assumption of behavioural anonymity is replaced by the assumption of behavioural interdependence that allows for personal links between agents' preferences and sets of choices (Samuelson, 2006).

These features challenge the basis on which neoclassical economics is based on two fronts: the assumptions it makes regarding the cognition of economic agents and the structural foundations of the economy itself.

The assumption that economic agents are rational optimisers, which includes their access to perfect information, is replaced in complexity economics by the pluralistic viewpoint: that people make sense of situations with limited resources. Work by Arthur (1999) based on cognitive psychology has shown how agents form expectations, not deductively, as assumed in traditional economic theory, but using inductive rationality. They are therefore not always going to make the mathematically optimal decision, but they are good at making quick decisions in the face of changing information (Beinhocker, 2007). Evolutionary economics further shows that selection (i.e. selecting for the 'most-fit' or beneficial outcome) is not always rational in the conventional economic sense. History is clear that economic decisions are often influenced by other factors like politics, aesthetics and ideology, which do not necessarily result in optimisation (Mokyr, 2006). Complexity economics argues for incorporating actual rational behaviour: "that of agents making decisions with incomplete information in complex, changing environments" (German, 2011: 27).

Furthermore, in general equilibrium analysis, agents interact through markets, not through each other, and in game theory, all players interact with all the other players. However, in the complexity approach, economic action is structured through emergent social roles and institutions, arguably just as in real-life. Agents interact through networked structures that operate across different levels and create new structures. The result of running bottom up agent-based models based on these foundations has shown the economy as a complex regime with an emergent set of behaviours that are mutually reinforced either positively or negatively (Arthur, 1999).

It can therefore be argued that the economy is a prime example of a complex, self-organising system (Prigogine, 1997), implying non-linear relationships, positive feedbacks, thresholds and that it is dynamical over time.[9] This aspect of the economy can be seen in the ongoing economic/financial crisis that started in 2008, which has continued to trouble economists and financial analysts. In fact, critics have actually accused economists' reliance on neoclassical economic theory and models of being largely responsible for the crisis (German, 2011).

Although complexity economics is still centred on mathematics, with models as an output, reviewing the assumptions of traditional top-down models that assume markets

[9]Although some authors argue that the economy is an example of a chaotic system, others believe that it has too many components and is therefore complex. In this thesis, I do not argue either way, but draw from both perspectives when relevant as they both form an alternative to thinking of the economy as a simple, linear system.

self-stabilise around an equilibrium is necessary if it is agreed that the economy is in fact a complex adaptive system. More recent findings have shown that learning is an important component of economic modelling and that interaction mechanisms can actually be more important than specific agent behaviours or assumptions regarding their rationality in driving asset markets (Blume and Durlauf, 2006).

Within the food system, traditional economics' fixation on treating the economy as a closed system in equilibrium has had serious implications. For example, the 'law' of supply and demand driving market price towards equilibrium is often a fundamental assumption in economic analyses despite evidence to the contrary in the form of shocks, stocks, backlogs, time lags etc. (Beinhocker, 2007). Recent rapid food price increases are a prime example of how this economic law does not equate with reality and that making policy decisions based on such incorrect information can have dire consequences for the poorest (FAO, 2010). Despite a period when food prices had been steadily declining for decades, since 2008 food prices have been extremely volatile and increasing, thus illustrating that a long-term linear relationship cannot be inferred from short-term trends (even if these span several decades). Food security and in particular price volatility (and how to cope with this) would benefit greatly from a more complex analysis of how the economy and markets function in order to provide more realistic information (if not necessarily predictions) upon which to base policy. Behavioural economics advocates relaxing some economic assumptions to include dynamism, non-linearity, positive feedbacks and models based on less than perfect information/rationality/markets. Although still imperfect, the explanatory value of economics as a discipline can be harnessed in lieu of its suspect predictive ability.

Complexity has also contributed to other more applied areas of economic theory and in particular the perception of risk by organisations. "Interconnected risk factors and possibility for cascading failures make complex systems fragile" (Bonabeau in Selsky and McCann, 2010: 172). Schweitzer *et al.* (2009) stress that an approach that understands the complexity of economic networks is critical for revising traditional paradigms of the economy. They focus on the difficulty of prediction and control of a networked system full of interdependencies and feedbacks and emphasise the need for a challenging research agenda in this field. "The tight connectivity of complex systems also increases the likelihood that a disruption in a system or one part of the system could jump a boundary and produce 'synchronous failure' (Homer-Dixon, 2006) or a cascading series of unexpected events (Farjoun and Starbuck, 2007)" (In Selsky and McCann, 2010: 172).

Recent work by Kali and Reyes (2010) illustrates that the connectedness of countries

can be an indicator of vulnerability to financial contagion depending on whether they are sufficiently integrated to be 'important' nodes. The result is that well-connected countries can dampen the effects of a shock, but that when they are originators of the shock, the effects of the shock are far more likely to spread than if it were to have come from a less well-connected country. There is capacity for dampening shocks under integration, but over-reliance on the network for provision of services during a shortage can mean that if there is a failure in one node, the whole system could be negatively impacted. The spread of the financial crisis in 2008 arising from failures in the US housing market leading to a collapse of banks in Western economies and a global credit problem, is an example of how our networked economy is impacted when a key node fails- and how system feedbacks can amplify these effects (Van der Heijden *et al.*, 2010; Biggs *et al.*, 2011). As these events are impossible to predict exactly, more resilient economic networks need to be forged that are sufficiently flexible to these uncertainties.

However, this is not only relevant to economic networks. Biggs *et al.* (2011) expand on this notion that as a result of global drivers becoming dominant over local ones and increased connectivity, we are entering an era of 'concatenated crises'[10] in socio-ecological systems. They use the 2007 energy-food-financial crisis as a perfect example of how individual responses to a crisis (e.g. biofuel production policies/export restrictions) together with global drivers (e.g. drought) can have a global impact (e.g. unprecedented rise in food prices) (Biggs *et al.*, 2011). This was recently repeated in the global food commodities market where environmental catastrophes (e.g. drought in Russia (Summer 2010), floods in Australia (January 2011)) affected production in crucial food exporting countries once again sending prices sky-high.

This analysis highlights the need for a new form of governance that accounts for these complex and uncertain processes across multiple levels. The inherent uncertainty in these complex, interdependent systems means that predicting such concatenated crises is probably beyond our means and we therefore need to learn how to exist in a dynamic global system undergoing diverse changes (Biggs *et al.*, 2011). Adapting will require commensurate societal and institutional changes and governance is a key foundation for this.

[10]Concatenated crises are understood as disturbances i.e. "shocks that emerge near simultaneously, spread rapidly and interact with each other across the globe" (Biggs *et al.*, 2011: 28).

2.4 Governance in the private sector

Governance is a common thread running through the thesis and is analysed and discussed deeply in **Chapters 4 and 5**. This section aims to link governance with relevant concepts arising from Complex Adaptive Systems (CAS) theory. It begins with a discussion on how complex systems theory entered management and organisational studies through the concept of 'turbulence' and what implications this has for strategic thinking about an uncertain future. Extending this body of thought from the systems theorists has further applications around stakeholder engagement in decision-making processes as well as for equality. These shifts in strategic thinking can be related to recent trends in corporate social and environmental responsibility (CSER) and especially how the concept of 'sustainability' has become an all-encompassing banner around which holistic systems thinking in the private sector can muster, which will be discussed further in **Chapter 4**. Finally, the relationship between these developments and an 'adaptive food governance' agenda is introduced. This forms the basis for the broader discussion in **Chapter 5**.

2.4.1 Organisational theory and turbulence

The complexity of systems can no longer be ignored in organisational management because the uncertainty and instability of the future becomes impossible to plan for actively. Clippinger (1999: 1) refers to the need to manage organisations that "have become so interconnected, so volatile, and so complex that they have become unmanageable by conventional means." There are two main implications of complexity for management: 1- small changes have disproportionate and often unanticipated consequences (sensitivity to initial conditions and nonlinearity), which negates the utility of forecasting and 2- complex systems self-organise and because the sum of their constituent parts is more important than the individual components, diversity of actors within the system should be maintained. The outcome is that it therefore falls to managers to influence the self-organisation of the system from below rather than controlling it from above, which has been the traditional method of management (Clippinger, 1999).

The following sections trace how CAS theory has been applied to organisation and management studies through the concept of 'turbulence,' which denotes an unpredictable, uncertain and complex environment. Turbulent environments make decision-making about the future that is based in linear, equilibrium thinking, problematic. Corporate Social and Environmental Responsibility (CSER) is used as an example of one response

that tries to rectify the systemic imbalances caused by linear strategic thinking by allowing for more holistic, diverse and inclusive perspectives. There are also a variety of tools like scenario planning and participatory practices that are aligned with this new form of strategic thinking that are briefly discussed.

2.4.1.1 Causal Texture Theory and Turbulence

Since the 1960s, some organisations have recognised the increasing complexity of the business environment and have tried to develop tools to cope with this, especially for decision-making about the future. Emery and Trist (1965) developed causal textual theory (CTT) where they describe a dynamic organisational environment as 'turbulent.' This 'turbulence' results from complexity as well as multiple causal interactions between elements in the system and their changing environment. The concept of turbulence comes from organisations finding themselves in an open system where they were operating in an increasingly complex and dynamic environment with various interdependencies (Emery and Trist, 1965). These characteristics are immediately identifiable with similar descriptions of chaotic systems and indeed, the work of Prigogine (1980) has contributed immensely to this field. The increasing volatility of the economy over the past two decades is an example of a high degree of external variability to which businesses must adapt (Macready and Meyer, 1999). Turbulence can be directly related to Clippinger's (1999: 25) description of the fitness landscape of organisations, which he maps onto an x-axis displaying the interconnectedness of the business environment (external ruggedness including a variety of factors like natural resources, suppliers, competitors etc) and y-axis displaying the interconnectedness of the organisation itself- its internal complexity (see Figure 2.2). An organisation needs to identify where they lie in the fitness landscape so as to adjust accordingly to the actual business environment. Turbulent environments would require organisations to be 'auto-catalytic networks' as per quadrant IV. These are characterised by innovation and flexibility due to an ability to self-organise and adapt to the most complex conditions.

McCann and Selsky (1984) defined another environment, which would arise when turbulence becomes endemic in a system: such escalating turbulence would result in a succession of structural instabilities (or an increase in entropy) eventually leading to a transformation or a 'bifurcation' (as described by Prigogine, 1980). Turbulent environments are not just evident in the private sector, but can extend to the public sector and to other organisational entities. Further developments in the field have come to contradict

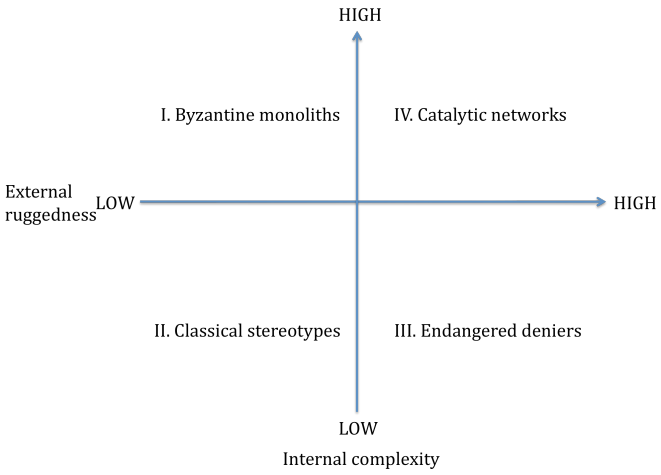

Figure 2.2: Fitness landscapes for organisations (Source: Clippinger, 1999)

some of the notions put forward by Emery and Trist such as that turbulence is an objective condition of the field (Ramírez *et al.*, 2010). Rather, Babüroglu (1988) suggests that people's experience of turbulence is moderated by their perception of their adaptive capacities and Selsky *et al.* (2007) explicitly suggest that field conditions will be experienced differently by different actors.

In turbulent fields, unpredictable sources of uncertainty in the transactional environment (unknown unknowns) lead to situations that have been described as " 'wicked' problems (Rittel and Webber, 1973), 'messes' or systems of problems (Ackoff, 1979) and 'meta-problems' (Trist 1979; Selsky and Parker 2005)" (Ramírez *et al.*, 2010: 22). How to handle this uncertainty has become the foundation of strategic planning in this field.

2.4.1.2 Tools for handling change and uncertainty

Turbulent environments require different decision-making tools for the future. Under turbulent conditions, traditional means of forecasting are no longer relevant because the future is "no longer stable, it has become a moving target [and so] no single 'right' projection can be deduced from past behaviour" (Wack, 1985: 73). Scenario building offers the potential for "imaginative and systemic thinking, which is becoming more valuable in an increasingly volatile world characterised by rapid change, surprise, discontinuity and frequent shocks, which are not easy to anticipate" (Selsky and McCann, 2010: 167). Complex systems are inherently unpredictable, and thus managers must learn to juggle shifting

objectives (Holling, 2001). This is likely to result in "a complicated and 'messy' matrix of formal and informal institutions" (Scoones, 2005: 12), which can only be adequately dealt with through a complex systems approach.

Pierre Wack, of Royal Dutch Shell, is the father of modern scenario planning; a planning tool that can provide insights into possible futures outside of a single, predetermined worldview based on identifying the future as an extension of the present. The key message from this new body of organisational theory is recognising change not as a disruption, but as a normal condition of organisational life (Ramírez *et al.*, 2010). Collaboration between actors is key to coping with turbulence and Ramírez *et al.* (2010) recommend scenarios as a tool for involving the perspectives of many different stakeholders in understanding the future, thus creating a form of collaborative governance. Scenarios can be harnessed as tools for discussing complex goals like sustainability, which can be interpreted differently by different people depending on their background and situation. It is also a useful way of generating a collective vision of possible futures from a range of stakeholders. These futures are not predictions, but thought experiments of how things could be or even normative ideas of how things ought to be and how to get there. By relying on a diversity of perspectives, they are ideal tools for making sense of CAS and this aspect will be discussed later on in this chapter.

2.4.1.3 Multiple perspectives

Complexity is reinforced by a "multiple interweaving of evaluative principles", which Stark illustrates in his case study on post-Soviet Hungary (Stark, 1999: 179). He argues that the challenge to governance is to maintain this diversity of principles because they form the basis of organisational adaptability (Stark, 1999). Recognising the need for diversity echoes Berkes *et al*'s (2003) statement that complex systems rely on a multitude of perspectives. This is akin to the ecological idea that increased biodiversity will increase resilience by affording the system greater capacity to absorb different shocks (Folke *et al.*, 2005). A diversity of opinion offers functional redundancy that means if a component fails for whatever reason (e.g. exposure to a stress) there is sufficient overlap to ensure that the whole system does not break down. In social systems this diversity operates in a similar way to build resilience because by maintaining a diversity of opinions and ideas, novel solutions and responses to as yet unknown stresses are preserved. This echoes Homer-Dixon's (2006) call for redundancy as a means of building system resilience that was mentioned earlier in the chapter. Creating redundant structures through maintaining

diversity can be a form of adaptive capacity, the identification of which is a central theme of this thesis.

There are few management or research tools that allow for this diversity and multiplicity to be accounted for, but developments in systems thinking have provided processes and methods for coping with the uncertainty that is generated from the diverse interconnectedness of a complex world (Lang and Allen, 2010). Systems thinking stems from an ontology of interconnectedness, but with an understanding that there are limits to our ability to understand how everything is connected to everything else; this creates boundaries and systems thinking is about how to explore these boundaries and deal with our inevitable lack of comprehensiveness (Midgley and Richardson, 2007). The definition of a system and its boundary is therefore a subjective process. Churchman's insight in the 1960s that value judgements always drive system boundary judgements is significant when discussing the ethics of systemic interventions (Midgley and Richardson, 2007). Applying a systems approach has further implications for research because it legitimises theoretical and methodological pluralism (Midgley and Richardson, 2007). Different theories assume different boundaries of analysis and so a flexibility of approach is crucial.

Checkland and Casar (1986 in Checkland, 2005) created a model of appreciation as an epistemology for how we create webs of significance that define and constitute the real world; reflexive that our experience in the world generates new interpretations of the real world and this defines our standards, norms and values on which we then make judgements and base our actions (Checkland, 2005). With this in mind, an 'ethical' definition of a system would need to involve as many perspectives as possible in order to be legitimate. Although this could often result in conflict, it is necessary for action research (Midgley and Richardson, 2007). Various authors have recognised this and have outlined frameworks for participation that are careful not to over-include perspectives, thereby stagnating action. These methodologies include Ulrich's critical systems heuristics (1987), Checkland's soft systems approach and Walker *et al*'s (2002) participatory approach for resilience management of socio-ecological systems. How 'wicked' situations are addressed, for example through the soft systems approach, is by placing different actors and their worldviews at the heart of the enquiry and working through an appreciation of these in order to generate learning from the situation (Lang and Allen, 2010). There is an important link here between the ethics of ensuring a multiplicity of viewpoints and ensuring equality between stakeholders. This has ramifications for how corporate social responsibility (CSR) trends are implemented in business strategies because CSR is often premised upon involving a larger number of interests in the role of the business despite

only a few actors setting the rules of the game. This contradiction is delved into more deeply from a governance perspective in **Chapter 4**.

2.4.1.4 Equality, Participation and Corporate Social Responsibility

Having a common ground in turbulent environments creates a climate of cooperation and social adaptability that in turn should result in a positive response underpinned by shared values in understanding the problem (Alahi, 2010). Athanasopoulou (2010) discusses how these inclusionary mechanisms can be incorporated into a corporate social responsibility (CSR) framework. From the 1970s, interventionists were questioning "the effectiveness of the invisible hand of competition as an ethical regulator of large corporations that shape the environment in which they operate and that, despite the necessity of government regulation, it is often not sufficiently knowledgeable, subtle or timely to reconcile the self-interest of corporate entrepreneurs" (Andrews, 1973: 58). In response, CSR was born in recognition of the social costs of economic activity and provided the opportunity for corporations to look beyond profits and focus corporate power on more socially desirable objectives (Andrews, 1973). In opposition to this notion were the economic isolationists, led by Friedman (1962: 133) who wrote that "there is one and only one social responsibility of business- to use its resources and engage in activities designed to increase its profits so long as it ... engages in open and free competition, without deception or fraud."

Calling on a systems approach and in particular the idea of needing a multiplicity of perspectives in order to understand a problem (or to generate useful ideas about the future) has implications for concepts of fairness and equality. "Wicked problems reflect the coalescence of social, technical and political dilemmas that cut across boundaries of communities, organisations or nations ... therefore decisions impacting on such multi-faceted issues being made through a single-issue lens will give rise to conflict between multiple stakeholder groups affected by cumulative impacts or unintended consequences [thereby] compounding systemic volatility of already turbulent environments." (Alahi, 2010: 224). Such positive feedback and interconnectedness across traditional boundaries requires new analytical tools for decision-making that take into account not only the characteristics of such dynamic and turbulent circumstances, but also the implications of the social dimension like deciding who gets to be included and how fluid power relations are constituted.

Despite these conflicting views, the notion of CSR has remained in various guises; as the notion of obligation that corporations have to society beyond their shareholders and

what is prescribed by law or contract (Jones, 1980) or as the degree of fit between the ethics of business and society's expectations of the business community (Zenisek, 1979). Athanasopoulou (2010: 244) identifies three modes of classifying CSR:

1. Stakeholder-driven CSR is a response to specific demands of largely external stakeholders.

2. Performance-driven CSR forms a link between external expectations and a firm's concrete CSR actions. It focuses on measuring CSR performance and selecting activities that can best deliver the requisite performance.

3. Motivation-driven CSR examines either the extrinsic reasons for a firm's CSR engagement or the intrinsic rationales of the firm's associated obligations and responsibilities.

However, Stormer (2003 in Athanasopoulou, 2010: 246) argues that the current economic paradigm, (where profit maximisation is the primary obligation of corporations), "does not allow CSR to move beyond the notion of an enlightened self-interest." Legal frameworks and the board's fiduciary duty to shareholders to maximise profit makes any other framing difficult to implement. A restructuring of the core of corporate governance structures is required in order to realise a complete shift towards principles of social and environmental responsibility. Stormer argues that "the neoclassical justification of the stakeholder model of corporations is no longer pertinent within an increasingly complex environment and that CSR should rather be conceptualised within an 'inter-systems' model where business is seen as one of several interrelated systems" (in Athanasopoulou, 2010: 246). Although this thesis looks at how companies are currently re-orienting their strategic plans to allow for the concept of social and environmental responsibility, the evidence shows that these shifts are still constrained by the overarching principle of profit maximisation. The argument put forward by Stormer is therefore extremely pertinent although it is not referred to further in practical terms in this thesis.

CSR has been entrenched in the ISO 26000 social responsibility voluntary standard (developed in 2010) that is governed by the principles of accountability, transparency, ethical behaviour, respect for stakeholder engagement, respect for the rule of law, respect for international norms of behaviour, and respect for human rights. It has 7 core subject areas: organisational governance, human rights, labour practices, the environment, fair operating practices, consumer issues, community involvement and development, the focus

of which is to maximise sustainable development bearing in mind the essential interdependence of each subject area. In order to implement the standards, organisations need firstly to recognise their social responsibility within their sphere of influence and secondly identify and engage with stakeholders. Once this is done, it is necessary to integrate social responsibility in decision-making processes throughout the organisation and to revisit practices on a regular basis to ensure that they are meeting continuously changing circumstances. The fundamental contribution of this new standard is that it recognises the need for the engagement of stakeholders beyond traditional expectations or what is defined by law. This emphasis on including multiple perspectives is a central tenet of employing a complexity approach to develop an adaptive governance.

Coming full circle, the recognition that a system of actors shape turbulent environments is a key element of Emery and Trist's (1965) CTT. Increased participation of multiple perspectives creates shared values that can serve as a common ground thereby facilitating stability (not equilibrium) (Emery and Trist, 1965). The mechanism they propose for bringing together these multiple perspectives is through the use of scenarios. But the idea of involving multiple stakeholders can also be used to address CSR issues relating to sustainability. Elkington and Trisoglio (1996) argue that sustainable development is a strategic issue and there is therefore an urgent need to form win-win solutions between corporations and their stakeholders. The formation of international bodies like the WBCSD, the Global reporting initiative (GRI) and the Food Ethics Council dealing with corporate issues around sustainability, is evidence of its increasing relevance. Despite this, we still lack much understanding of how to respond to complex issues like sustainability (which is an umbrella term under which most social and environmental problems fall). New ways of thinking and concomitant tools are required. It is here that a complex adaptive systems approach, understood by the business community through the concept of turbulence, becomes useful.

The papers forming **Chapters 4 and 5** deal more explicitly with the practical element of how sustainability has been incorporated into corporate strategy as way of coping with an increasingly turbulent environment. However, the original mechanism of applying this was through CSER and the incorporation of stakeholders' opinion in how business operates. This, often token, gesture has proved ineffective in dealing with the systemic issues that the concept of sustainability brings as many companies still face systemic risk. This thesis aims to shed some light on how the private sector can add to the adaptive capacity of the food system by internalising and recognising this complexity more fully into the foundations of how business is conducted.

2.4.2 Adaptive food governance

The characteristics of Complex Adaptive Systems (CAS) make them impossible to control and therefore difficult to manage or govern. As briefly discussed above, there are new ways of thinking about management and organisational theory that encapsulate the inherent uncertainty and unpredictability of CAS. The new ways of governing relate directly to Bohle *et al*'s (2009) definition of adaptive food governance as being sufficiently dynamic and flexible to cope with uncertainty as well as being integrated and holistic- arising from a network of agents. "The world food system is being reconfigured not only by the actions of authoritative actors such as states responding to pressure from their constituencies, but also through the autonomous actions of different social, political and economic groups whose aim is to ensure their own immediate food requirements" (Eakin *et al* 2010: 264). Not only are there increasing numbers of agents acting within the food system, but they have different understandings of what food is. A market-driven approach understands food as a commodity, from the environmental change literature, food is seen as an ecosystem service and from a human rights perspective, food is a basic need (Eakin *et al.*, 2010). Any form of adaptive food governance needs to reconcile these understandings, which means not relying on all-encompassing solutions like market-driven trade policies, environmental taxes or food aid packages as these only deal with certain aspects of the food system- a more holistic approach is required. Including a range of actors in the governance system is therefore the first step in reconciling these disparate understandings of what the outcomes of the food system are. Equitable participation across all levels of the food system is crucial to legitimise a system of adaptive food governance (Eakin *et al.*, 2010).

Complex Adaptive Systems (CAS), such as the food system, are process-dependent, organic systems with feedbacks across multiple scales and their emergent properties include having interactive, dynamic components that self-organise (Ison *et al.*, 1997; Folke, 2006). Complex adaptive systems are characterised by self-organisation[11] in which multiple outcomes are possible and so managing these types of systems requires taking unpredictability and surprise as matters of course, thus managers must learn to juggle shifting objectives (Holling, 2001). Dealing with this uncertainty requires "learn(ing) to manage by change rather than simply react(ing) to it" (Folke, 2006: 255) and this, in turn, requires learning how to make good decisions without full knowledge (Polansky *et al.*, 2011). Such adap-

[11] An emergent property of complex adaptive systems is that they self-organise- in an organisation this can be as the result of the combined effect of individuals actively changing practices from within in response to changing circumstances. This can be intentional, but it is only effective once it reaches critical mass and becomes an emergent property of the system.

tive or 'new' governance of self-organising entities tend to form "polycentric institutional arrangements" (Lee in Folke *et al.*, 2005: 449, Ostrom, 2009). These nested organisational units operate across multiple scales and a diversity of responses arise from this increased rate of interaction, making this system better equipped to deal with uncertainty and change (Folke *et al.*, 2005).

In order to sustain this continual adaptation and cross-level organisation, the following critical elements must be maintained: a diversity of actors, their localised interactions and the selective processes emerging from these interactions that shape the future structure and dynamics of the system (Folke, 2006). An important factor to consider is the changing (increasing and decreasing) temporal and spatial distance between different components of the food system (i.e. the disjuncture between coffee grown on a farm in Guatemala being found on a supermarket shelf in London). Thus system feedbacks become masked. This distance between the use of the resource and the environmental or social consequence (over space and time) of its production means that feedback signals do not work properly and so the self-regulating system fails to function effectively (Ramalingam *et al.*, 2008). Increased demand for bananas in the United Kingdom does not automatically translate into increased supply (and therefore better livelihoods) from, for example, Caribbean nations, because this relationship is mediated through a variety of other mechanisms: from the supra-national level in the form of preferential trade agreements and WTO disputes to the local level where the prices of agricultural inputs and access to transport infrastructure limit farmers' responses to market signals. Through increasing connectivity of globalisation, system components that would normally interact become distanced from one another whilst others become over-connected, leading to a breakdown in the system (i.e. collapse).

Up to now, humanity's management of socio-ecological systems has been to dampen variation in order to provide relative stability, but this interference has reduced systems' natural buffer capacity to shocks and led to positive feedbacks compounding shocks and increasing the likelihood of transgressing critical thresholds (Biggs *et al.*, 2011). To return to the analogy at the beginning of the chapter, this is evidence of us prolonging the growth phase of the adaptive cycle in exchange for system resilience thereby making collapse that is potentially much more catastrophic, inevitable (Homer-Dixon, 2006). Adaptive governance must ensure that these components once again interact in a manner that allows self-regulation and that there is the requisite diversity to provide redundancy in the event that a shock causes one part of the system to fail. Such failure would then allow for renewal whilst the system maintains its essential function (thereby building

adaptive capacity) rather than shifting into an alternative (and probably undesirable for the majority) state.

An emergent property of CAS is their ability to self-organise.[12] Anderson (1999) describes how a system's process of self-organisation can be harnessed to evolve adaptively to particular situations (e.g. the impacts of climate change). New behaviours/mental models/implicit theories emerge spontaneously from the interaction of individual actors; those behaviours that reinforce success are then selected for, repeated and become routine habits thereby reinforcing an organisation's structure (Anderson, 1999). Self-organisation therefore does not translate into no management, rather it means that there is no centralised control: "managers are stewards of the evolutionary process, not directors of activity- they provide governance instead of executing control [by] influenc[ing] the feedback that causes the network to self-organise" (Anderson, 1999: 127, 129). To extend the analogy to Prigogine's dissipative systems, which tend to spontaneous order through the continuous flow of energy, managers provide the continuous flow of energy into complex organisational systems by providing inspiration, generating challenges and encouraging the creative evolution of ideas (Anderson, 1999). They also provide a mechanism for communication of ideas between different branches of the organisation.

But, how does this translate into adaptive corporate governance in the food system? From the business literature "in a new business world that is an interacting web of fuzzy-boundaried, soft-assembled, self-organising coalitions, it initially seems unclear what kind of role our more direct and deliberate attempts at management and control could play" (Clark, 1999: 59). But he offers a solution: there is need of a governance system where the roles of 'Nanny, Coach and artificial DNA' are all played (Clark, 1999). He elaborates this analogy by saying that the 'Nanny' maintains an environment for creativity to flourish, the 'Coach' identifies potential obstacles and potential incentives to move the organisation forward and the 'artificial DNA' acts as a knowledge store and catalyst, which provides nudges at crucial points of development. Although arguably maintaining a top-down approach, an adaptive food governance regime would require these roles to be filled.

Some of the criticism levelled at this type of approach would be to argue that the conscious management of the system by a group of human actors negates the self-organising capacity of the system as a whole. By this logic, the resulting effect of management response would be caused by the mobilisation of bias in favour of the strongest (i.e. as a

[12]This can be as a result of many different situations: from the conscious effort by people within an organisation reacting to changing circumstances through to the colonial response of weeds to a cleared land area.

result of embedded power dynamics) rather than the evolution of new behaviours in response to changing circumstances. This argument denies the role that humans play in the socio-ecological systems of which we are a part and that what may seem as linear cause and effect on one level can result in an emergent property when taken in combination with other systemic process from a holistic systemic perspective. Seemingly disparate processes can suddenly coalesce and become transformative. A good example is the conscious decision to switch to renewable energy in European policy that acted as a catalyst for investment in biofuel production, which was then traced back as a factor leading to the food price increases in 2007-2008. In complex, adaptive systems such seemingly unrelated management decisions on one level can radically alter system behaviour at different levels as a result of feedback loops and complex interactions that we are not aware of. Although the power dynamics in these situations cannot be negated, rather than denying the aspect of self-organisation, management processes should attempt to become more inclusive and participatory- this diversity of opinion is actually advocated by a CAS approach to decision-making, especially when there are important trade-offs to be made (e.g. biofuels versus food crops). The importance of more inclusive 'bottom-up' approaches that focus on individual actors are discussed next.

As well as Clark's novel top-down model, a CAS requires the 'bottom-up' management that supports the system's self-organising ability from the most local levels. Structurally, the governance structure would require a heterarchy of interdepending actors as opposed to a hierachy of dependent actors or the complete independence inherent in the market (Stark, 1999). Clark (1999) goes on to list tools and devices through which an organisation could reach such diversity and flexibility: the use of 'tags' (e.g. logos/brands/symbols to reinforce meaning), building blocks (components that can be endlessly recombined) and internal models or scenarios, which are simplified representations of the environment that anticipate the future (see Clark, 1999 for full details). Polansky *et al.* (2011) also recommend scenarios as key tools for decision-making in the context of uncertainty. The use of scenarios as management tools is expanded on in **Chapter 4**: in essence they provide a dual role of process and outcome. In a heterarchy of interdepending actors, the process of scenario building provides the opportunity to bring a diversity of actors and their opinions together around the table to discuss their various versions of the future. The outcome of the actual scenarios themselves are also useful in that they provide new mental models that people can relate to because they were involved in their development. This emphasis on an inclusive process, a diversity of opinion and a focus on possible futures, mentally prepares people for coping with and adapting to uncertainty in the future.

Finally, in order to build the resilience of the system, the role of social capital has been highlighted.[13] Social learning and building a social memory of knowledge about the dynamics of the system are also important processes to be reinforced by adaptive governance. If decision-making is to be iterative, then a large component of an adaptive governance framework is based on learning between iterations. This requires communication between decision-makers, which involves levels of trust only achievable through strong social networks. Furthermore, much of the potential structures of adaptive governance discussed above include an element of joint governance between different stakeholders across different levels. Generating trust and common understanding around complex issues is crucial for effective collaborative governance (Polansky *et al.*, 2011). Social capital is therefore a key component of adaptive governance and is also vital for building resilience and reducing vulnerability to multiple stressors. It is also an important element of the sustainable rural livelihoods framework, which is described in the next section.

2.5 Sustainable rural livelihoods

The integrating concept of sustainable livelihoods was central to the Brundtland Report (WCED, 1987) and has since been dominant in the development literature, spearheaded by work done by Robert Chambers from the early 1990s (see Chambers and Conway, 1991). Facing an uncertain future with one of the only predictable factors being an increasing population, Chambers and Conway (1991: 2) proposed that any sustainable and equitable development strategy for the 21st century would have "to confront the question of how a vastly larger number of people can gain at least a basically decent rural livelihood in a manner which can be sustained, many of them in environments which are fragile and marginal." Their critique[14] of conservative thinking around concepts, values, methods and behaviours in the social sciences provided a welcome forerunner to alternative ways of dealing with development issues under conditions of accelerating change and uncertainty (Chambers and Conway, 1991). From its origins, the sustainable rural livelihoods (SRL) framework was designed with an uncertain future in mind and

[13]Social capital includes social networks, leadership and trust (Folke *et al.*, 2005; Scoones, 2005).

[14]This critique consisted largely of a criticism of reductionist approaches to development that they defined in into three areas: 'production thinking, 'employment thinking' and 'poverty-line thinking.' They argued that social science research required more practical and reflexive concepts that could cross the divide between different disciplines and their proposed framework was underpinned by three observable and measurable fundamentals: capacity, equity and sustainability. (See Chambers and Conway, 1991 for an in-depth discussion).

is therefore an ideal tool through which to approach development concerns in CAS like the food system. Its close links to the resilience literature is also clear from Chambers and Conway's (1991: 5) definition that a livelihood can be considered sustainable if it "can cope with and recover from stress and shocks, maintain or enhance its capabilities or assets and provide sustainable livelihood opportunities for the next generation and contribute net benefits to other livelihoods at the local and global levels and in the short and long term." This definition stresses the importance of the need for an SRL to develop the capacity to adapt to shocks across different levels and scales and can therefore be seen as a key focus area through which to build overall food system resilience.

The concept of adaptive renewal cycles provides insight to the SRL framework. In order to maintain an optimal system, high levels of stored capital are required, but this may make the system vulnerable in the long-term to disturbances or surprises that cannot be anticipated in advance (Holling and Meffe, 1996). Rather, the back-loop of an adaptive cycle (or Schumpeter's 'Creative Destruction') is a window of opportunity for inspiring novelty and creative innovation, which is a key element of adaptability (Berkes *et al.*, 2003). However, this requires diversity from a multitude of perspectives as well as social and ecological memory in order to allow the system to self-organise and enter the exploitation and conservation phases. The importance of maintaining a diversity of opinions was highlighted in the previous section and is reinforced here.

Indeed Chambers and Conway (1991) advocate increasing complexity and diversity rather than simplifying processes as a means of enhancing productivity. As was made evident in the discussion on turbulent environments, a cornerstone to effective management of uncertain and unpredictable futures is through engaging multiple perspectives. The SRL framework similarly provides a space for multiple, different perspectives and approaches to be negotiated and for the cross-level effects of certain responses to be fleshed out. Scoones (2005) provides an illustration of the importance of open, multi-stakeholder discussion. He points out that although a successful agricultural intensification strategy pursued by an individual may provide an opportunity for another to develop a strategy to process or trade the product, on the other hand it may undercut another's strategy by diverting land, labour, credit or markets. Appreciating the scale of impacts and responses is crucial because on one level livelihood specialisation may make sense for an individual, whilst the household diversifies and whilst a certain village may specialise, this could happen in the context of a diversified regional economy (Scoones, 2005). The point is that different strategies work at different levels and is the reason why a cut-and-paste policy approach across the board does not work. Stiglitz's (2006) critique of the 'cookie-cutter'

approach of Structual Adjustment Programmes (SAPs) that applied similar economic models to countries with diverse characteristics is a good example of why strategies need to be focussed on a particular level, but contextualised within broader national/regional objectives. Another important aspect is that due to globalisation, the adaptive responses of a community in one region could have impacts (positive or negative) on a community on the other side of the world. Adger *et al.* (2009) give the example of how increased production by Vietnamese coffee farmers in the 1990s lowered global coffee prices thereby negatively impacting coffee farmers in Mexico that were reliant on high prices. They refer to this as an example of 'teleconnected vulnerability' where the vulnerability of a socio-ecological system in one region may be exacerbated by vulnerabilities elsewhere (e.g. due to economic change) translated through the structure of integrated markets (Adger *et al.*, 2009).

This dynamism of livelihood portfolios across scales and levels is necessary in order to respond effectively to uncertain futures in a similar way to how organisations working in turbulent environments need to be flexible to cope with the vagrancies of operating within a CAS.

> "Enhancing livelihood capability in the context of change and unpredictability requires being adaptable, versatile, quick to change, well-informed and able to exploit diverse, complicating and changing resources an opportunities." (Chambers and Conway, 1991: 22).

According to the IDS framework, SRL's are achieved through access to a range of livelihood resources, (natural, economic, human and social capital[15]) which are combined in the pursuit of different livelihood strategies (Scoones, 2005). This achievement is mediated by structures and processes, institutions and a need to recognise the "often

[15]Bebbington (1999) was the first to broaden the scope of rural livelihoods into more than just natural resource dependent communities and he centred his approach around access to the four capitals. "Not only are these capitals the means to an end of survival, but they endow the user with the power to act and control how the resources are used" (Bebbington, 1999: 2022). Scoones (2005: 7) described the four capitals as follows: "Natural capital is the natural resource stocks (soil, water, air, genetic resources etc.) and environmental services (hydrological cycle, pollution sinks etc) from which resource flows and services useful for livelihoods are derived. Economic or financial capital is the capital base (cash, credit/debt, savings, and other economic assets, including basic infrastructure and production equipment and technologies) which is essential for the pursuit of any livelihood strategy. Human capital is the skills, knowledge, ability to labour and good health and physical capability important for the successful pursuit of different livelihood strategies. Social capital is the social resources (networks, social claims, social relations, affiliations, associations) upon which people draw when pursuing different livelihood strategies requiring coordinated actions."

complex and messy institutional matrix mediating livelihood change" (Leach in Scoones, 2005: 12). This matrix determines trade-offs between different capitals. An example of this trade-off is provided by de Waal where he observed that despite Maslow's hierarchy defining food access as a fundamental and basic necessity driving choices, during the 1984-85 famine in Darfur, Sudan, people chose to go hungry in order to preserve assets and future livelihoods (de Waal in Maxwell, 2001). What this illustrates is that it is impossible to discuss food security by focussing solely on a 'food first' perspective, but that a discussion of livelihoods is necessary. It also negates the standard assumption of rationality in traditional economic theory: that people would choose to sell assets before starving. Maxwell (2001) employs this in order to define three types of households: the enduring household that maintains its food security continuously, the resilient household that recovers quickly from a food security shock and a fragile household is one that becomes increasingly insecure due to its responses to shocks.

Using SRL as an analytical tool (and informing the methodology), the new role of the private sector in developing sustainable rural livelihoods for the provision of food security under uncertainty (not only of climate change, but of the food system itself), is explored in **Chapter 3**. It provides the final level of analysis, that of the household and individual, which needs to be accounted for in a regime of adaptive food governance.

2.6 Concluding remarks

This section has provided an overview of the history of food security as a concept and how this led to the development of a food systems approach to issues of food insecurity. Since the food system underpins the outcome (or absence) of food security, understanding it as a socio-ecological system has important implications for how relevant research is conducted on the food system. Furthermore, socio-ecological systems are a subset of complex adaptive systems (CAS). CAS have a theoretical underpinning that has developed over decades and which has been applied across a variety of disciplines, evolving over various iterations. CAS theory has therefore been incorporated in disciplines as diverse as institutional and organisational theory to economics and ecology from where it was first employed in the work of Holling (1973).

Considering the wide application of CAS theory, despite its relevance to a study of adaptive capacity in the food system, it has proved difficult to reconcile some of the different aspects of the theory as they relate to components of the thesis. This section

attempts to bridge some of the divides and to construct a coherent concept of how CAS theory has informed the work in this study and how it forms the common thread linking the three substantive papers that follow.

The next chapter is the first of the three empirical chapters that pull together the theory described in this chapter and apply it to case studies in order to answer the 8 core questions of the thesis. There are three aims that are addressed in **Chapter 3**: *to move beyond an understanding of food security as dependent solely on agricultural production; to ground the theoretical aspects of CAS with empirical data; and to investigate the potential role of the private sector in food system futures.* In doing this, the evidence provided in this chapter will answer key questions 3 and 6: *What role does the private sector play in achieving food security across scales and levels, and What mechanisms for adaptive food governance can be identified in the food system?*

Chapter 3

The role of the private sector in building rural food security

This chapter is based on the following paper submitted to Development Policy Review: Pereira, L., Cuneo, C.N. and Twine, W. C., "Food and Cash: Understanding the role of the private sector in rural food security."

In this paper, we acknowledge that the food system in rural South Africa consists of both formal and informal components of small-scale manufacturing enterprises, local traders, and farmers. It is necessary to include the full spectrum of these actors when addressing issues of building adaptive capacity in the food system. However, the role of private-sector actors in the developing world, especially within SSA, has largely been neglected by food policy analysts and government. Our results illustrate the importance of considering the role of retail in rural areas as a key part of any rural food policy strategy. The communities in our study site, Agincourt, were found to be exposed to four macro-trends; globalisation and projected climate change on an international level, deagrarianisation and the expansion of the private sector at the local level. These changes are occurring within the policy context of the South African government's focus on rural development policies (EDD, 2010). Employing a systemic approach to food security issues (that includes the needs of the private sector), highlights the need for effective coordination between institutions in order to meet the diverse needs of rural communities.

The paper was the result of a collaboration with a senior lecturer, Dr Wayne Twine, at the School of Animal, Plant and Environmental Sciences department at the University of the Witwatersrand (Wits) and a Fulbright Scholar, Nicholas Cuneo, who had conducted extensive research in the Agincourt Health and Demographic Study Site (AHDSS) during the course of his placement. I first learnt of the ongoing project at Agincourt through contacts at Wits who recommended that I get in touch with Dr Twine to see whether I might get access to the project's extensive database for the 'local level' aspect of my project. Dr Twine then put me in touch with Nicholas whom I approached with an idea for writing a paper using the questionnaire and interview data that he had collected in Agincourt together with the data on the private sector that I had collected during my fieldwork. Dr Twine also granted us permission to use the AHDSS's survey database and he thus became a co-author on the paper, offering advice and suggestions on its structure.

My contribution to the paper was to provide the overall idea of the paper, which aims to study the role of the private sector in rural food security strategies. I wrote the initial draft of the paper, analysed the AHDSS data and conducted my own field research where I interviewed storeowners. Nicholas ran the statistical analysis of his data and wrote the sections on globalisation and grocery collectives. The subsequent editing of the paper was done equally between the two of us.

3.1 Abstract

Here we conduct an analysis of food security in the Agincourt Health and Demographic Surveillance System (AHDSS) study site in South Africa. Our results highlight four macro-trends affecting food security in the region: future projections of climate change and globalisation at the international level and deagrarianisation and related rural development policies at the local level. These drivers are shaping an evolving food system characterised by an increased reliance on purchasing food rather than growing it, especially for the region's poorest households. As rural households become increasingly reliant on the private sector in meeting their nutritional needs, food policy should be adapted accordingly.

Keywords: Food security, deagrarianisation, private sector, sustainable rural livelihoods, Africa, South Africa

3.2 Introduction

Sub-Saharan Africa (SSA) has the highest regional proportion of undernourished people in the world (FAO, 2010). Food security is therefore of major concern for development on the continent. Although South Africa appears fundamentally food secure at the national level, this changes when the scale of analysis is reduced to the local or individual level (Altman *et al.*, 2009). The recent shift towards conceptualising food security as an outcome of the entire food system has led to more holistic approaches to understanding it as a complex challenge that needs to be addressed across multiple scales and levels (Ziervogel and Ericksen, 2010). Food security is integrally associated with these food systems, which either succeed in achieving this security or fail to do so. Understanding the food system as a socio-ecological system, subject not only to pressures of environmental change, but also to those arising from societal change, is fundamental to addressing the complex processes involved in maintaining food security (Ericksen, 2008*a*).

Two global change processes can be conceptualised as 'double exposure': the product of global environmental change (GEC) and globalisation acting individually, synergistically, and even antagonistically on a system to create uneven outcomes or 'winners' and 'losers', entrenching vulnerability to these drivers in areas unable to adapt (Leichenko and O'Brien, 2008; Adger *et al.*, 2003). On the local level, reducing vulnerability to these processes requires a shift to more adaptive livelihood strategies that build local resilience. Local food security outcomes will only be improved by increasing this resilience in the food system through developing adaptive capacity in people's food security strategies. The sustainable rural livelihoods (SRL) framework combines socio-ecological systems theory with local concerns around livelihood strategies, providing an appropriate tool in researching how to build more adaptive local food systems.

The structure of the paper is as follows: we begin with an introduction to food security in South Africa within the context of the double exposure of climate change and globalisation, followed by an overview of our methods. We then present the quantitative and qualitative results from the case study. In the discussion, we explore two innovative strategies elucidated by the study, which we contextualise within the processes of double exposure. Based on these findings on livelihood strategies, we then propose recommendations for increasing adaptive capacity by leveraging the positive impacts of these two global processes while minimising the negatives.

In this paper, we specify globalisation as the current trends of deagrarianisation and the expansion of the private sector in rural areas. We limit GEC to the potential future

impacts of climate change. We argue that these simultaneous pressures are transforming rural food systems in a manner so far unanticipated in food policy. African communities are particularly vulnerable to climate change due to their dependence on agriculture as well as their exposure to extreme events (Vogel, 2005). Simultaneously, Africa faces a change in rural livelihood strategies as part of an ongoing process of deagrarianisation[1]. Bryceson (2002) argues that structural adjustment programs (SAPs) and their aftermath had a profound impact on rural livelihoods and income diversification away from agriculture. This decline in agricultural productivity can be linked to the change in policy brought in by SAPs that saw: 1) the removal of subsidies for agricultural inputs (especially fertiliser), which priced them out of the range of many, and 2) market uncertainty, previously mitigated either by set prices or marketing boards that guaranteed demand (Bryceson, 2002). This uncertainty has been linked to the reluctance of private traders to travel to distant areas where there is little or no transport infrastructure to buy produce, as well as hesitation on the part of the farmers themselves to spend money traveling to markets if there is no price guarantee (Bryceson, 2002). As a result, many former agricultural communities have been compelled to diversify out of agriculture in order to meet their livelihood requirements. This economic variation has had social implications for divisions of labour among household members (as woman were often "part of an agrarian family work effort"), and in livelihood decision-making processes that have repercussions on households' vulnerability to economic and environmental stresses (Bryceson, 2002: 733). These processes have resulted in households' becoming increasingly reliant on income in a cash-based rural economy.

This study is an empirical investigation of food security strategies in a rural region of South Africa, with particular emphasis on the role that the private sector plays in achieving food security outcomes. As a result of the drivers mentioned above, agriculture is no longer the mainstay of rural livelihoods in South Africa as it is in many other places across the continent; partially a result of its relatively unique historical and economic position within the region. By focusing on how food security strategies fit into the greater scope of livelihood strategies, this paper identifies key areas that can be developed within South Africa to create more resilient local food systems capable of withstanding future pressures from globalisation and environmental change. These areas include: 1) creating employment opportunities to generate income; 2) improving smallholder agricultural pro-

[1]Where deagrarianisation is described as "the long-term process of occupational adjustments, income reorientation and spatial relocation of rural people away from livelihoods structured around agriculture" (Bryceson, 2002: 726)

ductivity; and 3) leveraging the social grant scheme for improving access for the poorest (Altman *et al.*, 2009).

This paper contains a two-part analysis. First, we use an SRL framework to examine the quantitative and qualitative data in our case study community in order to describe the current food system, with particular emphasis on the role of the private sector in livelihoods. Second, we present options for developing adaptive livelihood strategies based on these findings with the aim of promoting community-level food security into the future. We argue that the private sector is currently playing a major role in local food security strategies while the focus of policy remains fixed on agricultural production, rather than other processes within the food system, such as developing local markets and people's access to nutritious food.[2] Furthermore, addressing poverty-related issues of food security cannot focus exclusively on the lack of a household's assets, but on constraints they face in effectively making use of these assets as well (Carter and May, 1999). Finally, there is a need to address the broader question of differentiating between what defines a coping strategy that deals with a particular stress over the short-term versus an adaptive strategy that builds household and community-wide resilience in the face of long-term changes. How the government can facilitate long-term adaptation rather than short-term coping is critical for rural development policy under the South African government's New Growth Path (NGP) (EDD, 2010).[3]

3.2.1 Food security under double exposure

The Food and Agriculture Organization (FAO, 2010: 8) states that "food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Scholars have interpreted this definition into the elements of stability of food availability, access, and utilisation (Schmidhuber and Tubiello, 2007). Most studies focus on just one element of food security (usually production), but in order to conduct a holistic analysis it is necessary to take all three elements into account. These elements

[2]This is chiefly a product of the National government's food security department being run as a sub-division of the Department of Agriculture (see **Chapter 4**).

[3]The New Growth Path (EDD, 2010: 12) ambitiously refers "to restructuring land reform processes to support smallholder schemes with comprehensive support around infrastructure, marketing, finance, extension services etc.; upgrading employment in commercial agriculture especially through improved worker voice; measures to support growth in commercial farming and to help address price fluctuations in maize and wheat while supporting national food security; acceleration of land claims processes and better support to new farmers following land-claims settlements, programmes to ensure competitive pricing of inputs, especially fertiliser; and support for fishing and aquaculture."

are discussed below in the context of double exposure to the macro-trends of globalisation (through the expansion of the private sector), deagrarianisation, and rural development policy and GEC (demonstrated though climate change) (See Figure 3.1). People then respond in a variety of ways in order to cope with these changes, often with the result that these responses create feedbacks amplifying the changes in food security outcomes. In this study we look at the role of the private sector as a mediating actor that can build resilience in the system, allowing for different, more adaptive, response mechanisms.

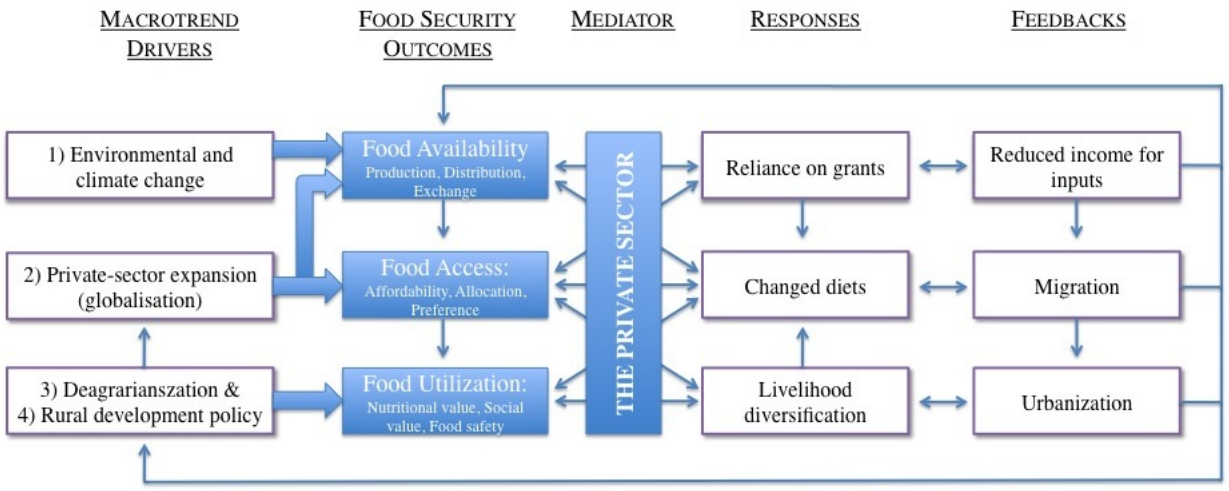

Figure 3.1: Conceptual model of the food system used in this study. (Source: Authors' own)

3.2.1.1 Food availability

Food availability is primarily concerned with the production and distribution of food with an emphasis on the productivity of agricultural systems. Agriculture is one of the most important sectors in Africa, both in terms of its contribution to national GDP, but also as a mainstay for local livelihoods. However, it is particularly sensitive to climate and climate variability arising from events such as the El Niño Southern Oscillation (ENSO), and there is high confidence that this sector will become increasingly compromised under climate change (Boko *et al.*, 2007). In southern Africa, an increase in extreme events have been reported to be exposing rural communities to a different and increasingly unpredictable context in which to farm: while drought has been identified as a prime risk, severe floods have also become more problematic over the past two decades (Thomas *et al.*,

2005). However, there is still limited scientific information on the observed frequency and projections of many extreme events in Africa despite much reporting of these events and their impacts (IPCC, 2012).

As climate change is a dynamic process occurring over many years, relevant short-term decision-making can be difficult, made more so by the uncertainty of models. In the absence of sufficient information from long-term regional models, early warning systems can be very useful to impart weather information to communities. The wider use of climate data for farmers is impeded by the spatial and temporal scale at which the data are available, which is often of little relevance to farmers who then lose faith in the projections (Ziervogel *et al.*, 2008). Though agricultural adaptation continues to take place in Africa (as always), subsistence farmers are not equipped with the necessary capital to be able to adapt adequately to changes even if they are aware of the need and appropriate means to do so (Thomas *et al.*, 2005). The challenge for ensuring food availability under climate change is to reduce subsistence farmers' vulnerability to climate change by increasing their capital base, thus enabling them to invest in technologies like irrigation and drought-resistant crops and in building infrastructure like facilities for the storage of excess produce. While our discussion focuses more on post-production means to improve food security, ensuring local production is vital if agriculture is to continue to supplement diets with the fresh produce necessary to improve micronutrient availability. Under the current trend of deagrarianisation, local agricultural productivity has been severely compromised; this decline must be reversed if rural communities are to become resilient in the face of global change.

3.2.1.2 Food access

Food access is largely determined by a consumer's purchasing power, which depends on economic growth, income, and resource distribution (FAO, 2003). Understanding how fluctuations in prices and supply translate into changes in the poor's access to assets—impacting their food security and livelihood strategies—is thus vital (Imber *et al.*, 2003). Misselhorn (2005) showed that among the poor in southern Africa, almost half of food intake is met through purchases in 'normal' years (i.e., they are net food-deficit producers) and there is a high reliance on food purchases to meet calorie requirements in years of crisis.[4] Food insecurity has thus become just one element in an entrenched cycle of

[4]The meta-analysis showed that 65 percent of food security was driven by a lack of access to food whilst only 35 percent was driven by a failure to produce sufficient food (Misselhorn, 2005).

vulnerability, as the poor often trade off livelihood strategies in times of crisis (e.g. selling assets to buy food) leading to a positive feedback cycle that exacerbates their vulnerability (Misselhorn, 2005).

As the food security literature expands, the role of functioning markets in maintaining food security is increasingly recognised, particularly the importance of the private sector as a source of system resilience as well as vulnerability (Stevens *et al.*, 2003). Indeed, the reliance of the poor (both urban and rural) on buying food was highlighted during the 2007-08 world food crisis, as were the strategies they undertook in order to cope with food price shocks (see IFAD 2010). The crisis was spurred by declining growth in production, shrinking stocks of grain worldwide, increasing energy prices, and rising demand from middle-income countries, together with two relatively new phenomena: loose financial speculation in agricultural futures as well as large-scale biofuel production (Mittal, 2009). The result was disastrous: an 83 percent increase in food prices globally between 2005 and 2008, leading to widespread shortages in low-income countries such as Haiti and Senegal, where food riots became commonplace (Rosegrant, 2008; Mittal, 2009). People who were reliant on food prices remaining stable were left unable to cope with a sudden spike in prices without a concomitant increase in their incomes or the buffer of viable, local agricultural systems from which they could access food.

Another influence of globalisation is the enhanced role that the private sector is playing in individuals' food strategies. Changes in the international financial regime have reduced barriers to foreign direct investment (FDI), which have, in turn, created new avenues for capital flow into the establishment and expansion of supermarket chains (Reardon *et al.*, 2003) and fast-food franchises (Ghezán *et al.*, 2002) across the developing world. While supermarkets have made major inroads in middle-income countries, displacing smaller firms and producers along the way, fast-food chains are capitalising on an increasingly migrant and well-compensated working class, recording substantial profits (Ghezán *et al.*, 2002). Indeed, the emergence of Western fast-food franchises across the developing world has become an important symbol of globalisation (Friedman, 1999). Wedded to this influx of transnational food suppliers has been the rise of food-processing plants, which have grown to become the greatest relative recipients of FDI within the overall food system. U.S. FDI in food processing companies increased fourfold from US$9 billion to US$36 billion between 1980 and 2000, while sales from those associated companies grew from US$39.2 billion in 1982 to US$150 billion in 2000 (Bolling and Somwaru, 2001; Hawkes, 2006). Together, this triumvirate of supermarkets, fast-food franchises, and food processing companies has changed the way that working-class people access the food they

consume on a daily basis across the developing world. It is therefore now necessary to include the private sector in food security studies (Schilpzand *et al.*, 2010).

3.2.1.3 Food utilisation

The above processes of globalisation have led to a major shift in dietary patterns, especially within middle-income countries, resulting in a 'nutrition transition' with a rise in relative consumption of fats and sweeteners worldwide (Hawkes, 2006). This transition has been implicated in a variety of public health issues, including levels of obesity, heart disease, and diabetes, which are increasing globally (WHO, 2003). Hawkes (2006) identified three major processes of globalisation responsible for precipitating this transition, which also serve to highlight the interconnections among the different levels of food security: 1) liberalising of international markets for trading and producing agricultural products (which has led to rapid increases in the availability of certain products, such as oil crops); 2) diminishing FDI barriers in companies that process and sell foods in developing countries (which has contributed to a shift in developing countries from smaller grocery outlets to larger, chain supermarkets selling a growing array of processed foods); and 3) increasing investment in and visibility of food advertising and promotion (which is aimed at changing the food culture in the countries in which such advertising is permitted). Altogether, these processes have contributed to a 'convergence of diets' in which peoples across the world have begun narrowing their focus on a limited number of staple grains, consuming more meat and dairy products, and increasing their intake of edible oils, salt, and sugar (Kennedy *et al.*, 2004; Hawkes, 2006).

The transformative processes of projected future changes in the climate and globalisation are having profound effects on food security, both positive and negative, creating a system of 'winners' and 'losers' that reinforces inequalities through uneven outcomes and generates increasing uncertainty about the future (Leichenko and O'Brien, 2008) (See for example Misselhorn, 2005). This is the macro-context in which rural livelihoods are set: 'double exposure' constrains strategies, but also provides opportunities that can be harnessed in order to create a more sustainable future. In our discussion, we return to how double exposure macro-trends are impacting food security strategies in the study site: as climate change leads to reduced reliability on annual agricultural productivity and thus lower crop yields, globalisation is fostering increased reliance on the private sector for the provisioning of food.

3.2.2 South African food security in context

South Africa's history is characterised by the systematic displacement of the indigenous black population, resulting in a process of 'black pauperisation', whereby blacks were stripped of land and other productive assets (Zimmerman, 2000; Aliber, 2003).[5] Under the apartheid system, areas demarcated as black reserves, or 'homelands,' constituted only 13 percent of South Africa's land area, and typically consisted of fragmented and isolated pockets of land with poor infrastructure (Aliber, 2003). The 1950s to the 1980s saw a massive relocation of the black rural population to these homelands as 'surplus' black residents on white-owned farms (i.e., those on whom the farm's productivity was not dependent) were forcibly removed and resettled (Seekings, 2000). As a result, population densities in the homelands soared, doubling between 1955 and 1969 (Simpkins, 1981). The former homelands are now home to 2.4 million rural households and a population of 12.7 million people (32 percent of the total population) (Adams *et al.*, 1999).

Lack of employment opportunities within the homelands, aggravated by severe shortages of arable and grazing land, led to widespread rural poverty (Francis, 2002; Aliber, 2003). This forced rural residents, especially men, to become migrant labourers in order to support their families. In fact, the main economic function of the homelands was to reduce and subsidise the cost of labour (Wolpe, 1972). The high population densities and drastic shortages of land transformed the economic and social organisation of these communities (Delius, 1996), precipitating the transition from an agrarian to a cash-based rural economy (Gelderblom and Kok, 1994). Seekings (2000) argues that an independent peasantry had been virtually eliminated by the end of the first decade of the apartheid regime effectively "nipp[ing] peasant commodity production in the bud" and making the rural population a functional labor reserve (Bryceson, 2002: 727). In a study by Marcus and Eales (1996) in which attitudes of rural households about land were surveyed, approximately 33 percent of respondents indicated no interest in acquiring more land, while a similar proportion wanted one hectare or less for subsistence cropping. The youth were particularly uninterested in farming, creating a demographic skew towards an elderly rural population being supported by a young, urban population where transfer payments became the mainstay for rural households (Bryceson, 2002).

Agriculture has therefore been shown to contribute, on average, very little to income among poor rural South African households, even in those households that maximise

[5]The progressive dispossession of black people of their land started with colonial expansion (from the mid-1600s to the mid-1800s) and reached its zenith during the apartheid era (1948-1994).

what they can from the land (Carter and May, 1999). Rather, there has been a trend towards more subsistence-based agriculture on small residential garden plots (rather than fields) and crop cultivation oriented towards domestic production and gift-giving rather than commercial sale (Bryceson, 2002). Carter and May (1999) attribute this trend in part to a lack of household assets, especially agricultural and other productive equipment that could be used in micro-enterprise. Insecure land tenure—predominantly communal tenure on state land under weak traditional governance— exacerbates the situation. This paucity of liquid assets underscores the lack of safety nets among poor households, leaving them vulnerable to income loss or failure of entitlements (Carter and May, 1999).

Post-apartheid social grants, particularly old-age pensions, have brought much-needed capital to rural areas, stimulating the now cash-based economy while simultaneously making the elderly a primary contributor to boosting rural purchasing power (Bryceson, 2002). This need for access to cash in order to buy food is important in South Africa because the ability to access social grants is mediated by socio-economic status and nationality. Evidence from our study areas suggests that application for child support grants is highest among households of medium to medium-high levels of wealth, not the very poor (Twine *et al.*, 2007). Various reasons have been identified (e.g. a complicated means test, the distance to nearest social security station, etc.), but the outcome is that the benefits associated with social assistance do not necessarily reach the most vulnerable (Twine *et al.*, 2007). This discrepancy reinforces the disparities between the 'winners' and 'losers' in South Africa and has major consequences for families' purchasing power and food security.

3.3 Methods

3.3.1 Study site and community

This study was conducted in the Agincourt health and demographic surveillance system (AHDSS) site located roughly 500 km northeast of Johannesburg in the local municipality of Bushbuckridge in Mpumalanga Province. Completing its first annual census in 1992, the AHDSS was initiated in 1991 as a collaboration between the University of the Witwatersrand Department of Community Health and the former Gazankulu homeland and Tintswalo Health Services (Tollman, 1999). The AHDSS was set up with a mandate to inform primary healthcare-centered reform by helping to close the knowledge gap about health outcomes, conditions, and services in densely populated rural areas of South Africa and by serving as a closely monitored pilot site for innovative health programs (Tollman,

1999). It now includes a population of around 84,000 individuals residing in roughly 14,000 households spread out across 24 participating villages (Thorogood *et al.*, 2007). Located in the former Gazankulu homeland, the research catchment area comprises a population and region that are significantly resource-limited. While some progress (such as electrification) has been made in developing the area in recent years, major infrastructural challenges remain, including the provision of running water and modern sewage systems to the vast majority of households. Communities are governed by a combination of traditional and civic leadership, which work either collaboratively or, in some cases, antagonistically with each other.

The Tsonga/Shangaan people are the majority ethnic group within the AHDSS. While most residents of the site are South African, there is also a sizeable immigrant population: almost a third of households in the study site are of Mozambican origin, including many families who arrived during the civil conflict in Mozambique in the mid-1980s (Kahn *et al.*, 2007). Although some of these families have attained South African citizenship, many remain undocumented, with significant consequences for their ability to take advantage of South African social services or gain formal employment within the country.

With a population density of 174 persons/km^2, the study site is too heavily settled to allow most families enough space within their homestead plots or even outside the villages on which to plant crops (Madhavan and Townsend, 2007). This situation stems from the aforementioned apartheid-era land policies as well as the influx of immigrants to the region since the 1980s (Giannecchini *et al.*, 2007). Moreover, the site is located in a semi-arid region of the country with inconsistent rainfall and predominantly infertile granitic soil, adding an additional layer of vulnerability and challenges to households that could otherwise depend more heavily on growing their own crops to supplement their diets. Together, these factors have resulted in very few, if any, households being able to maintain a truly subsistence lifestyle.

While income sources are varied, the area's low levels of education and very limited employment opportunities have resulted in considerable labor migration, making many households reliant on remittances from migrant labourers (Kahn *et al.*, 2007).[6] Many families supplement the food they grow and purchase by harvesting natural resources Table (3.5) in communal rangelands (Shackleton and Shackleton, 2004). However, utili-

[6]The HIV epidemic in the region has caused many families to lose their primary breadwinners, leading them to be even more vulnerable to food insecurity due to the loss of income associated with that household member (Hunter *et al.*, 2007). Recent estimates place antenatal seroprevalence rates at around 25 percent (Kahn *et al.*, 2007)

sation of these natural products as well as the sustainability of the methods of harvesting them is heavily dependent on the socioeconomic context in which such acts are carried out. The AHDSS site is very much an example of a socio-ecological system, in which environmental, economic, and social conditions are inter-dependent.

3.3.2 Data collection

This study required an ontological approach recognising the complexity of the food system under double exposure while allowing an empirical focus on food security outcomes at the household level. The importance of livelihood strategies in adapting to climate change has been highlighted in the literature (Adger *et al.*, 2003; Thomas *et al.*, 2005; Ziervogel *et al.*, 2006*a*). The SRL approach, which looks at how, within a given context, differential access to capital (natural, economic, human and social) defines how households pursue different livelihood strategies has successfully been employed in similar food system-related studies (Devereux and Maxwell, 2001; Scoones, 2005; Ziervogel *et al.*, 2006*b*; Misselhorn, 2009). This approach aims to emphasise the different elements that shape a household's livelihood in the community, what factors drive these livelihood choices, and how they are interlinked (Babulo *et al.*, 2008). A sustainable livelihood "can cope with and recover from stress and shocks, maintain or enhance its capabilities or assets and provide sustainable livelihood opportunities for the next generation and contribute net benefits to other livelihoods at the local and global levels and in the short and long term" (Chambers and Conway, 1991). This resilience is key for livelihood adaptation: "those unable to cope with or adapt to stresses become vulnerable to them, unable to achieve sustainable livelihoods" (Scoones, 2005: 6). There are various outcomes of successful livelihood strategies, including increased income, improved well-being, decreased vulnerability and maintenance of food security (Babulo *et al.*, 2008).[7]

This study employed a variety of methods to assess food security and coping strategies at the household level. Qualitative methods included holding focus sessions with key informants and conducting in-depth interviews with a representative portion of study

[7]The livelihood approach has been recommended in the literature as a useful tool through which to understand food insecurity because it: 1) emphasises the importance of examining an individual's capacity for managing risks and external threats to livelihood security, such as drought (Chambers, 1989; Scoones, 1998); 2) enables the agency of individuals to be captured in decision-making processes (e.g., through remittances) (Ziervogel, 2004); and 3) takes into account the overall complexity of people's lives (Lovendal *et al.*, 2004). Food security strategies are embedded within broader decisions regarding livelihood choices, making it necessary to have a firm grasp of the livelihood strategies available to people before undertaking a discussion of how they can adapt to impacts on their food security.

households, along with local storeowners. Quantitative methods included surveying study households using a questionnaire (see Appendix B, Questionnaire 1), collecting a snapshot of food prices in the area, and analysing previously collected data from participating households, which were extracted from the AHDSS database. The AHDSS data were gathered from a food security survey conducted in 2004 and in 2007 (see Appendix B, Questionnaire 2). Details of the design and methodology for the questionnaires have been published previously (Hunter *et al.*, 2007). Only the data from the households selected for this study were extracted from the database for analysis. Study households were selected using an algorithm to minimise research fatigue among catchment households and to ensure relatively equal distribution of households across socioeconomic strata and study sites. All research materials and methods were reviewed and approved prior to the commencement of the study by the Wits Human Research Ethics Committee (Clearance #: M090825).

Three small focus sessions (4-8 individuals) were initially held with household food providers from a diversity of socioeconomic backgrounds across the AHDSS communities from which we drew our sample. Sessions with food providers focused largely on the availability, accessibility, and consumption of food in the communities, as well as popular coping strategies used by families in response to household shocks. In addition to these sessions, we also met with local leaders from the communities, particularly those who were involved in organisations that had a direct impact on food security (e.g. farmers' groups, grocery societies) in order to better understand the function and capabilities of community groups in the areas in which we were working (and thus their perceived impact on food security in the region). All focus sessions were carried out in September 2009, facilitated by a XiTsonga-speaking researcher trained in qualitative methods and working under the direction of the site manager.

A sample of 117 households, stratified into thirds by socioeconomic status (SES), was selected from three villages in the AHDSS site. SES score was calculated based on household ownership of assets and access to amenities (see Collinson, 2010 for an explanation of the calculation). These data are collected for all households every two years in the AHDSS. Household SES scores were stratified into terciles from which a random sample of households was drawn. Of the 117 sample households, 94 (80.3 percent) were available to participate in the study (the majority of those not participating were not present at site over the sampling period). Of these, 33 came from households in the upper SES tercile, 30 from the middle, and 31 from the lower. Participation was entirely voluntary. After obtaining informed verbal consent, trained enumerators administered

a 30-45 minute closed-form survey to the household's primary food provider (usually the head female family member) in XiTsonga (see Appendix B, Questionnaire 1). This survey tool covered a variety of topics, including demographics, social capital, harvesting of natural resources, food security, recent household shocks, and coping strategies. Food security was assessed numerically using two validated tools for measuring food access that have proved especially effective in resource-limited settings: the Household Dietary Diversity Score (HDDS: Swindale and Bilinsky, 2005) and the Household Food Insecurity Access Scale (HFIAS: Coates et al. 2006). Household interviews were conducted in October 2009.

In order to gain a more in-depth perspective on the mechanisms being exploited by households to maintain food security both in times of economic or environmental hardship as well as throughout periods of relative normalcy, further loosely structured interviews were conducted with a portion of the sampled households. Fifteen (16 percent) households were selected based on their questionnaire responses, including their HDDS and HFIAS food security indices. Specifically, the two most food-secure and the two least food-secure households were chosen for each socioeconomic stratum (high, middle, and low), as well as a few households of special interest due to other factors (e.g., their involvement in certain groups or experience of a specific household shock). In-depth interviews were conducted in February 2010 with the primary food provider of the household (in most cases, the individual who had completed the questionnaire before) in XiTsonga, using a professional translator trained in qualitative methods. Interviews were conducted, recorded, and transcribed by the second author of the paper.

The interviews with storeowners were conducted in July 2010. These were open-ended and conducted jointly between the primary researcher and a field assistant who lives in the area and speaks fluent XiTsonga. Out of the 38 stores that were visited in and around the Agincourt AHDSS site, interviews were conducted at 15 stores that were chosen based on the type of store, its geographical location (in order to get a spread among the villages) and the willingness of the owners/managers to be interviewed. The stores were classified as follows:

- **Spaza shops**: small businesses run by locals with a small range of products available.
- **Cafés**: stores also run by locals, but better stocked than the Spaza shops.
- **'Indian' stores**: cafés owned and run by people of South Asian heritage.

- **General dealers**: larger shops with a diversity of stock usually located near main roads.
- **'Indian' general dealers**: general dealers owned and run by Asian immigrants.
- **Retailers**: South African supermarket chains found in urban areas around the AHDSS site.

The data from the AHDSS questionnaire are non-parametric. Two types of analyses were done using Statistica ©. For the questions with only a single binary answer, a contingency table with a chi-squared test for significance was done. For the questions where there was more than one set of possible yes/no answers, a Generalised Linear Model (GLZ) with a Wald test for significance was done.

3.4 Results

The results section is divided into two sections: the first deals with the quantitative data from the questionnaires and provides the context of food security in the area. The aim is not to measure the food security of households, but to contextualise the three elements of food security within the food system in the area. This will allow us to develop a holistic picture of the rural food system past an agricultural focus to incorporate the wider food system and in particular the private sector. Food availability (what a typical food basket consists of) and the nutritional quality of the food consumed by households are shown to be influenced by socio-economic status. Households' access to food is then discussed first through an analysis of how food is procured and second through different income strategies that provide the means for households to purchase and acquire food. Since the results show that a large amount of food consumed in the AHDSS site is bought rather than grown, the second section shifts focus to an analysis of the qualitative data that deals with: a) the local entrepreneurs that provide the means through which food may be purchased in the area (i.e. the private sector) and b) the role of grocery collectives as a local strategy employed by households to purchase food more affordably.

3.4.1 Quantitative Results

3.4.1.1 Availability and Utilisation

It is first necessary to understand what people eat before we can determine where it comes from as well as its nutritional value. A wide range of foodstuffs is consumed in the AHDSS site (Table 3.1). Grains are the staple food and were consumed by almost all households. These were followed by sweets, other foods (e.g. condiments, coffee, tea), vegetables, and meat (excluding fish) as the most commonly eaten foods. Fish and tubers were the least commonly eaten food groups, consumed by less than half of all households interviewed within the time period. Dairy was the only food group for which prevalence of consumption differed significantly ($\chi^2 = 0.05$) among SES classes, and was consumed more commonly by households with higher SES. This could have a variety of causes; because dairy requires refrigeration, for example, it can only be consumed by those with access to electricity and who can afford a refrigerator (or who keep milk cows). The widespread consumption of meat, typically thought of as a luxury food, is probably accounted for by the common practice of keeping chickens.

Table 3.1: Consumption of different food groups over 14-day period, by socioeconomic status (SES).

Food group	percent total households	percent low SES (n = 31)	percent mid SES (n = 30)	percent high SES (n = 33)	p-value (df=2)
Grains	98.94 (93)	96.77 (30)	100.0 (30)	100.0 (33)	0.358
Sweets	96.81 (91)	93.55 (29)	96.67 (29)	100.0 (33)	0.340
Other*	94.68 (89)	93.55 (29)	93.33 (28)	96.97 (32)	0.767
Vegetables	93.62 (88)	93.55 (29)	90.00 (27)	96.97 (32)	0.528
Meat	91.49 (86)	90.32 (28)	93.33 (28)	90.91 (30)	0.905
Fruits	89.36 (84)	87.10 (27)	90.00 (27)	90.91 (30)	0.877
Fats	89.36 (84)	87.10 (27)	90.00 (27)	90.91 (30)	0.877
Dairy	71.28 (67)	51.61 (16)	70.00 (21)	90.91 (30)	0.002***
Eggs	62.77 (59)	48.39 (15)	76.67 (23)	63.64 (21)	0.062*
Legumes	54.26 (51)	48.39 (15)	56.67 (17)	57.58 (19)	0.724
Fish	36.17 (34)	35.48 (11)	30.00 (9)	36.36 (12)	0.850
Tubers	34.04 (32)	25.81 (8)	33.33 (10)	48.48 (16)	0.156

Figures in parentheses are number of households. Significance of Pearson; * Significance at the 10% level; ** Significance at the 5% level; *** Significance at the 1% level

Although it is interesting to note that the majority of households ate from a variety of food groups over the previous two weeks, the relative amounts are not noted nor is the frequency of consumption. Table 3.2 provides more information in the form of what food groups were consumed by the household in the previous 24 hours. Here we see a lower percentage of vegetables, fruits and meat being consumed, which indicates that these may not be eaten on a daily basis and therefore not in sufficient quantities for a balanced diet. However, sweets and fats were consumed within the 24-hour period for most households, lending further support for the 'nutrition transition.' As before, the prevalence of consumption of dairy in the last 24 hours differed significantly by SES, being consumed more commonly within households of higher SES status.

Table 3.2: Consumption of different food groups over 24-hour period, by SES.

Food group	% total households	% low SES (n = 31)	% mid SES (n = 30)	% high SES (n = 33)	p-value (df=2)
Grains	94.68% (89)	87.10% (27)	100.0% (30)	96.97% (32)	0.062*
Sweets	93.62% (88)	87.10% (27)	93.33% (28)	100% (33)	0.108
Other*	93.62% (88)	90.32% (28)	93.33% (28)	100% (33)	0.209
Fats	78.72% (74)	74.19% (23)	76.67% (23)	84.85% (28)	0.550
Vegetables	74.47% (70)	74.19% (23)	73.33% (22)	75.76% (25)	0.975
Fruits	71.28% (67)	70.97% (22)	66.67% (20)	75.76% (25)	0.727
Legumes	42.55% (40)	41.94% (13)	43.33% (13)	42.42% (14)	0.994
Meat	40.43% (38)	35.48% (11)	43.33% (13)	42.42% (14)	0.789
Dairy	40.43% (38)	19.35% (6)	43.33% (13)	57.58% (19)	0.007***
Eggs	25.53% (24)	22.58% (7)	26.67% (8)	27.27% (9)	0.898
Tubers	11.70% (11)	12.90% (4)	6.67% (2)	15.15% (5)	0.560
Fish	10.64% (10)	0.00% (0)	13.33% (4)	18.18% (6)	0.052*

Figures in parentheses are number of households. Significance of Pearson * Significance at the 10% level ** Significance at the 5% level *** Significance at the 1% level

Table 3.3: Prevalence of cultivation within homestead gardens at time of data collection, by crop (n = 94)

Crop	% households cultivating	Frequency
Maize	50.0	47
Onions	29.7	28
Tomatoes	26.6	25
Spinach	23.4	22
Cabbage	18.1	17
Carrots	13.8	13
Sugar cane	11.7	11
Beetroot	8.5	8
Bananas	3.	3
Green peppers	3.2	3
Lettuce	2.1	2
Mangoes	2.1	2
Papaya (Pawpaw)	1.1	1
Beans	1.1	1
Cucumbers	1.1	1
Peanuts	1.1	1

With respect to cultivated food, all households that cultivated crops planted maize to some degree. Within homestead yards after maize, onions were the most widely grown crops followed by tomatoes and spinach (Table 3.3).[8] At the bottom of the list are papaya (pawpaw), beans, cucumbers, and peanuts. Both peanuts and beans can be stored and are therefore readily available from most of the local stores, which may be one reason that they are less likely to be grown at home. Of the food that can be grown, only 50 % of households were cultivating crops at the time of the survey.

Out of the 47 households cultivating crops, only 6 (12.7 %) were cultivating outside of their homesteads: of these households, all were cultivating maize, three were cultivating cassava root and two were cultivating other vegetables. Whether or not a family grew crops (either on the homestead or off-site) had a significant effect on household food security, with those cultivating reporting higher dietary diversity over a 14-day period (t=2.5416, df=94, p=0.0127). The number of households cultivating crops in homestead gardens varied significantly by socioeconomic status (χ^2 (2, 94) = 7.57, p = 0.0227) with the largest proportion of cultivators coming from higher income households (Table 3.4).

[8]Surprisingly, cassava was not being grown within homesteads (despite it being a seasonal substitute for maize across the border in Mozambique). However, some households were cultivating it on plots outside the homestead.

Table 3.4: Prevalence of cultivation both inside and outside of homesteads at time of data collection, by SES (n = 94)

Group	percent cultivating in group	Frequency
All socioeconomic groups (n = 94)	50.0	47
Lower socioeconomic status (n = 31)	32.3	10
Middle socioeconomic status (n = 30)	50.0	15
Higher socioeconomic status (n = 33)	66.7	22

This discrepancy likely has a significant impact on the type and quantity of fruit and vegetables that lower income households are able to procure (along with their associated micronutrients).

Table 3.5 lists what types of wild foods are gathered and which are gathered most commonly. From the data, it appears that harvesting natural resources such as edible insects and fish from local dams is one way in which residents, especially those in the poorest socioeconomic stratum, are supplementing their protein content. Nearly all households regardless of SES reported using indigenous spinach with many also reporting consumption of wild fruit, highlighting the importance of natural resources in nutrient supplementation regardless of wealth.

Table 3.5: Household consumption of natural food products and prevalence of harvesting versus purchasing or receiving as a gift, by SES [% in brackets]

Natural food product	% total households	% low SES (n = 31)	% mid SES (n = 29)	high SES (n = 33)	p-value (df=2)
Indigenous spinach	98.92 (91) [84.27]	100 (31) [96.55]	100 (29)[78.57]	96.97 (32) [78.13]	0.399
Wild fruit	80.65 (75) [94.59]	87.1 (27) [100]	72.41 (21) [85.71]	81.82 (27) [96.30]	0.347
Edible insects	59.14 (55) [55.56]	70.97 (22) [47.62]	55.17 (16) [56.25]	51.52 (17) [64.71]	0.249
Wild-caught fish	15.05 (14) [28.57]	19.35 (6) [33.33]	13.79 (4) [50.0]	12.12 (4) [0]	0.702
Wild birds for meat	8.60 (8) [77.78]	9.68 (3) [100]	10.43 (3) [75]	6.06 (2) [50]	0.807
Honey from the bush	7.53 (7) [83.33]	3.23 (1) [100]	17.24 (5) [100]	6.06 (2) [50.0]	0.125
Wild animals for meat	6.45 (6) [33.33]	6.45 (2) [50.0]	3.45 (1) [0]	9.09 (3) [33.33]	0.666

Figures in parentheses are number of households.

3.4.1.2 Access

As is evident from the previous section, not all the food that people consume is grown at home or gathered from the wild. In the households sampled, a significant number do not grow sufficient crops to feed all of their members ($\chi^2 = 28.3$; p<0.001). Although 81 % of respondents grew maize in their own plot over the last year ($\chi^2(1) = 19.78$; $p < 0.001$), 97 % of households still bought maize ($\chi^2(1) = 52.75$; p<0.01). In this study, a GLZ model based on data collected from the food security survey (Appendix B, Questionnaire 2) showed that the main factor given for insufficient food being grown to feed all the members of the household was inadequate rainfall (Wald value = 80.749; p<0.001). This indicates the vulnerability of households that grow crops to climate variability, which is projected to get more extreme under climate change (Boko *et al.*, 2007). When insufficient crops are grown to feed all the members of the household, household members buy their food from the market (χ^2 (1) = 44.17; p <0.001). After maize, rice (53 %) and bread (49 %) are the two staples most often consumed by household respondents. These commodities must be purchased, as rice cannot be grown in the area, and the bread was always processed, sliced bread. Purchasing food is therefore an important food security strategy for most households in the area. The role of local stores as food provisioning agents in the local food system is explored in the next sections. Given their centrality within the community's food security strategies, they are important actors in the food system; making these actors more resilient could therefore potentially increase the community's capacity to adapt to changes as they could form a buffer to both exogenous shocks (e.g. a natural disaster (flood) cutting off access to supply from wholesale suppliers) and endogenous shocks (e.g. low yields on local plots as a result of a drought) by providing a space in which households can access food without needing to travel vast distances.

In order to buy food, households must have an income. Livelihood strategies are therefore of key importance to food security strategies as they determine the purchasing power of households. Nearly all (99 %) households in the survey reported at least one source of income, which included permanent and temporary or piecemeal jobs, social grants from the government (either old-age pensions or child welfare grants), and self-employed work in the informal sector (e.g. selling clothes or other goods, building, traditional healing). As expected, having more sources of income for a household was associated with increased socioeconomic status in terms of assets: households in the lowest socioeconomic tier had an average of 2.06 sources, compared to 2.4 for those in the middle tier and 3.12 among those in the highest tier ($F(2,91) = 3.97$; $p = 0.022$) (Table 3.6). A full 84% of study

households were reliant in part on social grants as a form of income, emphasising the importance of this safety net in rural livelihoods regardless of SES.

Table 3.6: A breakdown of different sources of income, by SES

Income source	All households (n = 94)	Low SES (n = 31)	Mid SES (n = 30)	High SES (n = 33)
Permanent job*	44.68%	29.03%	43.33%	60.60%
Mean people employed/qualifying household (SD)	1.452 (0.705)	1.556 (0.882)	1.308 (0.630)	1.50 (0.688)
Temporary job	27.66%	23.33%	30.00%	30.30%
Mean people employed/qualifying household (SD)	1.269 (0.667)	1 (0)	1.111 (0)	1.6(0.966)
Social grant	84.04%	80.65%	86.67%	84.85%
Mean people employed/qualifying household (SD)	1.494 (0.749)	1.4 (0.645)	1.46 (0.81)	1.607 (0.786)
Informal work	20.43%	22.58%	10.00%	34.38%
Mean people employed/ qualifying household (SD)	1.05 (0.510)	1 (0)	1 (0)	1.222 (0.667)

[a] Significance of Pearson (χ^2) * Significance at the 5% level

A GLZ model on the various methods employed to supplement food intake showed that although the only significant means for getting food was to buy it (Wald stat = 155.508; $p<0.001$), other strategies were also employed. The next most popular was to receive food from neighbours, friends or relatives. Some households also made use of governmental food aid and some borrowed money to buy food. However, this formal assistance is meant as a short-term solution (approximately three months) and is not a strategy to be employed in the long-term.

Although most households met their food requirements for the year previous to the study ($\chi^2(1) = 28.3$; $p<0.001$), 10 out of the 13 households that did not (77%) cited lack of money at home as the primary reason, despite remittances[9]. The interviews showed a further breakdown of what coping mechanisms people employed when they did not have sufficient money to buy food (Table 3.7). Although most of the coping mechanisms are short-term solutions, one that could be developed into a long-term adaptive strategy is the formation of grocery collectives, discussed in greater detail in the following section.

[9]A follow-up study could measure the difference in food security between those houses receiving remittances and those that do not in order to ascertain the importance of migrant labour on rural food security

Table 3.7: Coping mechanisms for getting food, by SES. (Figures in parentheses are number of households.)

Coping mechanism	% total households (n = 94)	% low SES (n = 31)	% middle SES (n = 30)	% high SES (n = 33)
Asking neighbours, friends, or relatives for food	36.17 (34)	41.94 (13)	33.33 (10)	33.33 (11)
Sending children to eat at other homes because of lack of food	19.15 (18)	22.58 (7)	23.33 (7)	12.12 (4)
Making trades with others involving food	22.34 (21) 7 22.58 (7)	16.67 (5)	27.27 (9)	
Receiving help in harvesting crops from someone outside the household	9.57 (9)	12.90 (4)	13.33 (4)	3.03 (1)
Borrowing money from someone outside the household	53.19 (50)	51.61 (16)	60.00 (18)	48.48 (16)
Getting a ride from non-family member to be able to harvest natural resources far away	5.32 (5)	0.00 (0)	6.67 (2)	9.09 (3)
Receiving food from Social Services	4.26 (4)	6.45 (2)	0.00 (0)	6.06 (2)
Receiving food from a church or charitable organisation	5.32 (5)	12.90 (4)	3.33 (1)	0.00 (0)
Joining grocery group to bulk order staple foods and kitchen supplies	11.7 (11)	6.45 (2)	10.0 (3)	18.2 (6)
Cutting preferred foods from diet to save money	80.85 (76)	80.65 (25)	80.00 (24)	81.82 (27)
Limiting diversity of diet to cut costs	78.72 (74)	77.42 (24)	86.67 (26)	72.73 (24)
Eating less desirable food to cut costs	81.91 (77)	80.65 (25)	83.33 (25)	81.82 (27)
Eating smaller meals because of lack of food	76.60 (72)	77.42 (24)	80.00 (24)	72.73 (24)
Eating fewer meals/day because of lack of food	77.66 (73)	77.42 (24)	80.00 (24)	75.76 (25)
Going to sleep hungry	18.09 (17)	22.58 (7)	23.33 (7)	9.09 (3)
Fasting (i.e., not eating for a whole day)	18.09 (17)	22.58 (7)	23.33 (7)	9.09 (3)

It is worthy to note the discrepancy between assets and income. Table 3.7 shows the extent to which high SES households are still vulnerable because their assets are not directly liquid and their income sources are compromised. As Table 3.6 shows, 60% of high SES households depend on a family member with a permanent job as a source of income. Misselhorn (2009) and Hendriks (2005) refer to the negative impacts on food security that could arise from an increased dependency on formal employment because these households are more vulnerable to the loss of this single source of income. Diversifying the methods for accessing food can build a household's resilience to food security shocks.

3.4.2 Qualitative results: The role of the private sector

The data presented above has demonstrated that, since not all food is grown, purchasing food is a key food security strategy that directly impacts the nutritional quality of food that people consume, with further implications for food security. Below are the results from qualitative data: first, we provide an overview of where food can be bought in the AHDSS along with the role that the private sector plays in making food available to residents in the area. Second, we discuss a particularly adaptive strategy employed by some households in order to make buying food more affordable: the formation of grocery collectives.

3.4.2.1 Supply mediated through local entrepreneurs

There are a number of avenues through which community members can buy food. In most of the villages, there are spaza shops, cafés and 'Indian' stores within easy access, although the prices for different food products differ dramatically among the different stores. Closer to the main roads, there are also general dealers and 'Indian' general dealers, which have more stock, generally at cheaper prices. Major South African retailers as well as more general dealers can be found in neighbouring, urbanised areas. The majority of shop owners in the villages buy their produce from a large wholesaler in the town of Hazyview, the Metro Cash and Carry, about 40 kilometres from the main research site. Storeowners would always calculate their prices based on those received from the wholesaler. One exception to this was an 'Indian store' where the owner said that they often come together with friends in order to buy stock or they buy from the larger 'Indian' store in Thulumahashe because they get good deals. Sometimes they do not make a profit on certain items, selling them at cost to keep people coming to the shop.This practice can cause ethnic tensions within the community as South Asian storeowners outcompete locals

by drawing on their many family and friendship ties. The result of these deals has been to foster a feeling of antagonism among store owners from different ethnic backgrounds, especially as people not originally from the community are not allocated land by the chief and must often marry into the local community or rent space from locals in order to operate their business.

The role of social capital here is interesting: South Asian entrepreneurs capitalise on extensive kinship networks (i.e. bonding capital) in order to build successful businesses. However, these ties allow them to outcompete locals, raising inter-ethnic tensions within the community. Reconciling these tensions could be a step forward in building social capital (specifically bridging capital, in the case of the store owners) within the whole community, thereby reducing its vulnerability to shocks (see Misselhorn, 2009) for more on the role of social capital in building adaptive capacity). The role of social capital in the creation of adaptive capacity is further explored in the case of 'grocery collectives' below.

3.4.2.2 Constraints

There are two main constraints on operating these businesses in the villages. The first is transporting products from the wholesalers in the urban centres back to the shop. Those businesses where the owner had a 'bakkie' (small truck) were far better stocked than those for which the owner had to travel by taxi and bring back stock by hand (See Table 3.8). This latter mode of transport limits both the type of stock that is available and how often that stock can be replenished. One of the major complaints was that quite often stock expires before it can be sold and so the owners make a loss. This is true even for non-perishable items such as tinned beans. This also has dietary implications (again evoking the 'nutrition transition') because quite often the cheapest foods available are 'junk foods' like chips and sweets, which are often the only items reliably purchased from the shops. The refrigerators were also mainly used to stock soft drinks and sometimes alcohol. Rather than being sold in the stores, fresh produce is hawked from the side of road or outside spaza shops and cafés. There is a standard set of prices for these items (mainly spinach, potatoes, avocados, onions, tomatoes and citrus fruits) across most of the AHDSS site (ZAR 10 a bag) except for in tourist areas, where prices are considerably higher. As the data indicate, some households also grow their own fresh produce to supplement their nutritional requirements (Table 3.4).

The second major constraint was a lack of start-up capital. There was a stark contrast

Table 3.8: Taxi prices from Agincourt to urban centres in the area

Town	Price (ZAR)
Hazyview	R46
Bushbuckridge	R24
Thulamahashe	R21

between those shops where the owner had adequate cash flows to buy sufficient stock, invest in a 'bakkie' and staff to help sell products and those that did not. Often the latter had suffered a major financial setback. In one case the owner had passed away and in another the main breadwinner had lost his job and so was unable to provide capital to keep the business afloat. In the case of the one of the more successful enterprises, the original owner had won the lottery and had invested it in growing his business, which meant that even after he had passed away, there was sufficient capital to keep the business profitable. The differences between businesses where there is a capital base upon which the business can survive and where there is not is starkly presented in Figures 3.2 and 3.3. The empty shelves in Figure 3.2 tell the story of a business that is suffering because there is no longer any money to buy stock. The result is that the people who used to rely on this shop to meet some of their food requirements need to look further afield to buy provisions. The opposite is true of the fully-stocked shelves in Figure 3.3 that does a brisk trade in the centre of Agincourt. The store owner makes weekly trips into Hazyview in his 'bakkie' to replace stock. Addressing these inequalities in the rural food system is critical for adaptive food governance.

The alternative option for buying food is to make the journey into the urban and peri-urban centres to purchase it from one of the supermarket retailers or wholesalers there. Some women have formed grocery collectives in order to make this a more viable option and this strategy is discussed in the next section. Interestingly, most storeowner respondents said that they were providing a service to the community as they allowed for people to access food with convenience instead of paying the taxi fare to the nearest urban centre (Table 3.8). The provision of credit and wholesale specials were also given as reasons for justifying their service to the community. The special offers to residents include the provision of credit, especially to pensioners who can guarantee that they will pay their debts. Preference is also restricted to local residents as in some cases customers from different villages defaulted on their debts and subsequently left the region. This follows the conventional wisdom that the provision of credit is a benefit of traditional retailers (Minten *et al.*, 2010).

Figure 3.2: An empty spaza shop in a remote district of the ADHSS.

3.4.3 Qualitative results: the establishment of grocery collectives

The establishment of grocery collectives is a notable mechanism through which household food providers in the community (almost exclusively female) have increased their purchasing power and attempted to improve their overall food security by harnessing the power of social capital. These groups serve as a form of Accumulating Savings and Credit Association (ASCA) or 'stokvel' in which monthly contributions are collected from members and then pooled to purchase a collection of food staples in bulk from local wholesalers at least once a year, usually before the December holidays, when many relatives may come to visit (thus dipping into the household's food stocks) and household expenditures increase dramatically.

Almost twelve percent (11.7%) of study households reported being a member of one or more of these groups, with the greatest participation reported from households in the top socioeconomic tercile (18.2%). Although largely absent from the literature, the phenomenon does not seem to be confined to the region of study, with the few isolated

Figure 3.3: A fully stocked store in the centre of Agincourt that provides its customers with a wide selection of foods, often at discounted rates based on 'Big 11' specials at the Hazyview Metro Cash 'n Carry, South Africa.

references to similar groups reported from regions in the Eastern Cape (Bähre, 2002) and Cape Town (Du Toit, 2005). These can be traced back to the apartheid era when migrant workers would form a grocery collective in order to save money to bring food and presents back home (Bähre, 2002).

Most of the grocery collectives discussed in qualitative interviews were composed of around 10-12 female members, though several sources reported being involved with much larger groups (usually comprising extended family networks). Informants from the smaller groups, which are the focus of this section, reported that membership was usually capped, with defaulting members replaced by trusted women who had expressed prior interest in joining the group. According to the women, membership for these groups was based primarily on geographic proximity as well as willingness (and ability) to pay the monthly fee, which ranged between ZAR 100 and ZAR 150 (roughly 15-25 USD). In several cases, sources mentioned the large number of individuals within their neighbourhood who were interested in joining the group but unable due to the group's already having reached

'capacity,' which was set at twelve.

Almost all groups reported the purchase of several key staples mentioned above, including flour, maize meal, rice, sugar, and fish/cooking oil, as well as household cleaning products such as washing powder. In addition to these items, several groups (especially those on the upper end of the monthly contribution spectrum) reported purchasing other less essential products, such as dairy creamer, canned beans, tomato sauce, packaged soups, canned spinach, and mayonnaise. These products are collectively purchased at negotiated and/or reduced group rates from regional food wholesalers and then transported back to the Agincourt area, where they are then divided evenly among group members (or proportionally, in cases where one or more members were unable to make all twelve payments). In some cases, this transportation is provided to the group by the wholesaler. In other cases, the group relies on its accumulated social capital to gain access to a vehicle for the day to transport the products. The groceries usually last through May, providing temporary relief to the household while it replenishes its cash and food stocks in the wake of the holidays.[10]

Although grocery collectives can be viewed as particularly innovative strategies for building food security, they can still exclude the most vulnerable. As Misselhorn (2009) points out, while stokvels can be useful mechanisms for reducing the costs of buying food and serve as a lending source, they require members to have access to sufficient capital to be able to join and if for some reason a member falls on hard times, they can be excluded from the group. Under these circumstances, grocery collectives cannot be the only response to food insecurity.

3.5 Discussion

An overall trend that grounds many of this study's findings is the process of deagrarianisation which has resulted in rural communities' access to food being mediated by their ability to derive an income with which to buy food (rather than growing it on their own). This process has divided households into a spectrum spanning those that are sufficiently economically well-off to be able to buy their own food, but who also grow food to supple-

[10]In addition to allowing household food providers to 'save' money throughout the year in preparation for the holidays and to guarantee enough food to go around in the summer, these grocery collectives may also act as temporary moneylenders in rare cases when members need to take out a short-term loan, for example. In this case, the borrowed money accrues monthly interest at the level of 20 percent. The interest is used to purchase more groceries with the yearly order, which are then divided evenly among the group.

ment their diets, through to those households that are dependent on buying their staple foods as well as fresh produce and meat from stores with whatever money they can earn or receive from government grants. Entrepreneurs are similarly divided along a spectrum of those who can provide a service to their community because they have enough capital to stock goods in their store and can transport these goods from wholesalers, through to those who are failing because they can no longer afford to buy stock and have no means of getting it to their stores. When these stores fail for whatever reason, communities that are reliant on them have no convenient place to buy food and the whole locale suffers. In order to build an adaptive food system, the needs of the full spectrum must be taken into account. Finally, there is another class of individuals that needs to be considered; those who fall through the cracks of the grant system and therefore do not have access to any financial safety net. This category comprises the most vulnerable— undocumented migrants, in particular, who are often not considered, but who make up an increasingly larger part of the fabric of rural communities in South Africa. Another large group of vulnerable South Africans that fall outside the net of social assistance are adults between the ages of 18 and 59, especially men, who are usually not primary care givers able to make use of the child care grant system (Brockerhoff, 2010).[11] This is an issue of great concern for any adaptive food or rural development policy under the NGP.

The case for involving the private sector in these policies at local, national, and even international levels is also strong. Timmer (2009) recognised the potential role that the private sector and food retailers in particular can play in a new food policy. However, the role of private-sector actors in the developing world, especially within SSA, has largely been neglected by food policy analysts. The most detailed study to date has been on Delhi, India. This study showed that modern retail in the city is generally less expensive than traditional retail (e.g. wetmarkets) even for fresh produce, but that the poorest may not benefit (Minten *et al.*, 2010). However, the Delhi study involved a large, urban area whereas the situation in South African rural areas has been understudied, despite these areas suffering from higher levels of food insecurity than urban areas (Misselhorn, 2009). Our results illustrate the importance of retail in rural areas.

[11]The ability to access food by those who are unemployed and do not qualify for social grants is therefore severely compromised and, furthermore, changes intra-household dynamics considerably. There ability to cope (or not) is another important further research area.

3.5.1 Food security strategies and their implications for policy

Our research shows that the main food security strategy adopted by households in a representative rural community in South Africa is to buy staple foods like maize meal, rice and flour/bread rather than grow them. This finding is supported by other studies (e.g., Altman *et al.*, 2009). The crops grown at home or in small plots are used to supplement diets and, in rare cases, to provide supplementary income. This situation has two implications: 1) a reliance on the private sector for food provision (similar to that in urban areas, although there is more capacity for growing supplementary food in rural areas) and 2) a general trend of diversification out of agriculture as a key income sector for smallholders, which reinforces the literature referring to a deagrarianisation trend in Africa. These trends impact all three elements of food security.

Relying on national retailers for food provision to rural areas means that should there be a production-related shock (e.g. extreme flooding or droughts in an area of commercial agriculture), the likelihood is that larger urban areas are more likely to be provisioned before peripheral rural areas because the majority of major retailers' customers are in urban areas and it is more financially expedient than transporting limited food supplies across the country, especially given infrastructural constraints. As such, food availability and access may be especially vulnerable in these rural areas, particularly to an international shock causing prices to rise globally. Without a viable local agricultural sector together with an input of capital, rural communities will be subject to the instability of macro-supply trends without any local buffering capacity. At the same time, integrating with wider supply chains and the national market is a critical buffer when there are supply shortages in the local area and people must still buy food. The food policy message is to build a well-functioning local market that can integrate with broader markets. Such sustainable local markets may provide a buffer to macro-shocks, just as their integration with the global market at higher levels may provide a buffer to local shocks.

These strategies have more serious implications for food utilisation, with potentially devastating effects on those with the most limited means. Micronutrients are derived from fresh produce, which can be cultivated for consumption, purchased locally, or harvested from communal areas. As reported, lower SES households cultivate at significantly lower rates than their higher SES counterparts, due in part to smaller plot sizes and the capital involved in maintaining successful gardens. Additionally, fresh produce can be purchased from hawkers selling surplus produce; this method of access, also depends on SES. A final option exists in harvesting communal natural resources such as wild fruit or edible insects,

though even these resources may be disproportionately accessible to higher SES families with greater access to transportation Table (3.7).

Altogether, we see how socio-economic status influences access to micronutrients. Only higher SES households have sufficient income to sustain their own plots or grow food in their homestead (see Table 3.4), resulting in poorer households' becoming reliant on local suppliers for not only their staple foods, but their micronutrient intake as well.[12] The double impact of globalisation, leading to greater access to processed, fattier, cheaper foods along with increased dependence on purchased food among the poor and middle classes in developing countries is of mounting concern for achieving food security goals and requires policy intervention.

If there is a shock to local production, there is unlikely to be sufficient excess supply to meet the demands of the local population without a concomitant increase in prices. Based on the current system, it is also unlikely that local suppliers will start selling fresh produce bought from urban retailers because perishables need to be supplied fresh and would thus require making trips into town far more frequently than they currently do (once or twice a month). This leaves poorer households not only vulnerable to macro-economic and climatic shocks which impact their staple foods, but their micronutrient intake too. Micronutrients are often not included in food security discussions that focus on daily caloric intake, but they are essential to achieving complete food security.

This study therefore calls for a systemic approach to food security in the region that takes into account interactions between different levels of the system. This entails building individually resilient, yet interdependent food systems that can buffer shocks between levels (see Figure 3.4). At the local level, we advocate targeted support for sustainable production by all households (by promoting farmers' collectives, for example). Stimulating domestic food production is in the South African government's interests because it will build resilient communities (Bryceson, 2002) while meeting rural development targets for agriculture of establishing 300,000 households in smallholder schemes through restructuring the land reform process (EDD, 2010). It would create a viable local market where produce would not only flow into these areas (brought in by local entrepreneurs and demand from wholesalers), but surplus could, in turn, be sent to nearby urban areas where retailers are increasingly open to sourcing local produce and where incentives could further encourage smallholder sourcing (see **Chapter 5**). Such a system would better

[12]This trend mirrors that seen in other emerging economies like Mexico, where the access to less healthy foods by poorer households is increasing, resulting in malnutrition from obesity as opposed to lack of calories (FAO, 2011)

integrate rural communities with their urban counterparts while also making agriculture a viable source of income for participating households. Building an agricultural system that is adaptive to climate change will be critical and will require investment in irrigation schemes, access to inputs, and a focus on resistant crops. Together, households would benefit from a healthier and more diverse diet while stimulating the local economy. Income from selling surplus in good years could then be saved to form a buffer for years of climate shocks when harvests are poor. Increased integration would make it easier for fresh produce (and staples) to flow into the area than is currently the case (demonstrating the importance of also maintaining a viable formal retail sector from which local entrepreneurs can source their products). Such a system would, of course, depend on the further development of basic transportation infrastructure in rural areas. There is also an associated benefit for women who tend to make up the majority of fresh produce hawkers as can be seen in Figure 3.5

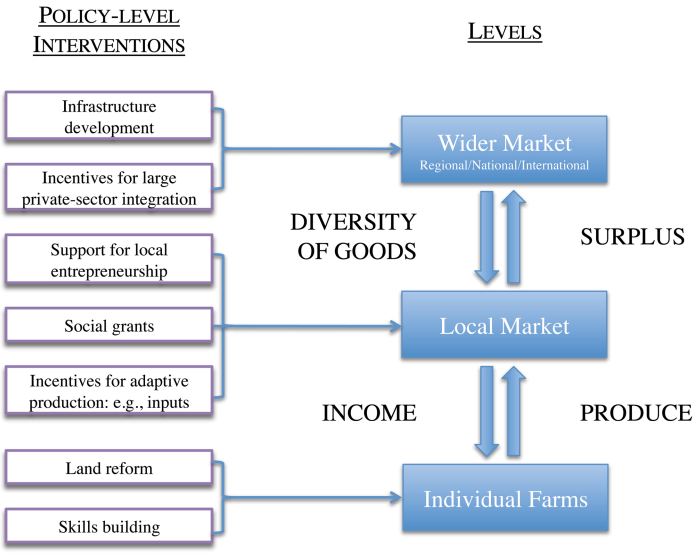

Figure 3.4: A multi-level approach to building a resilient food system. The diagram outlines various interventions at different levels that will build the adaptive capacity of the overall system by encouraging flows between different levels while maintaining the individual functionality of each. (Source: Authors' own)

Figure 3.5: Women hawking their fresh produce of tomatoes, cabbages and potatoes in the parking lot of Thulamahashe, South Africa.

3.6 Conclusions

The food system consists of both formal and informal components of small-scale manufacturing enterprises, local traders, and farmers. It is necessary to acknowledge the full spectrum of actors when addressing issues of building adaptive capacity in the food system. Ziervogel and Ericksen (2010) stress that food security responses must 1) recognise the interconnectedness of urban and rural areas and 2) move beyond a promotion of agriculture as the sole contributing factor to food security for rural populations. Our findings support recent interest in building viable smallholder agriculture for addressing rural poverty and food security (Wiggins *et al.*, 2010), but stress the necessity of developing the whole food system, not just agricultural production. As Reardon *et al.* (2009) illustrate, the rapid development of the agrifood industry has important implications for smallholders offering many opportunities, but also constraints like standards requirements, which can exclude many farmers.

The communities of Agincourt are exposed to four macro-trends; globalisation and cli-

mate change on an international level, and deagrarianisation and the government's focus on 'rural development' at the local level (see EDD, 2010). We observed two interesting strategies the communities have developed in the face of these macro-trends and within the context of governmental grants (a key source of community income) and insecure land tenure (reducing incentives for agricultural production): 1) purchasing food from local entrepreneurs and 2) the establishment of grocery collectives that could act as social capital clusters during periods of climate stress. This study also revealed the extent to which rural households are depending on social grants as a form of income; however, an adaptive food system cannot be built upon a reliance on external social assistance. Although there is clearly an important role for safety nets, especially under circumstances of volatile prices, production losses, and chronic poverty (Ziervogel and Ericksen, 2010), they alone do not constitute a sustainable intervention. Rather, a more holistic approach that would develop the entire food system in the area and integrate it regionally is required, where sustainable buffers to local, national, and international shocks are introduced. In this way, during periods of local shock, the community has access to regional resources and building the argument upwards, if the region were to suffer from a shock, it should be sufficiently integrated internationally for the international community to provide a buffer.

Given the process of deagrarianisation, agriculture is playing a declining role in rural livelihoods across Africa. Purchasing food has therefore become an important food security strategy for the rural poor in South Africa, but it is often constrained by a lack of access to sufficient income. Furthermore, a reliance on specific non-perishable foodstuffs impacts the micronutrients that the poorest can access if they are unable to grow their own fresh produce. The volatility of global markets and uncertainty of climate change further exacerbate the vulnerability of the population to food crises. As a result, the role of the private sector is becoming an increasingly important node in the food system for building adaptation, but this remains a relative blind spot in food policy. What is needed is adaptive food governance that develops the food system holistically– with an emphasis both on promoting local agricultural production as well as building sustainable livelihoods outside of primary production. These entrepreneurs already exist, but their success is variable. Strengthening the capacity of these local entrepreneurs will go a long way towards offering a more resilient food system for delivering food security.

Our study was limited by the need to describe the food system in the area while also providing empirical data about food security coping strategies. However, it provides a platform for more in-depth studies on food security in the area. The next step would be to conduct more in-depth interviews about what the community's preferred food system

would be (i.e. a scenario type approach) and their response to the interventions we have recommended. Rather than focusing on describing a problem, this approach would involve community members in developing a solution to food insecurity in the region. A more targeted approach that did not form part of a larger socio-economic study would also allow for more specific data.

3.7 Final remarks

Addressed in this chapter were thesis aims 1, 2 and 3- *To move beyond an understanding of food security as dependent solely on agricultural production, to ground the theoretical aspects of CAS with empirical data and to investigate the potential role of the private sector in food system futures.* In so doing, key questions 3- *What role does the private sector play in achieving food security across scales and levels?* and 6- *What mechanisms for adaptive food governance can be identified in the food system?* were answered. Following a CAS (and thereby a socio-ecological systems approach) allowed actors that would not normally be included in a rural food security study to be analysed, i.e. the private sector whose business it is to sell food, not just to grow it. By employing CAS to move out of the conventional box of rural African food security as dependent on agriculture, this chapter clearly showed the importance of private sector actors in the rural South African food system. The analysis of the local food system furthermore provided recommendations of how food policy (as a key method of governing the food system) could be targeted to create a more adaptive system that recognises the importance of these actors. However, as explained in **Chapter 2**, the food system is multi-level and complex and it therefore requires analysis over more than one, discrete level if the recommendations are truly to be effective. With this in mind, in **Chapter 4** the focus of the analysis moves up a level– to the national arena and looks at how the issues raised in **Chapter 3** (e.g. vulnerability to threats of double exposure) play into formulations of governance at the national level. This multi-level approach is how the thesis will address aim 4- *To analyse food system dynamics across scales and levels* and provide an answer to key question 7- *What are the drivers of adaptation across scales and levels in the food system?* The next chapter provides an analysis of governance in the South African food system that cuts across multiple actors- from the government to the private sector and civil society actors.

Chapter 4

Moving from Traditional Government to New Adaptive Governance

This chapter is based on the following paper published in Food Security:

Pereira, L. and Ruysenaar, S. (2012). "Moving from Traditional Government to New Adaptive governance: the changing face of food security responses in South Africa". Food Security, vol. 4, no. 1, pp. 41–58.

The paper was the result of a collaboration between myself and a fellow Commonwealth scholar, Shaun Ruysenaar, whom I met at the Royal Geographical Society's annual conference in September 2010. Shaun had previously published on the South African government's Integrated Food Security Strategy (IFSS) and so I suggested that we write a paper that looked at the different governance mechanisms in the South African food system. He initially contributed the section that focuses on the traditional governmental approach to food governance whilst I initially wrote the sections on adaptive governance that included governance from the private sector. I also suggested the food systems approach as the best framework around which to structure the paper following comments from a reviewer. This joint collaboration allowed me to develop my analysis and extend my ideas and analysis of the food system approach to governance, which influenced the resulting analysis in the other chapters. The subsequent revisions to the paper were shared equally between us both.

4.1 Abstract

The food system faces increasing pressure from dynamic and interactive environmental, political and socio-economic stressors. Tackling the complexity that arises from such interactions requires a new form of 'adaptive governance'. This paper provides a review of various conceptions of governance from a mono-centric or politico-technical understanding of governance through to adaptive governance that is based in complex adaptive systems theory. The review is grounded by a critique of the existing institutional structures responsible for food security in South Africa. The current Integrated Food Security Strategy and tasked governmental departments are not sufficiently flexible or coordinated to deal with an issue as multi-scalar and multidisciplinary as food security. However, actions taken in the non-governmental sector signal the emergence of a new type of governance. Apart from an increasing recognition of food security as an issue of concern in the country, there is also evidence of a changing governance structure including collaboration between diverse stakeholders. We review these governance trends with an understanding of the food system as a complex adaptive socio-ecological system where actors in the food system self-organise into more flexible networks that can better adapt to uncertain pressures.

Keywords: Food security, governance, adaptation, institutions, South Africa

4.2 Introduction

Beddington (2009) speaks of a perfect storm facing humanity, dominated by a concoction of food, water, and energy crises and compounded by a changing and potentially hostile climate. For the developing world, these are not future challenges but real and immediate, as evidenced in the 2011 famine in East Africa. Food security has been especially challenging for Africa since the 1970s with the state, as the guarantor of all securities (Hettne, 2009), struggling to ensure the food security of all citizens. Sub-Saharan Africa (SSA) is designated as a food insecure region (FAO, 2009) and this insecurity will only be exacerbated by its vulnerability to uncertain future stresses like climate change (Boko *et al.*, 2007). We argue that reducing this vulnerability necessitates a shifting understanding of governance from politico-technical foundations relating to the operations of government to more flexible, dynamic conceptualisations. Within the context of increasingly complex food systems requiring 'new' policy frameworks (Maxwell and Slater, 2003), "neither classical conceptions of governance nor conventional definitions of food security are sufficiently broad enough to encompass the requirements of food security governance during the 21st century" (Mohamed Salih, 2009: 34). This leads us to the question at the heart of this review: what conception of governance takes into account the complexity of food systems with food security as an outcome?

The structure of the chapter is as follows: in the following sub-sections, we provide a brief introduction to food security as an outcome of the food system. We also briefly outline the concept of governance in general terms, specifically outlining the schema developed by Termeer *et al.* (2010). Termeer *et al.* (2010) lay out three approaches to governance: mono-centric governance that places the state at the heart of political power and authority, multilevel governance that recognises the three-way displacement of governmental power across scales[1] and adaptive governance that has the goal of developing new concepts of governance that can handle the inherent complexity and unpredictability of socio-ecological systems (SES). However, identifying the failures and articulating the necessities of governance from a theoretical perspective is relatively easy compared to establishing such practices in reality (Maxwell, 2001; Sahley *et al.*, 2005; Drimie and Ruysenaar, 2010). The rest of the chapter showcases how these different theoretical approaches to governance are represented by a variety of structural and institutional responses to

[1]Termeer *et al* (2010: 33) refer to "the displacement of state power and control 1) upwards to international actors and organisations, 2) downwards to regions, cities and communities and 3) outwards to civil society and non-state actors."

food insecurity in South Africa.

In *sections 4.2 and 4.3* we therefore elaborate on the different conceptions of governance, grounding these with empirical examples from the South African food system. The second section deals specifically with mono-centric and some multilevel forms of governance, which understand governance in the political sense as embedded in governmental institutions such as those embodied in the South African Integrated Food Security Strategy (IFSS) (see Box 1). However, the success of these approaches has been mixed and they have not resulted in meeting the objective of creating a food secure country. In the third section we argue that mono-centric approaches have been unsuccessful because the food system is a complex, adaptive socio-ecological system and as such requires an approach to governance that recognises this complexity and dynamism. We therefore discuss how there has been a shift in the governance of the South African food system towards a more 'multilevel' and even potentially 'adaptive' form of governance that recognises the many cross-scale and cross-level linkages in the food system. We use the incorporation of non-state actors into the food governance system as an example, highlighting how issues of food security have entered corporate strategy, which has resulted in partnerships between different actors. The paper's overall aim is to highlight how by understanding these different conceptual approaches to governance, their synergies can be harnessed to create a food system capable of delivering food security. We thus conclude with a discussion on what can be learnt from this analysis for developing adaptive food governance in the context of an uncertain future in South Africa.

4.2.1 A Brief Discussion of Food Security and Food Systems

According to the Food and Agriculture Organisation (FAO, 1996: 2), "food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Such a definition illustrates - after a few decades of refinement from a neo-Malthusian focus on global availability in the 1970s to a mainstreaming of Sen's (1981) entitlements at the individual level in the 80s and 90s- that food security comprises stability of food availability, access, and utilisation (Schmidhuber and Tubiello, 2007).

More recently food security is recognised as integrally associated with food systems that either succeed in achieving this security or fail to do so. Food systems are characterised as interacting human and natural systems, and can therefore best be conceptualised as socio-ecological systems (SESs) (Ericksen, 2008*a*,*b*). If the food system is understood

Box 1: The Integrated Food Security Strategy (IFSS).

Despite the right to food being enshrined in the Constitution, there is no legislation that binds government to specific policy that tackles food insecurity. Due to worsening food security in the country circa 2001/2002, and a realisation that the existing response was inadequate, the South African government embarked on a 'new' Integrated Food Security Strategy. The major elements of the Strategy include:

- Acknowledging severe food insecurity in South Africa, it seeks to:

(i) Increase household food production and trading;
(ii) Improve income generation and job creation opportunities;
(iii) Improve nutrition and food safety;
(iv) Increase safety nets and food emergency management systems;
(v) Improve analysis and information management system;
(vi) Provide capacity building;
(vii) Hold stakeholder dialogue.

- Following a 'developmental approach' that focuses on the productive capacity of people and where these are lacking to ensure resources and income to secure food; the latter includes special emphasis on emergency relief. All interventions will be based on accurate (grounded) information with constant monitoring and evaluation.
- Establishing new institutions at each level of government in the form of coordinating units, food security, officers and forums.

The IFSS proposed integrating, or at least coordinating, a range of existing programmes focussed on food security in South Africa. This would combine a range of Departments implementing line function programmes within their own jurisdiction (e.g. the Department of Education would lead school feeding programmes), however, through the IFSS these would now be implemented in a coordinated manner. Leadership through the existing Department of Agriculture and the 'buy in' of the Social Cluster Departments is supposed to ensure such integration, through which comprehensive programmes (or a single Integrated Food Security Programme) can be developed in consultation and under advisement of the created institutions (as mentioned above).

as an SES, then food security is the result of a complex set of interactions in multiple domains. This complexity is created through interactions across different types of scales and levels,[2] as well as through multiple feedbacks[3] and thresholds (Ramalingam *et al.*, 2008; Thompson and Scoones, 2009). Such complex processes make SES unpredictable and they are therefore inherently uncertain. Since most policy is not designed for the surprises inherent in complex systems, these unanticipated feedbacks create challenges for policy (Gunderson, 2003) and therefore also for governance. In *Section 4.5* we develop this further by identifying the particular characteristics of socio-ecological systems (as complex adaptive systems) that need to be taken into consideration in order to build an effective and adaptive food governance.

The Global Environmental Change and Food Systems Project (GECAFS, 2011) frame-

[2]In this paper we understand scales as the spatial, temporal, institutional etc dimensions used to study phenomena and levels as the units of analysis within each of these scales (Cash *et al.*, 2006; Ingram, 2011). It is therefore possible to have multi-level and multi-scale as well as cross-level and cross-scale interactions occurring within a system.

[3]Feedbacks are inherent processes in coupled socio-ecological systems and they happen when actors respond to change, often having unintended negative consequences especially at different levels (Ericksen *et al.*, 2009).

work attempts to reconcile the complexity of wider global change processes (e.g. climate change, globalisation) with an approach that recognises the cross-scale and cross-level interactions in the food system. This framework identifies nine elements that make up the three food security outcomes. Food availability comprises production, distribution and exchange; food access comprises affordability, allocation and preference whilst food utilisation comprises nutritional value, social value and food safety (see Ingram, 2011 for an in-depth explanation). For the purposes of this review, the contribution of the food systems approach is its emphasis on food system activities that occur along the agri-food commodity chain from production to consumption and which then either result in or fail to provide food security. This conceptualisation frames environmental change consequences for food systems in the context of socio-economic and political change in order to understand the effects of the multiple stressors that interact with food systems, occasionally making them or their components vulnerable. The relationship between food security outcomes (availability, access and utilisation) and drivers of global change can be analysed through food system activities like food production, processing and packaging, distribution and retail or consumption (Ericksen, 2008*b*). Although not expressly mentioned in the framework, this conceptualisation has important implications for governance and vice versa. The holistic approach shifts emphasis away from a bias towards agricultural production to allow a focus on all food system activities (which can arguably be governed) as opposed to just the outcomes (for which processes are governed). The feedback loop of how these activities then further contribute to driving change is another important dynamic that needs to be considered in a governance regime. This review therefore takes the food system concept further by applying it to issues of governance in the food system.

4.3 Governance in general terms

The term 'governance' is employed across different disciplines and it would be wrong to claim homogeneity between these usages (Stoker, 1998; Jordan *et al.*, 2005). The concept has become such a buzzword recently that van Kersbegen and van Waarden (2004 cited in Kok and Veldkamp, 2011) identified nine forms of governance and Pierre (2000 in Kok and Veldkamp, 2011) specified a 'governance continuum' that ranges from state-centric approached on the one side through to societal perspectives on the other. Jordan *et al.* (2005) highlight some consistent definitions from a political science perspective, which

refer to governance as the shifting ability of the state to steer society, marked by a growth in multi-level government structures. Other pragmatic descriptions consider governance, as the exercise of authority in a given area and a synonym for efficient management within a specific system (Hewitt de Alcantara, 1998). Alternatively, governance could signify "a change in the meaning of government referring to the new method by which society is governed" (Stoker, 1998: 17), which some consider implies a distinction between traditional government and new governance (Jordan *et al.*, 2005). The new method of rule generally implies an increased role for non-state actors in policymaking and even implementation (Schilpzand *et al.*, 2010). This includes the rise of 'new' policy instruments driven by market mechanisms and voluntary agreements in lieu of the traditional legislative capacity of the state (Zito *et al.*, 2003). It is generally accepted that the shift to 'governance' rather than 'government' reflects increasing power being devolved to non-state actors who now participate in a more complex 'heterarchy' rather than a system characterised by hierarchical 'command and control' or market-based 'anarchy' (Jessop, 2003). However, many of these governance structures still rely on traditional forms of government regulation (Folke *et al.*, 2005; Peters, 2011).

Termeer *et al.* (2010) provide a useful threefold classification of governance types, namely, mono-centric, multi-level and adaptive. Their major focus relates to the relevance of scale in governance. They refer to the seminal paper by Cash *et al.* (2006) that identifies the 'scale challenge' in which the combination of cross-scale and cross-level interactions undermines the resilience of a socio-ecological system. Society faces three challenges arise in managing such a situation (Cash *et al.*, 2006: 11):

- **Ignorance**- the failure to recognise these interactions,
- **Mismatch**- the problem of fit between human institutions that do not map coherently onto the biogeophysical scale of the resource that they are designed to manage,
- **Plurality**- the failure to recognise heterogeneity in the way that scales are perceived and valued by different actors, even at the same level.

These challenges have implications for Termeer *et al*'s (2010) governance approaches. Mono-centric approaches to governance do not take issues of scale into account, which equates to an issue of ignorance. This type of governance is also referred to as the government perspective (Rhodes, 1997), hierarchical governance (Hill and Lynn, 2004), command and control systems of governance (Kooiman, 1993), or the classical modernist ap-

proach to governance (Hajer and Wagenaar, 2003). Multi-level approaches recognise these multi-level interactions, but at the price of increased transaction costs for co-ordinating multiple actors and with the criticism that it leads to a "hollowing out" of the State as governmental authority is dispersed (Termeer *et al.*, 2010: 33). Adaptive governance is the attempt to reconcile, not only interactions across multiple levels and scales, but the cross-level and cross-scale[4] interactions too. In the next sections, we review these approaches in more detail in order to assess the state of food governance in South Africa. Our findings show that when applied to a practical example, the approaches provided by Termeer *et al.* (2010) are useful, but that they are not as clean-cut as their schema suggests. In South Africa, mono-centric and multilevel approaches to governance can become conflated. The result is that the governance system gets caught in the internal contradiction of a centralist hierarchical structure that recognises the need for multilevel devolution of power on paper, but is not able to put it into practice due to institutional inertia. In *Section 4.5* we then explore the possibility of an adaptive form of governance arising from non-state actors that are rising to the challenges that government cannot meet. We then draw conclusions on how to incorporate elements from both forms of governance in order to address food security concerns in the country.

4.4 Food Insecurity as a contemporary governance issue in South Africa

Whereas South Africa is generally food secure at the national level, local and individual food insecurity remains a persistent challenge (Van Zyl and Kirsten, 1992; Altman *et al.*, 2009). Moreover, this situation is periodically exacerbated by food crises. Three recent food crises in 1992, 2002/3 and 2007/8, although associated with food shortages with different causes, were most detrimental through food price inflation limiting access to food. Drought in 1992, for example resulted in a 20-30 percent increase in food prices (Vink and Kirsten, 2002). Thereafter the more complex regional crisis of 2002 (Lambrechts and Barry, 2003; Drimie, 2004; Jooma, 2005) was exacerbated by exchange rate shocks (BFAP, 2010) and signals of increased exports to SADC, pushing local food prices up by approximately 16 percent with maize prices doubling (Watkinson and Makgetla, 2002). The latest food crisis was international in scope, the result of a global commodity price

[4]Here scale refers not just to the temporal and spatial scale, but to others including, for example, jurisdictional, institutional, management, network and knowledge scales (Cash *et al.*, 2006).

shock (FAO, 2008*b*) in which South Africa again experienced rapid food price inflation, despite suffering no drastic changes in local supply (Makenete *et al.*, 2007). These separate crises arose from different causes but shared the need for suitable and timely response mechanisms capable of reacting to complex and multi-level challenges. Poor governance exacerbates food insecurity because governments are unable to respond effectively to crises due to poor decision making, limited coordination, weak institutions, and scarce resources as well as the influence of neo-patrimonial politics (Cromwell and Chintedza, 2005; Dorward *et al.*, 2005). In South Africa, even the simple operation of handing out food packs and agricultural starter kits in response to the 2002 crisis encountered complicated institutional and operational challenges that were and remain difficult to overcome (Poltzer and Schüring, 2003; Drimie and Ziervogel, 2006).

4.4.1 Ongoing Limitations of State Responses to Food Insecurity

Eakin and Lemos (2006) illustrate that, although there are prescriptions of adaptive governance, more could be done to understand how these may be achieved in the day-to-day operations of government. Equally important in this review is how these prescriptions are limited by these day-to-day operations. Such an inclination suggests we need to acknowledge and understand the limitations (and successes) of mono-centric systems in terms of their impacts on food security and governing the food system.

4.4.1.1 Mono-centric (and Multi-level) Governance Structures and State Responses to Food Insecurity

The current paradigm of governance for food security in South Africa is very much embedded within a mono-centric rationale with the State at the centre of all governance. A state's ability to govern can be understood in terms of 'state capacity', which comprises a political/policy capacity (the ability to make informed decisions) and an administrative capacity (that executes those decisions) (Eakin and Lemos, 2006). Politically oriented notions of governance deal with the ways in which political systems function and how power relations influence their policies and outcomes. The political dimension is pivotal because it penetrates all realms of governance in which decisions need to be made, relating to power, resources, accountability, priorities, and choice. In decision-making processes, however, the governance perspective requires consideration of how the situation arose and who was excluded and not only an analysis of the power of who gets to decide (McLennan

and Ngoma, 2004). Equally important is how politics can encroach into the technical sphere.[5]

Technocratic notions of governance de-emphasise the political, and focus on administrative efficiency and effectiveness. The rubric of 'good governance'[6] brought with it new norms of public administration. Within Western bureaucracies, good governance relies especially on an efficient public administration (Hewitt de Alcantara, 1998), with new public management proponents calling for the replication of private sector-style, hierarchical management systems in the public sector. Such approaches have had unintended consequences by 'thinning out' public institutions and limiting capacity for good administration (Terry, 2005).

While state capacity is easily split into the realms of administrative and political capacity, it also forms part of a wider governance structure. There is significant overlap between governance structures and institutional arrangements, which determine the formation and implementation of policy within government but also act to control actions outside of it. Like governance, the interpretation of exactly what institutions are, what they do, and how they change differs between disciplines, as well as within them (Gorges, 2001; Scott, 2001). Institutional economics (North, 1990) considers institutions as the rules of the game, which determine structures of exchange and create various opportunities within society (Ostrom, 2003). Sociological perspectives, however, consider institutions as established procedures (Pierson, 2000). As institutions may be considered as both formal and informal rules across society (Ostrom, 2003), it is understandable that governance should not be conceived as 'government' but as a term that traverses the boundaries dividing the state, private sector and civil society. Yet addressing these implications necessitates the inclusion of what governments can and actually do, especially when it comes to food security. Indeed much of the traditional focus on food security governance lay in getting the institutions right and it is important not to neglect some of the ideas and lessons learnt

[5]Food security programs, for example, have been critically susceptible to patrimonial politics where their implementation is politically expedient (Cromwell and Chintedza, 2005). Outlining the importance of the decision-making process is an important aspect of overall governance that cannot be adequately dealt with in this paper. Forthcoming papers by the authors will unpack such issues in greater detail, but the basic argument is that elements within the decision-making and strategic agenda setting phases of policy-making may chart a course of action not based on what is in fact implementable (see Mosse, 2004) or applicable (see discussion below) and reflect entirely different objectives and agendas.

[6]Good governance "calls for improvements that touch virtually all aspects of the public sector- from institutions that set the rules of the game... to the interface of officials and citizens in political and bureaucratic arenas" (Grindle, 2004: 525-526). It derives from historical changes in the global political economy since the 1980s based on socio-political and economic transformations and the growing hegemony of liberal capitalist democracy (Hewitt de Alcantara, 1998; McLennan and Ngoma, 2004).

within the more traditional 'statist' responses. It should also be remembered that the state itself is not a monolithic entity but rather a "complex, multifaceted organisation, the internal structure of which represents a complicated nexus of institutions which provide incentives (and disincentives) for political decision-makers and organisational cultures in which bureaucrats formulate and implement public policies" (Ahrens, 2006: 7, Mathekga, 2006).

The latter discussion therefore begins to illustrate the blurry distinction between mono-centric and multi-level governance- seen in South Africa's case as inclusive governance structures plastered together by various institutional arrangements, with the state remaining as the central foundation. The overriding consideration for governance and food security is that the most persistent forces producing hunger today tend to be local or national rather than global, and are still governed best at the local or national level (Paarlberg, 2002; Young, 2004). Yet prescriptions of good governance and indeed adaptive capacity at these levels consider, rather 'unproblematically', the ability of the state to respond where necessary. Grindle (2011) clearly recognises the shortcomings in such an assumption: it is highly unlikely that all governments in countries where 'good' governance is recommended will be able to institutionalise the broad spectrum of required reforms. She calls for a more realistic framework of 'good enough' governance in which such shortcomings are clearly articulated and specific responses measured and prioritised. Similarly, Duit and Galaz (2008) recognise the difficulties that arise in state-centric approaches to adaptive governance. Little has been done to affirm and recognise the difficulties state departments face when considering similar challenges in the governance of food security, despite an extensive (but dated) literature on the matter.

After growing anxiety over global food security in the 1970s, many countries began taking food insecurity far more seriously. Much focus went into devising appropriate institutional frameworks with cohesive plans to be developed in response. This was echoed by policy-makers, academics and multilateral aid agencies as state-centred responses to food insecurity proliferated in the 1980s. The Institute of Development Studies provides a useful synopsis of the lessons learnt through some of the state orientated interventions.[7] At the time there was considerable variation in the definition of food security; responses from different agencies differed too. Importantly, food security as a term, provided a planning outcome, (that is programmes were steered toward ensuring food security above all other outcomes), or 'organising principle' predicated on integration across sectors (Maxwell,

[7]Maxwell (1990) presents a synopsis in the special edition of the IDS Bulletin (1990).

1990).[8] In the planning framework, institutional reforms needed to ensure the production of a coherent policy stance (Huddleston, 1990) and an overall strategy rather than a series of projects (Hindle, 1990). Maxwell (1990) provides the principle lessons of state responses to food security: integrated planning but independent implementation (i.e. no super-ministries), action over planning, the value of risk-taking and innovation and the importance of new modes of organisation in multi-disciplinary teamwork.

Despite increasing recognition of the need for adaptive food governance, we still face the institutional barriers that plagued earlier state-based responses to food insecurity. At the crux of the challenges of adaptive governance lies Maxwell's (2001) call for changing organisational cultures by focusing on 'tasks' to be achieved rather than 'roles' defined by line-functions. At the same time, this is insufficient without effective communication of what these tasks are. Maxwell (1990; 2001) observes that government departments, most notably 'food security units,' are dominated by a hierarchical role culture, with interactions characterised by rules and regulations representative of a classic Weberian bureaucracy. The bureaucratisation of government can hamstring its ability to take on new forms of governance and to achieve specific or specialised tasks. Bureaucratic structures tend to subsume deliberative exercises within conventional processes and return quickly to business as usual before the changes were implemented (Hagendijk and Irwin, 2006). Transforming the very nature of the governmental bureaucratic apparatus then remains a fundamental challenge.

4.4.1.2 The Institutional Response to Food Insecurity in South Africa

Complementing the wider literature described above, May (1999: 98) insists that successfully reducing food insecurity in South Africa requires a strategy grounded in a "series of coherent policies and coordinated programs that strengthen the asset base of the poor in respect of labour, human capital, productive capital, and social assets." During apartheid, the government's priority was to ensure national self-sufficiency (by encouraging domestic production on large-scale, commercial white-owned farms) rather than explicitly dealing with accessibility at the local level (Van Zyl and Kirsten, 1992; Pieterse and van Wyk, 2005). The first of several similar attempts at food security planning was the Food and Nutrition Strategy for Southern Africa, promulgated during the last years of apartheid (DOA, 1992; Van Zyl and Kirsten, 1992). The recommendations from this

[8] While recent understandings of food security might challenge this logic, the rationale has shown a strong resilience as the discussion below attests.

strategy followed familiar themes of 'holistically' responding to food insecurity, which entailed changing macroeconomic policies and providing emergency relief programs. Similarly, the proposed governance structures and various institutional responsibilities were commensurate with those recommended in the literature. No 'super-ministries' were to be created. Instead, a committee of experts would work with a central unit responsible for multidimensional food and nutritional planning. As the unit would rely on line-functions of different departments, it was essential that the character of the unit permitted multidimensional interaction. Finally, the unit would function relatively independently with the requisite funds and delegated powers.

Through reshuffling linked to the transition to democracy in 1994, the Food Security and Nutrition Strategy was subsumed by more grandiose macroeconomic plans in the form of the Reconstruction and Development Programme (RDP) of the Transition Government (1994-1996) and the market-orientated Growth, Employment and Redistribution Programme (GEAR) thereafter. In 1998, a food-security working group was again established to develop a discussion document on food security policy (Makhura, 1998). Finally in 2001/2, facing a widespread food crisis in southern Africa, the Integrated Food Security Strategy (IFSS) was adopted to streamline, harmonise, and integrate the government's existing but ineffectual responses to food security (NDA, 2002). The strategy document reads almost verbatim of the Food Security and Nutrition Strategy proposed ten years earlier.

Effectively, institutionalising the IFSS confronted many of the challenges raised in the literature above. One of the major structural challenges to holistic responses remains their effective institutionalisation (Scott, 2001). Institutionalisation in this context refers to how strategies like the IFSS are able to shift the actions of bureaucrats to ensure the delivery of food security objectives. In South Africa, the institutional deficiencies of the IFSS have been the subject of review from a range of perspectives (e.g. (Hamid, 2005; Drimie and Ziervogel, 2006; Misselhorn, 2006; Drimie and Verduijn, 2007). Predominantly, despite proposals to realign programmes and integrate planning through new institutional structures proposed within the IFSS (see Box 1),[9] the existing 'rules of the game' (meaning the existing operations of government line-functions) have conspired against the implementation of any reforms. Additionally, Drimie and Ruysenaar (2010) argue there is a disjuncture between understanding the complexity of food security and the reality of this complexity. This is largely reflected in a lingering agricultural production bias in the

[9]Watkinson, 2003 provides a useful summary of individual programmes to be aligned within the IFSS.

state with the Department of Agriculture regularly tasked with the coordination of food security- a task well beyond its abilities and indeed its culture. This department lacks the political authority needed to ensure stakeholder dialogue and coordination (with no legislated policy or formal institutions to back it up), has insufficient dedicated funds for food security and is pre-occupied with its line function: agriculture. That the institutional arrangements of the Constitution that define provincial Departments of Agriculture as largely autonomous only confuses matters further (Rep. of South Africa, 1996). By this, even the traditional view of a hierarchical governance system within government is a false premise. There is in fact no command and control in agriculture and therefore no real multilevel organisational culture through which to implement the IFSS. The disjuncture becomes even more complicated given the growing complexities of the food system and the increasing role of the non-state actors and a focus beyond purely that of agriculture (Maxwell and Slater, 2003; Ericksen *et al.*, 2009).

One of the main lessons for food governance stemming from the IFSS is that in order for new institutions of governance to work properly, implementers must distinguish organisational culture from formal institutions. A change in terms of the formal institutions (new policies, regulations or even political regimes) does not necessarily mean the fading of an organisational culture shared by the people within them (Mathekga, 2006). However it may limit their ability to engage important stakeholders outside of these realms (Drimie and Ruysenaar, 2010). Although South Africa has only had a relatively short experience with comprehensive food security policies, the way it has responded reasserts the aforementioned challenges in how responses are organised within the state. That 'revised' policies seem to follow familiar themes hints at received wisdom and institutional memory dictating policy development more than anything else (Keeley and Scoones, 1999). This response brings into sharp relief the need for adaptive governance; a process best captured through improving a state's political and administrative capacities to respond to challenges (Folke *et al.*, 2005).

4.4.1.3 Re-classifying State Responses to Food Insecurity

Duit and Galaz (2008) provide a framework for classifying the state's movement towards adaptive capacity and its ability to deal with different (more complex) situations. They suggest that adaptive capacity within the state is largely a function of 'exploration' (innovating new solutions) and 'exploitation' (refining old solutions for efficiency gains), and that through fulfilling each of these, states can be categorised as having a specific type

of adaptive capacity, namely, rigid, robust, fragile, and flexible. Each type allows for different abilities to respond to issues of complexity depending on 1- the rate of change and 2- the predictability of outcome. As governance systems overlap, especially in terms of jurisdiction, management, networks and knowledge but also spatially and temporally (Cash *et al.*, 2006) they may either buffer or amplify one another from one level or scale to the next. A rigid national government might therefore benefit from the buffering of more flexible local governance structures in reacting to complex crises, whilst having the same type of response at different levels might amplify problems.

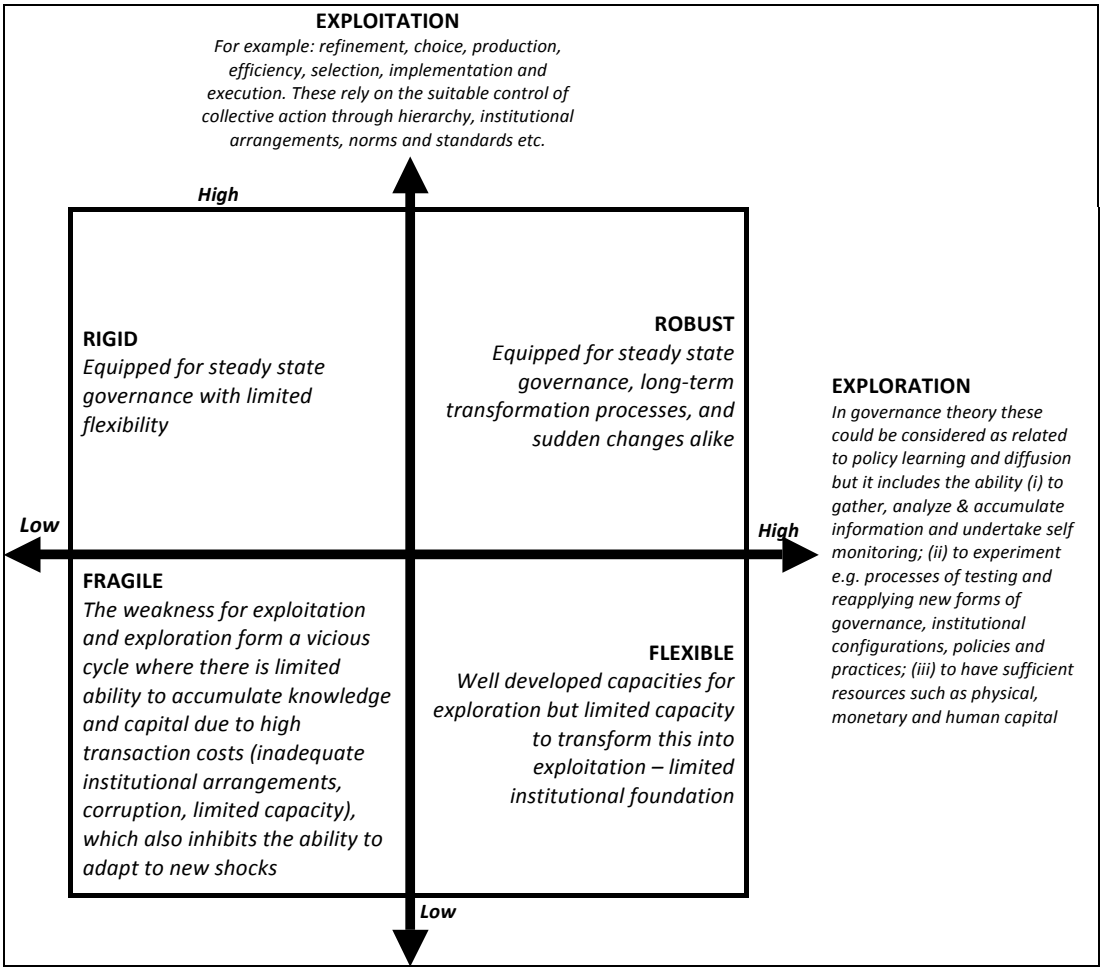

Figure 4.1: Adaptive capacity of four governance types (Adapted from Duit and Galaz, 2008)

Although such typologies are abstract and generalise the complex institutional arrangements and organisational dynamics within government structures, they nevertheless

broadly define ideal governance types and highlight where challenges lie in moving towards them. The IFSS and current government response in South Africa hover between a rigid and fragile governance system, with the bias towards agriculture and ill-conceived institutional arrangements limiting exploration and relying largely on the exploitation of already stretched line functions (Drimie and Ruysenaar, 2010).

Recent responses to the 2008 food crisis, which was indicative of complex interconnected causal factors manifesting in price fluctuations and inaccessibility at the local level, highlights the limitation of the South African state apparatus to conceive and articulate multidimensional responses at different levels. Despite claims of a suite of responses applied holistically- with the usual vanguard of food packs and agricultural starter kits indicating only superficially integrated responses- these actually comprised existing programs that (may) individually benefit food security, many of which are controlled and devised at national levels. This response is very different to a premeditated and systematic application of them holistically. It also highlights the complete lack of co-ordination between departments despite the IFSS goals of integration and addressing the wider causes of food crises. What was novel about the response of the 2008 crisis were the changes within the wider governance of food security outside of government as will be described in the next section. Although a typology of state systems, Duit and Galaz's (2008) framework reinforces the pressing need to find a suitable middle ground of governance that can cope with the peculiar characteristics of complex adaptive systems. This extends to an increasingly accepted rationale that food security requires a move towards adaptive governance beyond the state. However, as the state is likely to remain at the core, such challenges will continue to impede the transition.

4.5 Expanding notions of Governance beyond the State

The previous discussion is orientated around a politico-institutional foundation of the state's role in governance or mono-centric approaches to governance. Alternatives or critiques of the modernist 'Western logic' based on principles of Weberian Bureacracy and 'hierarchy' initially and 'the market' more recently have also emerged. For example, the way in which official bureaucracies have overlooked many civilians in most African countries has shifted the focus to social capital and informal processes. These alternatives refer to the ways in which people create platforms of public administration in contrast

to traditional bureaucratic models. They require reflexive consideration of new forms of governance that recognise these relationships and processes (Swilling *et al* 2002 in McLennan and Ngoma, 2004).[10] Although we do not expand on the 'African critique' to Western-style liberal democratic governance (see Swilling *et al.*, 2002 for an in-depth analysis of governance in African cities), many of its criticisms reflect the problems we identified in the mono-centric approach to food governance. The importance of 'relational capital' in a complex, fluid and inter-connected society with entrenched diversity does not map well onto the governance schema proposed by development institutions (Swilling *et al.*, 2002). We need only look to the failures of structural adjustment programmes (SAPs) and in particular their impact on the food system, to get a sense that there must be a wiser alternative for food governance in Africa (Von Braun and Diaz-Bonilla, 2008). In this next section, we explore shifts to a more flexible approach to governance that recognises the characteristics of the food system and as a result includes the governance of non-state actors. The examples centre on the private sector and what shifting governance trends can be captured in re-defining what constitutes 'good corporate governance.'

4.5.1 Characteristics of a Complex Adaptive System

The food system, as an SES, can also be classified as a complex adaptive system (CAS). CAS are process-dependent, organic systems with feedbacks across multiple scales and levels within them, and their emergent properties include having interactive and dynamic components that self-organise (Ison *et al.*, 1997; Folke, 2006). The following elements are crucial to maintain a functioning system: a diversity of actors, localised interactions, and the selective processes that shape future structures and the dynamics of the system (Folke, 2006). In the food system, these elements are being slowly eroded through an increasing concentration of actors and a distancing of production and consumption. This distance between the use of the resource and the environmental or social consequence (over space and time) of its production means that feedback signals do not work properly and so the self-regulating system fails to function effectively (Ramalingam *et al.*, 2008). Through increasing connectivity brought about through globalisation, system components that would normally interact become distanced whilst others become over-connected, leading

[10]The scope of this paper does not allow for an in-depth exploration into the important and neglected terrain of functional and appropriate alternatives. Including mention of it here hopes to set the scene for a far greater appreciation for such alternatives within the overall umbrella of 'adaptive governance', which although building on emerging research into informal systems such that of Bohle *et al.* (2009) remains dominated by western ideology and theorization.

to a breakdown in the system. "The tight connectivity of complex systems also increases the likelihood that a disruption in a system or one part of the system could jump a boundary and produce 'synchronous failure' (Homer-Dixon, 2006) or a cascading series of unexpected events (Farjoun and Starbuck, 2007)" (In Selsky and McCann, 2010: 170). By definition SES are unpredictable due to their inherent characteristics of complexity, non-linearity and feedback loops that create uncertainty around their future state. Dealing with this uncertainty requires "learn[ing] to manage by change rather than simply react[ing] to it" (Folke, 2006: 255), thus managers must learn to juggle shifting objectives and conditions (Holling, 2001). Organisations in such systems need to adopt particular strategies in order to balance their independence to respond to changes, but ensure that they are also sufficiently connected to other system components to maintain their resilience (Ramalingam *et al.*, 2008). Adaptive governance theories advocate that these components interact in a manner that allows self-regulation.

Since the 1960s, some organisations operating in the private sphere have recognised the increasing complexity of the business environment and have tried to develop tools to cope with this, especially for decision-making about the future. Emery and Trist (1965) developed causal textual theory (CTT) where they describe dynamic organisational environments as 'turbulent.' This 'turbulence' results from complexity as well as multiple causal interactions between elements in the system and their changing environment. There are clear parallels between these 'turbulent environments' and CASs because both originate from chaos theory. These parallels include non-linearity, sensitivity to initial conditions, and self-organisation. Roggema (2010) extends the idea of turbulent environments beyond the scope of the private sector to include governments in what he terms 'swarm planning.' He notes that a government with rigid rules and procedures will become inert because under those conditions it is impossible for creativity and new solutions to emerge (consistent with the rigid classifications described above). On the other hand, small innovative companies are able to operate flexibly and react to fuzzy questions. He argues that an innovation shift that values exceptional talents and imaginative creativity where the traditional role of government is lessened to one of stimulating ideas and guiding network-based organisations, is needed to cope with turbulence and all the complexity and uncertainty that it implies. The key message from this body of organisational theory is to recognise change not as a disruption but as a normal condition of organisational life (Ramírez *et al.*, 2010). Collaboration between actors is vital for coping with turbulence and Ramírez *et al.* (2010) recommend scenarios as a tool for involving the perspectives of many different stakeholders in understanding the future, thus creating a

form of collaborative governance. This mechanism will be discussed further in subsequent sections.

4.5.2 Adaptive Governance in Socio-Ecological systems

In an adaptive governance framework, managing a complex system relies on collaboration between a diverse set of stakeholders operating at different social and ecological scales in multi-level institutions and organisations (Folke, 2006). Rhodes (1996) refers to policy making through multi-layered, self-organising, and inter-organisational networks. It is here where a shift from the primacy of top-down government towards more de-centred governance mechanisms occurs, in which political capacities appear dependant on the effective coordination of interdependent forces within and beyond the state (Jessop, 2003). This, however, does not necessitate solely a 'bottom up' approach: rather than excluding the top-down approach of the state, adaptive governance involved incorporating other actors in order to increase the flexibility of governance responses. This is referred to in subsequent sections.

Recent work by Bohle *et al.* (2009) on the informal rules governing the urban food sector in the Bangladeshi megacity, Dhaka, combines the concept of adaptive capacity[11] into an 'adaptive food governance'. This they define as an interrelated system of (in)formal rules and networks that are set up to guide the food system to adaptability and resilience in a system under double exposure.[12] This links to the food systems framework that emphasises the inter-relationship between environmental, socio-economic and political drivers (drivers of double exposure) and food system activities, which are the processes that adaptive governance is designed to manage. It requires replacing conventional notions of risk governance, stability, and control with a governance system that is sufficiently flexible, integrated, and holistic to deal with "the complexity, uncertainty, and violence of the food system" (Bohle *et al.*, 2009: 53). Such shifts mirror a changing understanding of the state in light of globalisation where it is helpful to think of the State as one element of a greater whole. This moves governance out of the traditional jurisdictional scale into the network scale where relational approaches dominate hierarchical interactions. In the case of Dhaka, this relational approach provides a flexibility of food governance that lies

[11] Adaptive capacity can be defined as "the ability or capacity of a system to modify or change its characteristics or behaviour so as to cope with existing or anticipated external stress" (Brooks *et al.*, 2005: 34).

[12] Double exposure refers to the impacts that systems face from both global environmental change and globalisation (O'Brien and Leichenko, 2000).

in the balance between the formal and informal 'rules of the game' that determine how food flows though the city (Bohle *et al.*, 2009). Despite formal authorities wielding power over the citizens, it is these highly flexible, yet constantly contested relations between the city-dwellers themselves that ultimately govern this urban food system and at the centre lie the street vendors (Bohle *et al.*, 2009). This relational multiplicity provides a form of equity between actors that is the foundation of adaptive food governance.

Folke *et al.* (2005) identify two essential parts to adaptive governance relevant for this article (see Termeer *et al.* (2010) for a summary of the problems adaptive governance tries to overcome). The first is building adaptive capacity within the system to deal with uncertainty and surprise; the second is supporting flexible institutions and social networks in multi-level governance systems. The world food system is being reconfigured not only by the actions of authoritative actors such as states responding to pressure from their constituencies, but also through the autonomous actions of different social, political, and economic groups whose aim is to ensure their own immediate food requirements, profits or other benefits (Eakin *et al.*, 2010). Not only are there increasing numbers of agents acting within the food system, but they have different understandings of what food is. A market-driven approach understands food as a commodity, from the environmental change literature, food is seen as an ecosystem service and, from a human rights perspective, food is a basic need (Eakin *et al.*, 2010). Any form of adaptive food governance needs to reconcile these understandings, which means not relying on all-encompassing solutions like market-driven trade policies, environmental taxes, or food aid packages as these only deal with certain aspects of the food system: a more nuanced, holistic approach is required. Including a range of actors in the governance system is an important step in reconciling these disparate understandings of what the outcome of the food system is. Equitable participation across all levels and scales of the food system is crucial to legitimise a system of adaptive food governance (Eakin *et al.*, 2010). Such adaptive or 'new' governance of self-organising entities tend to form "poly-centric institutional arrangements" (Lee 2003 in Folke *et al.*, 2005: 449). These nested organisational units operate across multiple scales and from an increased rate of interaction; a diversity of responses then arises, making this system better equipped to deal with uncertainty and change (Folke *et al.*, 2005). An example of the beginnings of a poly-centric food governance system in South Africa was the food security workshop that was held in Johannesburg in 2009, which saw a large range of interested parties discussing the dynamic, social and generative complexity of the South African food system, identifying the key blockages in the system (See the discussion on Land in **Chapter 6** and suggested ways forward Gordon Institute

of Business Science 2009). The workshop was convened by the Food Security Directorate in the National Department of Agriculture; the South African Human Rights Commission; the Development Bank of Southern Africa; the National Business Initiative; Gesellschaft fuer Technische Zusammenarbeit (GTZ); Green Choice; Action Aid; Reos Partners and the University of Cape Town and participants ranged from academics and NGOs to local and international food businesses and government. Apart from the benefit of being able to bring such a large group of stakeholders around one table in the recognition that each plays an important part in achieving food security, the social capital that was generated should also not be overlooked.

The role of social capital has been highlighted in building resilience. Social capital includes networks, leadership, and trust and has been echoed in the sustainable livelihoods literature (Folke *et al.*, 2005; Scoones, 2005). Social learning and building a social memory of knowledge about the dynamics of the system are also important processes to be reinforced by adaptive governance. This emphasises the call for the increased involvement of a diversity of stakeholders in the governance of adaptive systems. At the same time these actors themselves (such as those that attended the workshop) go back to their organisations and can play key, transformative roles in leading an adaptive agenda. As Bohle *et al* (2009: 56) point out "Key persons, as nodes in this network, can provide leadership, trust, vision and meaning. Adaptive systems of governance often self-organise as social networks, with actor groups that can draw on multiple knowledge systems. Adaptive systems of governance have therefore been defined as poly-centric forms of social coordination, in which actions are coordinated voluntarily by individuals and organisations with self-organising and self-enforcing capabilities." The food security forum provided just such an instance where this type of poly-centric co-ordination led to social learning and potentially a new form of governance will emerge from the system.

4.5.3 Bringing in the Private Sector

It is now widely recognised that there is a definite role for non-state actors, particularly businesses, to play in achieving food security (Liverman *et al.*, 2009; UN, 2009; Schilpzand *et al.*, 2010). If we understand the food system as a complex interaction of social and environmental systems, then it is clear that any form of governance for food security needs to take this into account. When dealing with complex SESs, too much intervention or regulation according to a preconceived idea stunts the process of self-organisation and inhibits a flexible response to change (Stacey 1993 in Ison *et al.*, 1997: 261). The strength

of the non-state sector in the South African food system relative to that of the government means that there has been sufficient space to allow 'self-organisation' of the constituent parts of the system to organise around the concept of food security. This has been a two-fold process.

The first has happened through a gradual shift by business (largely spurred by some key thinkers- like Mervyn King (see IoD, 1994; 2002; 2009)- in extending 'good corporate governance' to include stakeholders in the decision-making process. This process has made the corporation a more flexible organisation that can respond more holistically to changes within the food system, although it has also brought with it recognition of many constraints that the system faces, particularly in the form of uncertainty. The second has happened organically through self-organisation behaviour, typified by the creation of cross-sectoral partnerships both along the food system (e.g. between suppliers and retailers) and across it (e.g. between companies and NGOs). This has allowed integration in system governance.

4.5.3.1 The Shift in Corporate Governance: A South African Example

In South Africa, there has been a shift in corporate governance from an understanding of the role of the firm as purely profit-focused to one where it not only has a duty to its shareholders, but to society at large (Roussouw, 2005). The King reports[13] (IoD 1994, 2002, 2009) provided a crucial steppingstone in this process by formalising the incorporation of environmental and social responsibility into corporate strategy. This response has also led to an indirect increase in stakeholder involvement through setting up partnerships with NGOs as well as the establishment of projects working with local communities and farmers.

South Africa holds a unique position in Africa being relatively better developed with a globally integrated business sector, which gives it a leading role in advancing good corporate governance in the region (UNECA, 2007). The end of apartheid left South African corporate governance in a "highly turbulent and fluid context ... where South African companies [needed to meet] international corporate standards without neglecting their allegiance to the African continent" (Roussouw *et al.*, 2002: 301). In response, many companies facing this dual tension, established governance mechanisms that understand the messiness of the network of interests that companies need to take into account on

[13]These comprise a set of non-legislated principles and guidelines for company reporting in line with the Global Reporting Initiative (GRI). These were first proposed by the South African Institute of Directors in 1994 and there have been two subsequent editions published in 2002 and 2009.

a daily basis (Hamann and Kapelus, 2005). Recognising this complexity and enhancing the potential for collaboration within a network of interested parties could lead to more sustainable forms of local governance for companies operating under these circumstances (see Hamann and Kapelus, 2005 for examples of this from the mining sector).

The institutionalisation of the governance principles set out in the King reports, as well as international trends in this direction such as the establishment of the Global Reporting Initiative (GRI), has meant that concepts like 'sustainability' have become common parlance within the business community. This has arisen together with an increased focus on Corporate Social Responsibility (CSR), a phenomenon born in the 1970s that questioned the 'invisible hand of competition' as an ethical regulator of large corporations. In response, CSR was born in recognition of the social costs of economic activity and provided the opportunity for corporations to look beyond profits and focus corporate power on more socially desirable objectives (Andrews, 1973). "Wicked problems reflect the coalescence of social, technical and political dilemmas that cut across boundaries of communities, organisations or nations ... therefore decisions impacting on such multifaceted issues being made through a single-issue lens will give rise to conflict between multiple stakeholder groups affected by cumulative impacts or unintended consequences [thereby] compounding systemic volatility of already turbulent environments" (Alahi 2010: 224). Such positive feedback and interconnectedness across traditional boundaries requires new analytical tools for decision-making that take into account not only the characteristics of such dynamic and turbulent circumstances, but also the implications of the social dimension like deciding who gets to be included and how fluid power relations are constituted. Faced with these turbulent environments, companies are starting to recognise their role within the wider community. This is not an altruistic notion, but the recognition of a need to engage sufficiently with stakeholders in order to minimise risk. This is particularly apparent in the food sector where "companies are changing the institutions upon which they are based in order to adapt to the challenges posed by environmental and social concerns." (Tiger Brands Interview, 2009). This has led not only to an increase in social and environmental programs, but a complete overhaul in the way businesses operate (see **Chapter 5**).

The re-definition of good corporate governance has extended concepts like sustainability from mere ideals to measurable deliverables (e.g. see Woolworths' Farming for the Future and other initiatives in **Chapter 5**.). This has a direct impact on the way in which these companies do business and their prioritisation of the communities in which they work and who form their customer base. This is encapsulated in another retailer's

focus on food security as an area of concern. This has its foundations in the restructuring of their farm development program to be not just about social upliftment, but rather to focus specifically on food security. Hence, from the beginning of 2009 they developed a strategy for sustainability, which they are streamlining across divisions (Pick 'n Pay interview, 2009). The conflation of sustainability initiatives with other aspects of social and environmental issues is evident throughout the corporate literature, however, despite the confusion, the interesting point is that it is there at all. These various social and environmental initiatives are elaborated in **Chapter 5**.

4.5.3.2 Governance through Partnerships between Stakeholders

Complex adaptive systems display certain characteristics including connectivity and interdependency (Ramalingam *et al.*, 2008). This ontology of interconnectedness brings with it a commensurate number of stakeholders that should be included in the governance of the system. Indeed, Checkland's (2005) cautionary reminder that our subjective experience in the world generates interpretations of the world that define our standards, norms, and values, insists that any 'ethical' systemic intervention would need to involve as many perspectives as possible in order to be legitimate. Although this process of multi-stakeholder involvement could often result in conflict, it is nevertheless necessary (Midgley and Richardson, 2007). Berkes *et al.* (2003) expand this further to say that complex systems actually rely on this very existence of a multitude of perspectives. The challenge is how to incorporate these into a governance framework that is not so overburdened with engagement that action is stagnated. Various authors have recognised this challenge and have proposed a variety of approaches including Ulrich's (1987) critical systems heuristics, Checkland's soft systems approach (Checkland, 1984), and Walker *et al*'s (2002) paper on a participatory approach for resilience management of socio-ecological systems. The importance of multiple interacting perspectives can be found in examples of cross-sectoral partnerships that are becoming norms in the food system. The development of partnerships also echoes the trend of increasing autonomous governance between different 'non-authoritative' actors within the food system (Eakin and Lemos, 2006).

Partnerships between food and beverage companies and NGOs have become a recent international phenomenon for developing creative solutions to impacts from environmental change (Schilpzand *et al.*, 2010) and this trend has continued into South Africa. Moving into the social and environmental sphere has meant that the private sector has found itself out of its depth and so has sought partnerships with specialists in the field: "We

aren't the experts" (Pick 'n Pay Interview, 2010). Involving a variety of expertise helps to ensure that a variety of objectives are met by projects and a more holistic solution is developed. These objectives are also not only centred around going 'green' or becoming 'sustainable' for marketing reasons, but can also include a complete shift in the focus of the company to include social and environmental concerns. In their corporate strategy, Pick 'n Pay explicitly mention food security as a central concern of the company with a focus on various agriculturally focussed initiatives, but couched within an understanding of the complexity of the problem and that it is the needs of consumers that need to be met through a sustainable supply chain (Ackerman, 2011). Identifying these joint concerns of government and the private sector is important for creating spaces of collaboration. As well as achieving corporate social/environmental responsibility (CSR/CER) aims, partnering with NGOs has also been developed as a business strategy.

When Backsberg wine estate decided to go carbon neutral in 2006, they partnered with the NGO, Food and Trees for Africa in order to offset their carbon emissions. This eventually turned into an international endeavour involving more of the value chain as their wine importers in the UK also decided to go carbon neutral in order to negate the argument that importing wine from Europe was less carbon intensive (Backsberg Wine Estate Interview, 2010). Recognising the potential knock-on effects of such projects in shaping the wider system are critical in a discussion of how adaptive governance could play out in practical terms.

There are also tensions between formal institutions and the more informal rules emerging from the system. Although there has been a level of co-operation between competitors on environmental issues like recycling "because the area of impact is bigger if you do it together" (Woolworths Interview, 2010), this collaboration has been problematic to implement because of pressure from the Competition Commission (Pick 'n Pay Interview, 2010). These tensions need to be addressed through an increased recognition by the respective parties of how the governance of the food system is changing. The Competition Commission plays a central role in South Africa by limiting collusion and bringing those who engage in unfair practices to book. In 2008/09 there was a case of collusion between food processors over fixing the price of bread that was brought before the Commission (see Competition Commission, 2010). The subsequent investigation resulted in substantial fines for those companies involved, serving as a stern warning for those who engage in such practices. At the same time, this important role needs to be re-evaluated so as not to inhibit positive collaboration between competitors, especially over social and environmental issues. This is one of the key challenges that needs to be addressed in an

'adaptive food governance' system. Collaborating in non-competitive areas brings benefits and opens up the possibility for further collaboration (Woolworths Interview, 2010). By forming connections between different organisations involved in the food system, across different scales and levels, the system 'self-organises' to build its resilience. Problems can be tackled from a more holistic perspective by involving more voices and solutions are therefore less rigid and constrained.

4.5.4 The Challenge of Uncertainty

Uncertainty of future conditions and states of the system has been recognised as an important element of a complex adaptive system (CAS), but most management systems still rely on understandings of stable equilibria where the future is predictable given enough information and can therefore be planned for (Ramalingam *et al.*, 2008). Embracing uncertainty therefore clashes with the traditional management idea that seeks to eliminate it, but there is an increasing recognition that "it is better to work with inevitable uncertainty than to plan based on flimsy or hopeful predictions" (Ramalingam *et al.*, 2008: 27). This is still a daunting concept, especially when entire companies, livelihoods, or a country's food security hang in the balance. Building a resilient food system means not only increasing its capacity to absorb shocks and maintain its function, but also means increasing its capacity for renewal, re-organisation, and development in line with understanding the process of adaptive cycles (Folke, 2006: 253). This requires an 'agility' of response where organisations need to adapt rapidly to unexpected conditions; in other words they need to improvise (Ramalingam *et al.*, 2008: 40). The element of uncertainty that comes with environmental change and specifically climate change has been identified as a key challenge facing the South African food system (Pick 'n Pay Interview, 2009; Woolworths, 2009). The potential impacts of climate change have been recognised, but not knowing exactly what is going to happen, when and how intense the variable is going to be, makes planning for building resilience extremely difficult. Food supply chains operate across multiple levels and scales and there is uncertainty between all interactions through unanticipated feedbacks, unknown thresholds, nonlinear dynamics, and sudden shocks, which makes the system unpredictable. One of the main challenges is to improve communication across multiple levels because impacts at one level will have an effect on other levels (identified in multilevel governance approaches). Co-ordination and communication not just between actors working on similar temporal and spatial levels (e.g. companies and NGOs), but also across scales (e.g. between government and business) is crucial to ensure

these nested systems do not collapse through positive feedbacks. A key means of improving institutions for food security in South Africa is through increased interaction between different actors in the food system and in particular to involve the state in these processes of self-organisation. This can happen through fora such as the food security forum that brought actors from different aspects of the food system together to discuss issues of food security after the food price crisis in 2008 (Gordon Institute of Business Science, 2009). Although this will not negate the problem of having to deal with uncertainty, it will help to build capacity that allows institutions to respond to uncertainty.

Creating institutions that are flexible enough to respond to this information flow is as critical as creating capacity to respond adequately to shocks. Neither prescriptive decision-making to cope with unexpected shocks (crisis management), nor the rigid, state-centred existing institutional arrangements of the IFSS are adequate solutions. Tackling complex cross-level issues requires a combination of "top-down approaches (which are too blunt and insensitive to local constraints and opportunities) and bottom-up approaches (which are too insensitive to the contribution of local actions to larger problems)" (Termeer *et al.*, 2010: 36). This entails making use of strategies that understand the dynamics of change, accept uncertainty, and strike a pragmatic balance between present concerns and future potentialities through the use of tools like scenario planning rather than forecasts (Ramalingam *et al.*, 2008, see also Henrichs, 2006).

This requires leadership, which disrupts existing patterns, encourages novelty, and interprets rather than creates change (Plowman *et al.*, 2007) and is a step away from the top-down hierarchical idea of leadership that is normally associated with governmental organisations in particular. A shift from the idea of forecasts to the use of scenarios can be important for embracing adaptive governance. Scenarios are particularly necessary in complex systems that "exhibit turbulent behaviour, extreme sensitivity to initial conditions, and branching behaviours at critical thresholds' like the food system" (Wood *et al.*, 2010: 49). Scenario building offers potential for "imaginative and systemic thinking, which is becoming more valuable in an increasingly volatile world characterised by rapid change, surprise, discontinuity, and frequent shocks, which are not easy to anticipate" (Selsky and McCann, 2010: 167). They have recently become popular mechanisms for companies to deal with future uncertainties in their strategic planning, but have been employed for over forty years by companies, military planners and policy-makers (Ramírez *et al.*, 2010). Extrapolating present stability into the future is a common fallacy in strategic planning, which can be overcome through continuous change thinking because when discussing the possibility of future disruption, participants are forced to engage with a future contex-

tual environment, which they may not previously have conceived of in a structured way (Selsky and McCann, 2010). The benefits of increased participation and the multiple perspectives that are allowed in scenarios have the double benefit of giving managers a more varied set of possible responses to future disturbance (Selsky and McCann, 2010). These mutually beneficial results of active engagement in scenario building exercises has also been highlighted by (Henrichs, 2006) although he offers a proviso that the outcomes of the exercise will be largely dependent on how the process is designed and which stakeholders are invited to participate. Creating a platform for inclusive engagement between all stakeholders is of critical importance with the resulting insights being invaluable tools for adaptive governance. Scenarios are "at home in the world of continuous change and the turbulent environment" (Selsky and McCann, 2010: 180) and are therefore useful tools for planning in uncertain futures.

4.6 Concluding Discussion

4.6.1 What can Government learn from a Complex Adaptive Systems Approach?

Despite a criticism of the South African government's ineffectiveness in implementing an effective food security strategy, this by no means negates the importance of the state. The state is still the accountable (and dominant) entity when it comes to redistribution to the most vulnerable. In South Africa, this role is enshrined in the country's Constitution (clause 27 (1) (b) of the Bill of Rights, Rep. of South Africa, 1996). However, in order to fulfil this role it must leverage resources and knowledge from non-governmental entities and through these synergies build adaptive capacity within the food system (Eakin and Lemos, 2006). Food governance is no longer purely the ambit of the state, but lies in the complex articulation between the state, the private sector, international institutions, and civil society and the state requires capacity in order to manage these relationships (Eakin and Lemos, 2006). The state must provide support to the private sector, but give special attention to the most vulnerable that are often left out of discussions (Dorward *et al.*, 2005). This means going beyond the artificial, but persistent divide between state-led and market-driven solutions (Jessop, 1998; Dorward *et al.*, 2005) to an understanding that effective governance comes from the intersection between these formal and informal rules. Furthermore, although centralised organisations like governments are not

necessarily equipped for dealing with complexity, they are still able to create enabling environments for adaptive governance through legislation, recognising bridging organisations, encouraging creativity, and fostering an environment for flexible institutions (Folke *et al.*, 2005: 463).[14]

There is already evidence of this shift happening in South Africa in the New Growth Path (NGP) document released by the Economic Development Department (EDD, 2010). This document explicitly identifies the agricultural value chain as a key sector for growth in the South African economy. It also explicitly emphasises the importance of social dialogue and recognises that business, organised labour and civil society are core institutional drivers for change in the country, but that there is need for more constructive and collaborative relations between all stakeholders. Although this new strategy will undoubtedly face many teething problems, the recognition by government of a need to work cross-sectorally and to engage constructively with stakeholders is a step in the right direction and much can be taken from this. Although the NGP has also received quite a lot of criticism from some quarters, it has provided the platform for an honest discussion to be had on the future of South Africa. It also illustrates how the government could negotiate the new spaces of governance that are rapidly developing, particularly in the food sector, so as to ensure a flexible rule-making system that still protects the most vulnerable.

On a broader level, adaptive capacity is best captured through the ability of a state's policy and administrative capacities to respond to crises. In the face of globalisation, which presents governments with new tools but also a wider sphere of problems, these crises have generally become more complex (Eakin and Lemos, 2006). While these new problems have led to changes in novel areas, such as biotechnology, transformations with respect to food security are less obvious. The case study of the IFSS suggests that, although food security is recognised as a complex problem by officials, the response remains locked into 'traditional' operations of the bureaucratic state. Not only does this have serious implications for the food insecure, it questions the ability of government to function as an intermediary as well as the potential for synergies between state and non-state actors. As Lyall *et al* (2009: 3) highlight, "the limits to governance in the global South are thrown into sharp relief precisely by the limits of the state to control and lead debates." When it comes to the adaptive governance of food security, such constraints do not necessarily mean that governance systems are not changing. It only means that much of the change is occurring without the inclusion of the state, which can be both useful, but in

[14]This shift towards adaptive governance is particular to certain complex system and that the traditional role of the state for providing coherent policy on specific issues should not be negated.

the long-term could prove highly problematic considering the aforementioned role that the state has to play in supporting the vulnerable. This opens up an important area for further research on the role of the state in supporting the vulnerable using an adaptive governance approach.

4.6.2 Dealing with Complex Problems Requires Governance that Recognizes this Complexity

Adaptive governance of a complex system like the food system needs to meet certain criteria. It needs to be holistic, interactive, flexible, and capable of dealing with uncertainty, change, and surprise. A critical implication for understanding governance of the food system is that it is already a hybrid system combining inputs from government as well as that of business, NGOs, and even private citizens (Schilpzand *et al.*, 2010). This multidimensionality is already reflected in the new institutions of partnerships that are developing between different actors within the South African food system. Encouraging poly-centric arrangements of these cross sectoral, multi-level interactions is vital for maintaining the system's ability to self-organise and remain flexible. However, building the adaptability of the system requires creating capacity for it to manage its resilience in the face of uncertainty and surprise (Folke *et al.*, 2005). Uncertainty has been recognised as a major future constraint within linear, 'cause and effect' thinking that permeates management decisions around future planning. This is useless in a complex system where the dynamic process of learning and understanding patterns of interaction and association should rather be emphasised (Ramalingam *et al.*, 2008).

There needs to be a shift in perspective from wanting to control change in a system assumed to be stable, to sustaining pathways of social development that are cognisant of the increased frequency of abrupt change (Folke *et al.*, 2005). Partnerships are important mechanisms through which to engage actors from multiple perspectives and with diverse expertise in order to solve complex problems. When it comes to the need to make decisions about an uncertain future, scenarios have been identified as useful tools through which to get an array of stakeholders to engage with possible futures thereby internalizing current issues. A more widespread adoption of these practices is one way of actively shaping the food system whilst acknowledging this shift towards recognising its characteristics of complexity, which cannot be controlled or managed by a handful of actors.

4.6.3 Summary and Future Considerations

If the objective of food security is to be achieved through building the resilience of the food system, new models of governance need to be incorporated into current systems of practice. This chapter has identified a new governance space developing across a range of actors, which has been made explicit through the creation of cross-sectoral partnerships to deal with complex issues like sustainability and food security. The South African food system is therefore showing signs of moving towards this poly-centric organisational model, at least within a network of non-state actors, but it is necessary for the state to adapt its mono-centric model to enable it to get involved and ensure that the outcomes are fair for the most vulnerable in society. Arguably, there is a long road ahead: learning to cope with uncertainty rather than planning to control it is going to be a challenge. With the signs of an increasingly hostile environment becoming more apparent, adaptation is finally entering discussions around governance. However, without recognising the complexity of the food system, it will be impossible to build sufficient adaptive capacity to build the country's food security under future uncertainties. This chapter has shown that in the South African governance structure there are elements of flexible, adaptive thinking, but it has not yet permeated governmental strategy around the problems of food insecurity. A shift to adaptive food governance across all actors within the food system needs to happen sooner rather than later. How to support this process without being overly prescriptive is likely to prove the greatest challenge. It will be an iterative journey, but it needs to be undertaken now.

> "In the face of intensification of societal complexity ... [we should see governance as] the complex art of steering multiple agencies and institutions which are operationally autonomous from one another and structurally coupled through... reciprocal interdependence... Governance appears to have moved up the theoretical and practical agenda because complexity undermines the basis for hierarchical top-down control" (Jessop 2003 in Ramalingam *et al.*, 2008: 51).

If we are to weather the imminent storm (Beddington, 2009), we need to start taking the idea of how to govern complexity seriously because insufficient adaptation in the food system's governance will negate any positive benefits made in other areas of adaptation.

4.7 Final remarks

In **Chapter 4** I set out to address aims 2 and 3- *To ground CAS in empirical case studies and to investigate the potential role of the private sector in food system futures* thereby answering key questions 4- *What evidence from the private sector shows that the food system is complex and adaptive*? and 5- *What are the implications of this for adaptive food governance?* The study of different types of governance in the South African food system showed that whilst there is still a lot that is wrong, there are glimmers of hope that the system is starting to self-organise into a more poly-centric governance structure that brings together multiple stakeholders to address the critical issue of food security. Using a CAS approach helped to highlight both the complex characteristics of the South African food system, but also the processes that actors were undergoing in order to adapt to the challenges they were facing. In **Chapter 5**, this analysis is extended to include Brazil and therefore moves the level of analysis higher- to a regional level comparison between two countries that goes towards achieving aim 4- *To analyse food system dynamics across scales and levels.* **Section 5.1** goes back to the critique of modelling offered in **Chapter 1** that addresses the challenge of aim 1- *To move beyond an understanding of food security that is dependent solely on agricultural production, and therefore the reliance of future food security predictions on production data based on climate model inputs* by building a small econometric model on the relationship between food prices and production in order to tear away at some of the complexity underlying their association. Building on this understanding of where the important nodes in the food system are, **Section 5.2** offers a discussion of the actions that food retailers have undertaken in Brazil and South Africa in order to meet sustainability and food security challenges. The final section **Section 5.3** provides a deeper analysis of the drivers of adaptation and changing governance strategies through case study examples from South African food companies. The last two sections answer key questions 3- *What role does the private sector play in achieving food security across scales and levels?*, 5- *What are the implications of these findings for adaptive food governance?* and 6- *What mechanisms for adaptive food governance can be identified in the food system?* thereby achieving aim 3- *To investigate the potential role of the private sector in food system futures.*

Chapter 5

Adaptive food governance and the corporate sector

Chapter 5 is the third and final empirical chapter of this thesis and as such ties together the themes raised in the previous chapters under the umbrella of adaptive capacity in the food system. It is divided into three sections: The first section expands the discussion raised in **Chapter 1** on the limitations of modelling the food system and discusses the links between climate change, food prices and food security with data from Brazil. It is based on the following conference paper:

Pereira, L. and Chiarini, T. (2010) "Understanding macroeconomic processes in the food system under climate change: a study of food prices in Brazil." Global Business and Technology Association Annual Conference, Kruger National Park, 5-9 July 2010.

For the initial paper, I collaborated with Tulio Chiarini, an economist at the University of Itajubá, Brazil. He ran the econometric analyses whilst I wrote up the remainder of the paper. However, the results that now appear from the analysis were not part of the original paper and were run with help from a colleague at the University of Oxford, Eric Schneider. This first section sets the scene for looking at the importance of the private sector actors as boundary organisations that bridge the macro and microeconomic aspects of food security, which was addressed in **Chapter 4**. This focus on the private sector is then expanded in the second section, which has its origins in a paper submitted to Revista

de Gestão Social e Ambiental:

Pereira, L.M., Fontoura, Y. & Fontoura, C.F. "Strategic corporate shifts towards adaptive good governance under environmental change: a comparison between South African and Brazilian Retailers."

This paper looks at strategic corporate governance shifts that are currently underway within the food sectors. It compares the food security and climate change adaptation strategies in the Brazilian and South African retail sectors and follows from the discussion around the shift towards adaptive governance in South Africa in **Chapter 4**. The idea behind collaborating on the paper arose at the Earth System Governance conference in Amsterdam, December 2009 where I met the co-authors Yuna Fontoura who is a student at the Getúlio Vargas Foundation in Rio de Janeiro and Carlos Fontoura who is a researcher at the Catholic University of Rio de Janeiro. My contribution was to initiate the idea behind the article, to draft the initial outline and to analyse and write up the empirical information on the South African retail sector. My co-authors researched and wrote the sections on the Brazilian retail sector included in the paper. I subsequently rewrote and added in more detailed information on both country sectors for inclusion in this chapter thereby deepening the analysis.

The third section of this chapter looks more explicitly at four strategic areas where food retailers have the potential to build adaptive capacity to climate change in the food system. These areas are innovation, customer awareness, procurement policies and retail as a buffer under shocks. This is an empirical section based on data collected from interviews that I conducted in South Africa some of which were included in my contribution to Chapter 18 of the Global Environmental Change and Food Systems synthesis report (See Schilpzand *et al.*, 2010).

5.1 Understanding macroeconomic processes in the food system under climate change

The 2007-08 global food price crisis followed by the 2008 financial crisis led to renewed interest in global food security and attaining the first Millennium Development Goal (MDG) of reducing poverty and hunger. Despite this commitment, over the past decade the number of undernourished people worldwide has steadily climbed upward, exacerbating the problems of an already fragile global food system. The United Nation High Level task force on the global food crisis identified a multitude of factors contributing to the increase

in world food prices, which continued into 2011 (World Bank, 2011). These factors range from energy prices and biofuel policies to the financial crisis, speculation in agricultural commodities, and environmental hazards associated with climate change. Ripples from the food price crisis have also affected the business sector, which faces increasing pressure to develop innovative responses that address food security issues and sustainability in the value chain (UN, 2009). However, in order to develop and enact solutions, one needs a greater understanding of how the food system actually operates, as a "co-evolved [system], with mutually dependent and interacting social and ecological components and highly uncertain and unpredictable outcomes" (Ericksen, 2008*b*: 237).

Stevens *et al.* (2003) describe food security as a dynamic concept where the stability and reliability of access to food over a period of time is guaranteed. This is particularly difficult to ensure within the supply and demand volatility of the global market. Food access is largely determined by purchasing power, which depends on economic growth, income and resource distribution (FAO, 2003). A vital link in the food system is to understand how changes in the prices and quantity of food affect changes in how the poor use their assets, which then translate into food security and livelihood strategies (Imber *et al.*, 2003). Thus, the interaction between climate change processes and food prices have become dominant features on the research agenda. So far, research has taken place mostly at the macro-level through the use of models to project food prices from production changes under different climate change scenarios (See Parry *et al.* (2004); Fischer *et al.* (2005); Nelson *et al.* (2009) and **Chapter 1**). These approaches have neglected to include all possible climate change impacts, focusing on international trade and the global supply chain instead of the impact at the consumer level and concomitant food security and livelihood implications (e.g. Imber *et al.*, 2003; Meijerink and Danse, 2009; COMESA, 2010).

Projections for climate change impacts on agricultural production show that whilst developed countries are likely to benefit from climate change due to increased productivity, the developing world is likely to face a pronounced decrease in productive area, with Africa predicted to suffer the most because of added stress and uncertainty in regions already vulnerable to climate variability (Fischer *et al.*, 2002; Slingo *et al.*, 2005). This dynamic directly affects food security in terms of a net decrease in food availability; however the effects on the element of food access are more complex, particularly as food pricing is already a complicated process. Despite recurrent media references to climate-

related impacts on agricultural markets,[1] few quantitative empirical studies analyse this link, making policy and strategy development in this area largely assumptive guesswork. Coming to terms with this relationship has great strategic relevance, domestically and internationally, both in terms of economic development and competitiveness for those countries with agriculture-based economies as well as for agribusiness in general.

5.1.1 The Food System, Climate Change and Business

As the food security literature has developed over the past 20 years, the integral role of functioning markets to food security has become increasingly recognised and with this, the role of the private sector in ensuring system resilience under stress (Devereux and Maxwell, 2001). Regarding climate change, there has been more of a focus on putting a price on carbon as a mitigation strategy whilst adaptation in the private sector has been centred on corporate social and environmental responsibility and carbon emissions transparency (Klassen and McLaughlin, 1996; Esty, 2007; Schelling, 2007). Recently, some authors have critiqued this approach and have argued that climate change is now a business problem directly affecting company operations, not just shareholder investment, which calls for a strategist's approach rather than that of a philanthropist (Porter and Reinhardt, 2007). The role of businesses in adaptation to climate change and not just mitigation is becoming increasingly important because the effects of a changing climate system are already being seen (Vogel, 2009). Furthermore, business has been called on to contribute towards development issues, particularly in the food sector, not just through social investment programmes, but through strategic investments throughout the value chain (Food Ethics Council, 2009).

Climate change is a particularly peculiar problem because of the uncertainty surrounding not only its direct impacts, but also around how these will be translated through the Earth's systems. In the case of socio-ecological systems, many of the tools that we currently employ for modelling systems are insufficient for capturing the complexity in their interactions. Economics in particular has been criticised for basing its assumptions on

[1] E.g. "The World's Growing Food-Price Crisis" Vivienne Walt, Time 7 February 2008; "Coffee and sugar prices stirred by shortages" Javier Blas and Jenny Wiggins, Financial Times 11 May 2009; "Demand from China lifts US soyabean prices" Chris Flood, Financial Times 20 May 2009; "Poor harvests set tea prices boiling" Javier Blas, Financial Times June 9 2009; "Concerns mount over sharp rise in food costs" Javier Blas, Financial Times June 10 2009; "Colombian crop fears see coffee prices heat up" Chris Flood, Financial Times 20 October 2009; "Sugar Prices heat up amid Brazil concerns" Chris Flood, Financial Times 19 December 2009, World Food, Financial Times Special Report, Friday October 14 2011; "Bumper wheat crop ease concerns over food security" Javier Blas, Financial Times December 9 2011; "Cattle prices hit record after US drought" Gregory Meyer, Financial Times, 20 January 2012.

systems in equilibrium when the physical sciences recognise the difference between open and closed systems (Beinhocker, 2007). Ideas from complexity science have started to reinvigorate economic thinking and have rebranded this offshoot complexity economics. One of the key ideas stemming from this collaboration has been to refocus the use of models as tools with explanatory, not only predictive power; this means that the assumptions of how the system works are as critical as any predicted relationship. It has therefore been suggested that it is necessary to test theoretical models with actual non-aggregated data to see how valid these assumptions are when applied to the real world (Beinhocker, 2007). Climate change has been problematised within the food system as having a future impact on production that will have consequences for global food prices and thus impact food security. However we already confront difficulty in understanding how food prices are determined without the added impact of climate change. In order to understand how future production impacts from climate change will affect food prices,[2] we first need to look at historical proxies for climate change impacts on production in order to determine relationships at different levels in the current food system.

Determining the relationship between historical proxies of climate change and past food prices is of critical importance to both development and business strategy because it can provide insights into potential impacts in the future. However, the usefulness of the outputs from such analyses must be contextualised. Climate change is a stress that will exacerbate the pressures currently faced in the food system and so there is a need to come to terms with the complexity of this system when developing strategies around climate change mitigation and adaptation, as these are not mutually exclusive. This research needs to be done in a way that furthers our understanding of how the food system functions rather than merely producing an output of the future state of the system if all the model assumptions are met. Such a reorientation of the research agenda can spearhead innovation and strategic thinking by business and government actors in the emerging economies that will be facing increasing pressures to think carefully about sustainability in economic, environmental and social terms.

5.1.2 Aim and Methods

The overall aim of this section is to ascertain how relevant information from large-scale econometric models is for a discussion of food security under climate change. The outputs

[2]This focuses only on the impact that climate change will have on agricultural production. In fact it will have a far greater influence on the food system through affecting for example, distribution logistics.

from the models mentioned in **Chapter 1** include future projections of world prices of key food commodities. These are modelled under a given CO_2 emissions scenario or the world price of food groups (e.g. cereals) as a function of temperature increases (See Easterling *et al.* 2007; Nelson *et al.* 2009). Although these can be useful for a macro-understanding of how climate change could impact the food system, this information is not necessarily helpful for a food security analysis of the impacts of climate change across different levels. This section therefore employs a simple regression, using historical data, to try to illustrate the complex nature of the relationships that determine the price of food commodities. As will be demonstrated by the regression results, ascertaining any direct, linear relationships in the food system within a country is very difficult. Given this result, it is even less likely that an estimate of global food prices based on a change in production (whether for a commodity or a group of commodities) can be used to analyse food security. There are two objectives of this study: the first is to conduct an econometric analysis of maize and wheat production and prices in Brazil to see what information can be obtained from such an analysis and the second is then to discuss the gaps that such an analysis identifies in integrated models as well as what elements of food security cannot be determined through such an analysis.

5.1.2.1 Brazil

Our country of analysis is Brazil: an emerging economy with high socio-economic inequalities[3] and a globally important diversified agricultural sector. Due to its large agricultural area, and the diversity of its agricultural sector, it operates similarly to a region rather than an individual country. This has interesting implications for regional buffering of climate related impacts on food prices. It also makes Brazil a good country for comparing to other large agricultural exporters like the US, China and Russia. The traits that enable it to buffer some shocks to its food system also make it a useful country to compare with countries that are not as resilient because of less diversified agricultural economies or that are considerably smaller. This has implications for using the region as the unit of analysis, which will be discussed again in **Chapter 6**.

5.1.2.2 Data

We use annual, national data on production, acreage, domestic and international prices from 1990-2007. Unfortunately due to lack of data on domestic prices, the time series is

[3]The latest World Bank figures show that in 2009 Brazil's GINI coefficient was 54.

restricted to 17 years of data. This complicated the analysis as there was insufficient data for a co-integration analysis which would have better suited our aims. We therefore had to run a simpler analysis. This also means that the useful information that can be gained from disaggregated data is often abandoned for a less data intensive model. In terms of food security, this leaves a gap in our understanding of what the processes are at lower levels of the system.[4]

As the original price, production, and trade series data were non-stationary (a unit root could not be rejected using a Dickey-Fuller test), first differences were used in the regressions. The natural log of the series was also taken so that the price coefficient would reflect a price elasticity.

The data were sourced as follows: Production (Instituto Brasileiro de Geografia e Estatística, Pesquisa Agrícola Municipal— IBGE/PAM); Domestic price (Fundação Getúlio Vargas, Agroanalysos); International price (International Monetary Fund, International Financial Statistics— IMF/IFS). Import/Export data (FAOSTAT). Producer price was transformed using the IGP-DI deflator (prices Jan. 2010=1): mean wholesale price of a 50kg sack of wheat flour was transformed using IGP-DI deflator (prices Jan. 2010=1), Paraná State and mean wholesale price of a 60kg sack of grain maize was transformed using IGP-DI deflator (prices Jan. 2010=1), Paraná State.

5.1.2.3 Methods

In this study, we initially wished to analyse the relationship between food prices and projected climate change by examining historical data. However, due to the scale mismatch[5] between climate events, and the setting of food prices, the paper was split into two parts. The first provides an analysis of the studies showing the impacts of climate variability on

[4]In Brazil, although producer prices have been differentiated from wholesale prices in the agricultural sector since the 1980s when coffee was a major product in the Brazilian economy, this data was not available for the two commodities that we analysed (OECD Statistics). The reason we would have liked to have included both producer and wholesale prices would have been to highlight that there are a variety of domestic prices and that the price of goods differs from production to consumption. This would have meant that we could draw conclusions about food security that are not directly related to the farm-gate price. Although the wholesale price is not a perfect reflection of the price set by all middlemen, it nevertheless indicates that there is a difference between the price received by farmers and prices further along the value chain. This can be due to a variety of factors, not least of all the commission taken by middlemen, but also transport costs. Transport is a particularly important factor in African markets where the infrastructure in most rural areas is virtually non-existent.

[5]See Cash *et al.*, 2006 as mentioned in **Chapters 1 and 2**, but this refers to the mismatch between the geographical space and temporal scale in which crops are grown and prices are set (or the data available) as well as from making direct causal links between changes in the climate and the ultimate prices that arise.

agricultural production and how these are projected to affect Brazilian agriculture into the future. From the relationship between climate variability and production, we use historical production changes as a proxy for predicted future climate impacts on agriculture (but this assumption is later challenged in our analysis). Although on top of weather related changes, historical production changes are dependent on multiple factors including disease, pest outbreaks, and lack of sufficient inputs and markets, our assumption is that these perturbations are likely to continue into the future and therefore do not affect the overall aim of the analysis which is to understand how fluctuations in production affect prices. Furthermore, there is a large, respected literature that states that a projected increase in the frequency and severity of extreme events as a result of climate change will reduce crop yields and production below the impacts from changes in mean variables alone (Easterling *et al.*, 2007). This creates the possibility that surprises similar to the erratic changes in production seen historically as a result of multiple causes, will occur in the future due to climate change. Furthermore, there is evidence that shows with a high confidence that climate change will also increase the risk of fires, pest and pathogen outbreaks (Easterling *et al.*, 2007). An increase in these risks would have similar abrupt impacts on production.

Using variations in production as a proxy for climate impacts, the second part analyses the effect of national crop production, the trade balance and international prices on the domestic commodity price. The study is limited to maize and wheat because these are two staple crops, which are internationally traded as commodities in their own right rather than in a processed form.[6]

The first regression is run using the following equation where ($P_{domestic}$) = domestic price, ($M_{production}$) = domestic production, (P_{global}) = international price and ($T_{balance}$) is the trade balance (of exports minus imports).

$$P_{domestic} = M_{production} + P_{global} + T_{balance} \tag{5.1}$$

However, since there is potential endogeneity in this model because domestic production and domestic prices are mutually causative, we ran another regression using Equation (5.1). Where (A_i) = area planted this year, (A_{t-1}) = area planted the previous year and P_{t-1}) is the domestic price the previous year.

[6]Although a staple food in the country, cassava tubers degenerate rapidly therefore it cannot be traded in its fresh state and must be dried or made into a flour (FAOSTAT, 2010).

$$A_i = A_{t-1} + P_{t-1} \tag{5.2}$$

This is a partial adjustment model of agricultural supply response developed by Nerlove (1958), which holds that the acreage planted with maize in the current year is dependent on the acreage planted in the previous year and the price in the previous year. Both domestic and international prices were used in this model to test the supply response of Brazilian maize producers. We then ran a regression to see how much the change in production was a product of acreage and how much could be contributed to an error term (i.e. affecting the yield).

$$M_{production} = A_{maize} + e \tag{5.3}$$

The error term (or residuals) from this equation represents the part of maize production that cannot be explained by changes in acreage. We are here assuming that the largest supply response was from local producers adapting the acreage planted with maize, as it is not a limiting factor in Brazil. However, a more comprehensive test would have included input costs such as the costs of labour, seed and fertiliser.

To estimate a less endogenous form of Equation (5.1), we therefore substituted the error term (e) from Equation (5.3) for maize production in Equation (5.1), yielding the following equation:

$$P_{domestic} = M_{exogenous} + P_{global} + T_{balance} \tag{5.4}$$

where $M_{exogenous}$ is the exogenous change in production of maize that cannot be accounted for by area changes.

Equation (5.1) was also used to run a regression on the wheat data series. As there was multicollinearity between the international price and trade balance, in the second regression, we removed the trade balance from the equation and reran the analysis.

5.1.3 The Brazilian agricultural sector

Following the agricultural boom of 2005, Brazil is now the third largest agricultural exporter after the United States and European Union. In 2007 (the final year of our dataset), it ranked first in the production of sugar cane, coffee, beans and oranges, second for soybeans, third for maize and fifth for cassava (FAOSTAT, 2010). In 2007, Brazil contributed 9.9 percent to the total maize exported globally, just behind Argentina at 13.6 percent

(FAOSTAT, 2010). The United States dominated the maize export market by exporting 51.8 percent of the total in 2007 and 47.9 percent in 2009. Brazil's share of maize exports fell in 2009 to 7.7 percent where it was overtaken by France to be ranked fourth. According to USDA figures, in 2008 the agri-food sector in Brazil accounted for 28 percent of GDP ($55.6 billion) and employed over 16.4 million people. As such, agriculture is an important component of the Brazilian economy and is set to grow in global dominance over the coming years (Scare *et al.*, 2009).

However, there are three factors affecting this potential growth. The first is increasing pressure for sustainability given Brazil's vast natural resources, which means that the sector is having to consider the environmental impacts of its value chain (Scare *et al.*, 2009). The second is an increasing reliance on governmental support to the domestic agricultural sector through credit for investment programmes like PROGRAMA MODERFROTA (Programa de Modernização da Frota de Máquinas e Equipamento), debt relief programmes and rural credit programmes run under social relief and poverty reduction programmes like PROMAF (Projeto de Modernização da Administração Financeira) and PROGER (Programa de Geração de Emprego, Trabalho e Renda) (USDA, 2005). Finally, and most significantly for this study, projections of Brazilian agriculture under climate change show reductions in low-risk areas for production for all crops studied except sugar cane and cassava (EMBRAPA, 2008). In this context, Brazil's dynamic agricultural sector provides an interesting case for studying the linkages between climate, production, prices and trade at a national level.

5.1.4 Climate Change

Anthropogenic global climate change represents one of the greatest challenges for the 21st century, both in terms of mitigation and adaptation. Given the scientific uncertainty still surrounding the consequences of climate change, adaptation is a particularly difficult area to tackle because it requires action now for an unknown future. Despite these uncertainties, the Fourth Assessment Report (AR4) of the International Panel on Climate Change IPCC reports robust findings that climate change will affect food security with a direct impact on agricultural production (Easterling *et al.*, 2007). Unfortunately, plant experiments informing the process-based crop model simulations are focussed on the world's major food crops (e.g. IPCC projections only include wheat, maize and rice) and so-called traditional food crops like sorghum, millet and cassava. Important tropical commercial crops like coffee and sugar cane are often left out. A recent statistical climate

crop model by Lobell *et al.* (2008) has included up to ten different crops per region of analysis. This shows declines in rice (-4.5 %), maize (-4.2 %), wheat (-6.1%), cassava (-4.3 %) and soybean (-3.3 %) production in Brazil, which is in line with a recent report by EMBRAPA (2008). Based on projections for 2050 under the best case B2 scenario (predicting a temperature increase of 1.4 – 3.8 degrees by 2100), the report projects severe losses in the value of agricultural production due to a decline in productive area for cotton (-R$401 million), rice (-R$530 million), coffee (-R$1,7 billion), soya (-R$5,47 billion), beans (-R$360 million), and maize (-R$1,5 billion). These losses will only temporarily be mitigated by projected increases in the value of sugar cane production by 2020 of R$29 billion as this increase in land suitability will be short-lived and losses of around R$27 billion are projected for this sector by 2070.

For those models that include an economic model in order to project food prices under climate change, results show a positive relationship between an increase in global mean temperature (GMT) and an increase in food prices (where a warming of 5.5 degrees would result in up to a 30 percent increase in prices (Easterling *et al.*, 2007). A more recent study by Nelson *et al.* (2009) using a partial equilibrium model, shows a stronger relationship between climate change and food prices with the result that a scenario with no CO_2 fertilisation effect results in a 7 percent decline in calorie availability in developing countries relative to 2000. However, as mentioned in chapter one, these studies are very much aimed at providing figures from general macro-level models that only take into account a gradual increase in GMT over time, but does not include the influence of an increase in extreme events on food security, nor of possible feedbacks in the food system.[7] These effects are arguably more critical for adaptive capacity, but they require a different type of analysis that makes use of non-aggregate data on a smaller scale. In the next section, we undertake the first step in such an analysis that aims to look at the historical relationship between fluctuations in crop production, commodity prices and trade.

Table 5.1: Regression of domestic wheat price against domestic production, international price of wheat and the Brazilian wheat trade balance, (obs = 19) *NOTE: Dependent variable is domestic price, method of estimation used Least Squares, White Heteroskedasticity-Consistent Standard Errors and covariance, no autocorrelation present in the regression, R-squared = 0.3553. Standardised Beta coefficients provided to show relative importance of independent variables.*

Domestic price D1	Coeff.	Std. Err.	t	P>|t|	Beta coeff
Production D1	0.000	0.000	0.80	0.434	0.114
International price	0.098	0.069	1.41	0.178	0.535
Trade balance D1	-0.000	0.000	-0.03	0.974	-0.012
Cons	-1.041	1.526	-0.68	0.505	.

5.1.5 Results

For wheat, an import crop in Brazil, the regression results (Table 5.1) showed insignificant relationships between all the variables and domestic price. However, since the balance of trade and the international price were collinear, we removed the trade balance and reran the regression.

Table 5.2: Regression of domestic wheat price against domestic production and the international price of wheat, (obs = 20) *NOTE: Dependent variable is domestic price, method of estimation used Least Squares, White Heteroskedasticity-Consistent Standard Errors and covariance, no autocorrelation present in the regression, R-squared = 0.3474. Standardised Beta coefficients provided to show relative importance of independent variables.*

Domestic price D1	Coef.	Std. Err.	t	P>|t|	Beta coeff
Production D1.	0.000	0.000	0.69	0.498	0.085
International price D1.	0.102	0.028	3.66	0.002	0.553
cons	-1.258	1.375	-0.91	0.373	.

In the second wheat regression (Table 5.2), without the trade balance variable included, there was a positive relationship between the international price of wheat and the domestic price of wheat, which is what is to be expected in a wheat importing economy. However, this relationship changes for maize, which is an export crop in Brazil.

This regression (Table 5.3) showed a negative relationship between production and domestic price, i.e. that with an increase in production, prices would decrease. This is

[7]The most notable of which is with the increased pressure to mitigate climate change through the use of biofuels. Brazil's bio-ethanol from sugarcane is widely recognised as the most sustainable, yet competitive of first generation biofuels (IAASTD, 2009) and with international policy (such as the European Union's Biofuel Policy (See `http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0028:EN:NOT`) as well as the oil price signalling that this is a lucrative market for Brazilian agribusiness, more land can be expected to go into farming sugarcane for ethanol than for food crops: a positive feedback loop.

Table 5.3: Regression of domestic maize price against domestic production, the international price of maize and the Brazilian maize trade balance, (obs = 19) *NOTE: The Dependent variable is domestic price, method of estimation used Least Squares, White Heteroskedasticity-Consistent Standard Errors and covariance, no autocorrelation present in the regression, R-squared 0.33. Standardised beta coefficients provided to show relative importance of independent variables in the regression.*

Domestic price D1	Coef.	Std. Err.	t	P>|t|	Beta coeff.
Production D1	-0.000	0.000	-2.29	0.037	-0.527
International price D1.	0.077	0.021	3.63	0.002	0.469
Trade Balance D1.	0.000	0.000	1.01	0.330	0.209
Cons	-0.834	1.01	-0.83	0.422	.

a similar type of conclusion to those reached in the models mentioned in **Chapter 1** where the impacts of climate change on crop production is the variable of change that is determining price increases. However, given the potential endogeneity of this model, we ran a second analysis on the data in an attempt to ascertain the direction of the causal relationship between price and production.

Table 5.4: Regression of area of maize planted against the area planted in the previous year and the domestic price in the previous year, (obs = 19) *NOTE: The Dependent variable is maize acreage, method of estimation used Least Squares, White Heteroskedasticity-Consistent Standard Errors and covariance, no autocorrelation present in the regression, R-squared 0.8025. Standardised beta coefficients provided to show relative importance of independent variables in the regression.*

Maize acreage	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
Acreage_t-1	-0.190	0.181	-1.05	0.309	-0.574 0.193
Domestic price_t-1	0.218	0.071	3.06	0.007	0.067 0.369
Cons	.009	0.017	0.54	0.595	-0.026 0.0446

The results from this regression (Table 5.4) show that there is a significantly positive relationship between the domestic price and the acreage of maize planted in the following year. However, running the analysis against international price shows a non-significant relationship between acreage and international price (Table 5.5).

These regressions indicate that farmers are responding strongly to the price of maize in the previous year when making their planting decisions in the following year, but they are not responding to the international price. From this we can infer that farmers are responding to domestic prices through the amount of land that they bring into cultivation the next year.

Table 5.5: Regression of area of maize planted against the area planted in the previous year and the international price in the previous year, (obs = 19)*NOTE: The Dependent variable is maize acreage, method of estimation used Least Squares, White Heteroskedasticity-Consistent Standard Errors and covariance, no autocorrelation present in the regression, R-squared 0.08733. Standardised beta coefficients provided to show relative importance of independent variables in the regression.*

Maize acreage	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
Acreage_t-1	-0.354	0.179	-1.98	0.065	-0.733 0.0248
International price_t-1	0.131	0.110	1.19	0.250	-0.101 0.363
Cons	-0.000	0.020	-0.02	0.981	-0.043 0.042

Table 5.6: Regression of domestic price against exogenous production and international price, (obs = 19)*NOTE: The Dependent variable is domestic price, method of estimation used Least Squares, White Heteroskedasticity-Consistent Standard Errors and covariance, no autocorrelation present in the regression, R-squared 0.1722. Standardised beta coefficients provided to show relative importance of independent variables in the regression.*

Domestic price D1.	Coef.	Std. Err.	t	P>|t|	Beta coeff.
Maize_exogenous D1	-0.000	0.000	-0.87	0.400	-0.253
International price D1.	0.068	0.031	2.17	0.046	0.415
Trade balance D1.	0.000	0.000	0.36	0.727	0.080
Cons	-1.398	0.966	-1.45	0.168	.

Thus, it is possible to remove a large part of the endogeneity between domestic maize production and the domestic maize price by running a regression of domestic maize production on the domestic maize price. Having then run the regression based on Equation (5.3), we determined the error term that we could use as the 'true' value of environmental impacts (or impacts not affecting the amount of land being put into production) that determines domestic prices. The residuals from the regression of Equation (5.3) (the part of production that is not accounted for by changes in acreage planted with maize) better reflect the climate proxy that we originally assumed and are also less endogenous to price than the original production. (They do not account for prices of inputs such as labour and fertiliser, but that is not within the scope of this study.)

The final regression was then run using Equation (5.4).

The results in Table 5.6 shows that domestic prices are actually determined most strongly by the international price. The proportion of production not explained by changes in acreage sown with maize (the residual representing climate) is not significant in explaining domestic prices.

5.1.6 Implications for food security

Putting a food security lens on an economic analysis has important implications for how the evidence is interpreted. This brief analysis indicates the need for a more nuanced understanding of how the food system delivers food prices under production changes (whether these are attributed to climate change or to market reactions to weather extreme events). The main output of global models of food prices under climate change assume that the driver of change in the system is pressure from supply (due to climate change impacts). However, what this shows, and what many experts working in the field have found, that farmers actually respond more to price signals than they do to environmental impacts (Liverman, 1986). Although climate change impacts on the food system can in no way be ignored in the long-term, without a clearer understanding of the finer points of how decisions around agriculture are conducted, we cannot hope to adapt to the threat of climate change on food prices. This entails recognising the limitations of global model outputs as tools for decision making. An analysis of data aggregated at the national level indicates relationships that are not always accounted for in model assumptions (and if they are, the empirical evidence sometimes shows relationships in opposite direction to what would be expected from model assumptions). These include in particular the role of agricultural policies, not just in the country of study, but also in countries that have a dominant role in international markets. For example, Brazil saw a spike in maize exports in the early 2000's (FAOSTAT data). This could be attributed not just to price incentives, but potentially to governmental policies coming into effect as the Cardoso government started instituting the pro-rural and agricultural development policies outlined above in the mid-to-late 1990s.[8]

Addressing these mechanisms is crucial for food security studies in all countries; those that are net food exporters and net food importers. What this analysis has shown is that even within the same country, different mechanisms govern relationships between different commodities and their prices. If a goal of food security policies is to ensure food is accessible, then understanding how the vagaries of the international market operate in country-specific situations is imperative. For example, in a country that is heavily dependent on agricultural exports, like Malawi, if production declines under climate change as is projected, the loss in terms of trade could impact the country's ability to import other crops that it does not produce in sufficient amounts to meet domestic demand. It will also impact the country's food security where some crops cannot be 'substituted' due to

[8]PROGRAMA MODERFROTA was created in 1999, PRONAF in 1996 and PROGER in 1995.

the differing nutritional and social benefits of different food types. This analysis is therefore not just relevant for Brazil, but can be used to shed light on the differing economic relationships that are relevant in different national situations. Domestic complexities are similarly relevant, particularly when one includes factors like transport impacting prices after the farm-gate. Especially in a country the size of Brazil, more information about food security outcomes could be gained from an analysis at the State level in order to see whether there are vast discrepancies in food prices between, for example, producing states (in the Centre and South) and others (e.g. the poor, drought-prone North-Eastern states).

This study only looked at two commodities, which are not perfect substitutes, but the evidence that they behave substantially differently in Brazil means that grouping commodities (e.g. into cereals) results in these different behaviours being lost through aggregation. How commodities are priced through different dominant mechanisms has broader impacts when extended to include other crops that provide different nutritional requirements. As staples, wheat and maize fulfil similar nutritional requirements (if not social functions), but this is not the case for other food commodities like meat, fruit and vegetables. If the decrease in production of a cash crop negatively affects an agricultural exporter's terms of trade to such an extent that they can no longer afford to import other essential food commodities, the country's food security will be severely compromised: not just from a calorific perspective, but from a nutritional and social perspective too. For example, South Africa's population is heavily reliant on bread as a staple food, but the country imports much of its wheat. An inability to import sufficient wheat to meet local demand (whether due to a global shortage, speculation or a poor domestic harvest leaving a larger shortfall) would severely compromise the country's food security as was seen through the food price crises of the past two decades (see **Chapter 4**). In this case, the argument that liberalised trade in food commodities will rectify the impacts of climate change on food production in developing countries is flawed even if the country has other sources of foreign exchange. It has further ramifications for businesses looking to establish themselves in this sector because understanding the interconnections and feedbacks within the food system will become more and more important.

This analysis also only focuses on one section of the food system: from production to wholesalers, but this is not how the majority access their food. Rather most consumers buy some or all of their food through private sector actors further down the supply chain, even if they are food producing households (See **Chapter 3**). Food affordability is determined both by household income as well as the price of the food itself (including

transport, processing and storage costs) and so it is arguably in this sphere that food security outcomes are either met or not. The private sector bridges the macroeconomic and the microeconomic divide. Although their role has largely been ignored in the food security literature, which has focussed either on communities, farmers or governments, most food companies can be viewed as "boundary organisations" that play an intermediary role between different arenas, levels and scales (Cash *et al.*, 2006: 15). How food companies govern their internal processes, functions and strategic objectives is therefore critical for achieving food security outcomes from the food system. The next section expressly looks at food retailers in South Africa and Brazil and how they have taken on the challenges presented by climate change on the food system. The final section then looks at the capacity of these organisations to make the food system adaptive in an uncertain future.

5.2 Governance for food security under climate change: strategic shifts for the food retail sector in Brazil and South Africa

A dominant shift in food system governance from the public to private sector has taken place, bringing with it questions of the role that non-state actors are likely to play in food system adaptation to global environmental change (Liverman *et al.*, 2009; Schilpzand *et al.*, 2010). Under these discussions, the role of business in food security has been identified as vital, resulting in a shift towards including the private sector as a key player in attaining food security goals such as the first Millennium Development Goal (MDG) of reducing extreme poverty and hunger. A key document highlighting this is the UN private sector food sustainability guide, which provides guidelines on where in the food system action is required and how businesses at all points along the value chain can contribute towards achieving sustainability in the food system with the ultimate objective of global food security (UN, 2009).

When analysing corporate strategies around social and environmental issues, like food security and climate change, it is necessary to embed this within regional and national conceptions of the role of business in dealing with these issues, which often stem from ideas rooted in Corporate Social Responsibility (CSR). CSR in Latin America has been shaped by two trends. The first is based on the region's Catholic traditions of philanthropy where

companies have stepped up to the plate in order to fill in the gap when governments have lacked resources to invest in societal and sometimes environmental problems (Puppim de Oliveira, 2006). A newer conception of CSR in the region has been modelled along the lines of Western based companies looking to improve their image, particularly within their supply chains and has thus been heavily influenced by INGOs, the headquarters of MNCs and multilateral institutions (Haslam in Peinada-Vara 2006: 62). These foreign roots are not necessarily appropriate for the Latin American (or arguably the African) context and so there has been a call for developing a model of CSR that addresses local issues- that are often more societal than environmental- as well as strengthening governments' capacity (Schmidheiny, 2006).

Regionally, Brazil has led the game in redefining the concept of CSR since the development of ETHOS[9] in 1998 (Correa *et al.*, 2004) and has also spearheaded non-financial reporting (Araya, 2006). In Africa, South African companies dominate as they play a similar role on the continent to that of multinationals globally (Malan, 2005). Although this has led to these companies adopting a more 'African' approach to CSR,[10] they still face resistance in many African countries because their expansion is viewed as a form of neocolonialism (Malan, 2005). This section provides an analysis of corporate governance for food security under climate change in the retail sectors of Brazil and South Africa. In this paper, we investigate the main proposals for food security governance under climate change, identify significant steps that are being proposed in the retail sector and compare these processes and their proposed impacts in the two countries. Through this process, we aim to start bridging the divide between theoretical conceptions of governance involving the private sector and its implementation in corporate governance.

We analyse the ongoing actions of four major food retailers in Brazil and South Africa that deal with pressures from climate change and food insecurity. Firstly, we look at how changes came about in corporate governance in these two countries, what the pressures are that sparked these changes and discuss whether the responses are actually adaptive or just green window-dressing. This is done through an analysis of company reports, websites and news articles as access to key informants proved difficult (See the discussion on methods in *Section 1.4*). We then compare the findings for the two countries in order to identify any normative trends in governance that could be leveraged to build adaptive governance for food security under climate change in emerging economies.

[9]Instituto Ethos de Empresas e Responsabilidade Social (ETHOS) has 780 affiliated companies throughout Brazil and is based in São Paulo.

[10]See **Chapter 4** and also Swilling *et al.*, 2002 for more on 'African governance.'

5.2.1 The food sector in Brazil

Brazil's competitive advantage lies in the agricultural sector and it has the potential to become a global agribusiness powerhouse (Economist, 2010). This is due to high natural capital: a variety of climatic conditions and soil characteristics suitable for growing and harvesting diverse products twice a year, large tracts of arable land available for expansion, an abundance of fresh water and the availability of phosphate and limestone mineral resources (Lopes, 2010). The Agriculture and Livestock Confederation of Brazil (Confederaçao da Agricultura e Pecuária do Brasil- CNA) estimates the contribution of agribusiness to GDP at 33 percent in 2010, but this is low considering it involves the labour market, chemical fertiliser, transport and all primary processing as well as agriculture itself and so the methodology for generating the statistic has come under criticism (Interview Buanain, 2005).

Brazilian agricultural policy has changed dramatically over the past 40 years. The period leading up to the 1990s was characterised by highly skewed distribution of farm income to large, unproductive farms or 'latifundios,' but the debt crisis in the late 1980s forced the government to deregulate and liberalise commodity markets. Private financial instruments were also introduced with the result that government support currently accounts for only 3 percent of farm receipts (similar to New Zealand and Australia) (see Chaddad and Jank, 2006 for a more in-depth discussion of the institutional and policy trends). Towards the end of the 1990s, under Presidents Cardoso and Lula there was a shift towards land reform with increased support to supporting family farms in order to address rural poverty under programs of 'agrarian organisation' (Chaddad and Jank, 2006). This process was largely spearheaded by the Landless People's Movement (MST), the Catholic Church and other NGOs that saw poverty and inequality being entrenched through the exclusion of small farmers from the burgeoning agricultural sector (Chaddad and Jank, 2006). As a result of this shift, the policy support programmes mentioned above (PROGRAMA MODERFROTA, PROMAF and PROGER) were instituted. Parallels can be drawn with current trends in post-apartheid South Africa with the agricultural agenda being associated with rural development, which is largely linked to land redistribution.

At the same time, concurrent with these economic trends in the agricultural sector, increasing incomes and urbanisation combined with a liberalising economy allowed an influx of FDI in the agribusiness sector, which saw many large, foreign firms displace smaller domestic ones in the 1990s (Chaddad and Jank, 2006). This concentration of large agribusiness firms has resulted in tightly, vertically coordinated agrifood supply chains—

from large multinational food processors to retailers and fast food chains- that cater for increasingly differentiated tastes, and that demand much more from farmers in terms of food quality and safety and exposing them to international competition (Chaddad and Jank, 2006). As a result, farmers have had to adjust to the demands of these new markets.

The history of the food retail sector in Brazil demonstrates the dynamism of this sector. When the idea of supermarkets first arrived in Brazil, consumers were surprised by a novel format that enabled them to buy a variety of products all in a single location. The first supermarket was built in 1948 and by the end of 1970 there were more than 3000 stores. Even with the pressure from various economic problems such as price freezes, in the 1980s the supermarkets were already Brazil's main food distribution channel with 13646 stores spread throughout the country (Souza, 2002).

The liberalisation of the market started in the 1990s when the entry of major global players such as Sonae (1995), Jerónimo Martins (1999), Royal Ahold (1997) and the American giant Walmart (1995),[11] forced national companies into international competition. This started a series of mergers and acquisitions (among national companies and between national and international companies) that consolidated Brazil as a target for global players in this sector (Souza, 2002). Today, the Brazilian food retail sector comprises more than five hundred companies, but most of the revenue accrues to a few major players. A survey from the Brazilian Supermarkets Association analysing the 20 biggest supermarkets shows that the three major players (Walmart, Carrefour and Pão de Açúcar) are responsible for approximately 75 percent of the revenue topping $80 billion in 2010 (ABRASNET, 2010). In the 2009 Stores Global Powers of Retailing report, these companies placed 1st, 2nd and 106th respectively (out of 250) illustrating their global dominance (Deloitte, 2009). With 85 percent of consumption happening through this channel, the sector is highly important for both the public and the country's economy

[11] It is interesting to note that Walmart recently entered the South African market under huge opposition (See the article "South Africa resists march of Walmart" in The Guardian on 10 October 2011 `http://www.guardian.co.uk/business/2011/oct/10/walmart-massmart-south-africa-merger`). One of their main reasons for entering the South African market is to establish themselves there before moving into the rest of Africa (the last great retailing frontier), but this is not the same environment as when they moved into the Asian and American developing markets because South Africa already has a very well-established retailer base. Given the inevitable competition with local retailers as well as the hostile welcome they received from large parts of civil society, it will be interesting to follow their progress. Should South Africa prove to be the one market that the multinational cannot crack, it will result in an interesting path for food retail in the rest of Africa, but this all remains to be seen, especially considering their low-price strategy already seems to be working (See the article "Walmart's acts force rivals to cut prices" in Business Report on 16 July 2012 `http://www.iol.co.za/business/companies/walmart-s-acts-force-rivals-to-cut-prices-1.1341641`).

and we can infer that severe impacts in its supply chain could lead to food access issues unless alternatives are established.

A favourable economic environment over the past decade has entrenched these retailers as an integral part of the urban food system as increasing prosperity has resulted in more disposable income. According to Grupo Pão de Açúcar's annual report (GPA, 2010), 74.2 percent of Brazil's population is now middle class (category B and C),[12] up from 48.5 percent in 2001. The poor, category D, declined from 33.8 percent to 19 percent over the same period with class E almost disappearing from 13.2 percent to 1.8 percent over the same time period. This shift has had a big impact on the total volume of income, which increased more than 40 percent over 8 years, with a nominal increase from R$976 billion in 2002 to R$1.38 trillion in 2010. The lower-middle class (category C), which was the second largest with 28 percent of all income, rose in 2010 to 31 percent or R$428 billion of all income available for consumption. At the same time, category D jumped from 15 percent to 28 percent, reaching R$330 billion of disposable income. As the report states, this social migration reinforces consumption of high-end products and in line with this, GPA's growth increased with 2010 being a particularly positive year for food sales, particularly of certain categories like complementary perishables (yoghurt, cheese), high value added products, imports and exclusive brands (GPA, 2010).

Therefore, studying how climate change impacts are dealt with by these actors, and how the government includes this sector in its Climate Change National Plan, is essential for understanding food security in the country where the main strategy is the government-led 'Zero Hunger' or *Fome Zero* programme[13] that provides support to around a third of Brazil's population (FAO, 2009). In this document, although the issue of food security is acknowledged, the assessment of impacts and mitigation/adaption proposals only contemplate the producers. As highlighted in the previous section, the food system may

[12]These categories are based on the Economic Classification Criterion used by marketing associations in Brazil. It is based on a point system whereby households are allocated points for the number of assets and services they own (like televisions and refrigerators) and the education level of the household's head. (See Associaçao Brasileira de Empresas de Pesquisas (ABEP) `http://www.abep.org/novo/Content.aspx?ContentID=301` for more information)

[13]This programme was established in 2003 and falls under the Ministry of Social Development and Combating Hunger (Ministério do Desenvolvimento Social e Combate á Fome) although it involves other ministries including the Ministries of Agrarian Development, Health, Education and Agriculture. It was developed in order to realise the human right to adequate food and it consists of many programmes, divided into four main categories: Access to food, Supporting family agriculture, Income generation and Social mobilisation. Some of the individual programmes include the *Bolsa Família* mentioned earlier, microcredit programmes and the installation of water cisterns in the semi-arid Northeast. See the website for more information: `http://www.fomezero.gov.br`

be significantly altered under climate change and retailers will be facing pressures both to maintain procurement through their local and international supply chains, but also to ensure that their food products remain affordable for their growing client base.

5.2.2 The food retail sector in South Africa

The Latin American food retail story that started in the mid 1990s, which featured waves of FDI by global multinationals such as Ahold, Walmart, and Carrefour, has only just begun in Africa and there are definite pockets of supermarkets growing in southern and eastern Africa (Weatherspoon and Reardon, 2003; Arda, 2007). According to a study by Reardon *et al.* (2003), post-apartheid South Africa has become the African front-runner with roughly a 55 percent share of supermarkets in overall food retail. South African retailing is composed of two different sectors: the informal sector comprising hawkers, small stands and spaza shops and the formal sector, which consists of large format hyper and supermarkets, smaller superettes and then 'non-major' stores like convenience stores, urban counter and self-serve stores (Weatherspoon and Reardon, 2003).[14] We focus on the latter although the informal sector plays an important food security role (see **Chapter 3**). The progression of these formal sector stores is similar to the experience of retailers in Argentina and Costa Rica where the format changed from supermarkets to hypermarkets and then convenience stores. Geographically, retailers moved from high-income areas and in major cities to rural towns and townships where they began to cater to middle and lower income strata (Weatherspoon and Reardon, 2003).

South Africa's two top retailers, Pick 'n Pay (1967) and Shoprite Checkers (1979), have approximately 40 percent of the turnover in the sector each and have also invested heavily in other African countries as well as India, Australia and the Philippines (Reardon *et al.*, 2003). As Johannesburg Stock Exchange (JSE) listed companies, they ranked 127th and 129th respectively in the 2009 Stores global survey making them relatively important players in the South African economy (Deloitte, 2009). Woolworths and Spar complete the formal retail sector with Massmart[15] and Metcash being the country's two main wholesalers (Louw *et al.*, 2006). With growing urbanisation and a burgeoning middle class, food retailers play a significant role in the country and are prime actors in the agri-food chain for innovation around development issues (Louw *et al.*, 2006) and potentially climate change adaptation. That being said, this "rapid rise of supermarkets" has also

[14] See USDA (2011) for updated figures on the market share of each of these types of retailers

[15] Massmart has now been taken over by Walmart.

extended into poor neighbourhoods and the new trend in the region is of "supermarkets to the poor" making them important both from a food security perspective, as well as for rural development (Weatherspoon and Reardon, 2003: 1).

In direct contrast with Brazil's increasing prosperity, South Africa's growth over the past decade has largely benefitted the upper income group with 40 percent of the country's income going to 10 percent of the population (EDD, 2010). Agriculture does not make as significant a contribution to South Africa's GDP as it does in Brazil, amounting to 2.3 percent in 2010 (from StatsSA). From the early 2000s, the stronger rand resulted in lower profitability from exports where agriculture actually shed workers (EDD, 2010). Despite fulfilling arguably a similar function in two emerging economies, food retailers in Brazil and South Africa operate under different societal pressures. Brazil's retailers are tasked with providing a burgeoning middle class with higher-end, more nutritional and varied food products whilst in South Africa, retailers need to cater for the tastes of the higher income classes whilst still catering for the needs of an impoverished majority that no longer grow their own food.

5.2.3 Governance in the food retail sector

In **Chapter 4**, we provided an in-depth discussion of corporate governance in South Africa, but there are interesting elements of contrast between the Brazilian and South African systems, which significantly impact adaptive strategies in the sector. Here we outline some of the key features that define each country's corporate governance strategy and how well equipped it is for adaptively dealing with climate change and food security pressures.

From 1950 to 1990, the Brazilian economy was centred on the domestic market and the government was the main direct investor and regulator of private investments. After 1990, the opening up of Brazilian markets and the privatisation of many government-owned companies attracted international investors that brought different governance models and questioned traditional country practices. The economic scenario became more competitive and most of the companies saw the adoption of governance structures as a means to increase corporate performance (Rebelo and Vasconcelos, 2002).

Two key events in Brazilian governance history were the foundation of the Brazilian Institute of Corporate Governance (IBGC) in 1995 and the establishment of ETHOS[16] in

[16]The ETHOS institute is a non-profit organisation, founded by individuals in the private sector. It is dedicated to mobilising and helping companies to further their pledge of social responsibility and

1998. The purpose of the IBGC was to be the Brazilian reference of corporate governance and to contribute to the sustainability performance of organisations by influencing agents towards greater transparency, fairness and accountability. The institute published the first version of the Brazilian Code of Best Practices in Corporate Governance in 1999, with revisions in 2001, 2004 and 2009. This set out principles of corporate responsibility and the social function of the company being one that includes: "the creation of wealth and employment opportunities, encourages scientific development through technology, enhances the qualification and diversity of the workforce and improves quality of life through educational, cultural and care actions and environmental protection" (IBGC, 2009: 10)

Brazil also has an extensive history regarding the protection of the environment, although most of it derives from government-led governance implemented through model environmental legislation. As environmental awareness increased, society began to demand a more active participation from companies and to question how sustainable their actions were. In Brazil, this movement culminated with the creation of Bovespa's (Brazilian Stock Exchange) Corporate Sustainability Index which since 2005 functions as an investor tool to identify companies that are socially responsible, sustainable and lucrative. It is considered that these companies create long-term shareholder value as they are more prepared to face economic, social and environmental risks.

Government leadership is also particularly felt in the climate change discourse and through the Climate Change National Plan (MMA, 2008), the Working Group on Climate Change Impacts on Brazil and the Role of the Environment National Council (CONAMA) in the adoption of adaptation measures. They comprise a portfolio of mitigating and adaptive actions in order to reduce, avoid, and eventually adapt to the many impacts of climate change. It is important to highlight that mitigation is still regarded as the highest priority because it is the only means through which to slow down the impacts of climate change. Mitigation is also Brazil's central policy stance given their leading involvement in developing the REDD+ mechanism under the Kyoto Protocol to pay countries to reduce their emissions through avoided deforestation and forest degradation (the 'plus' refers to other benefits including conservation, building carbon stocks and improved forest management). After COP 17 in Durban, South Africa in December 2011, it was discussed that agriculture may also be introduced under a similar mechanism, but it will take years of negotiation to see whether and how this comes into fruition.

sustainable development. More information is available on their website: `http://www1.ethos.org.br/EthosWeb/pt/31/o_instituto_ethos/o_instituto_ethos.aspx`

With some of the effects of a changing climate already becoming evident, the need for specific adaptive actions is becoming increasingly important. Even though most of the actions stem from the government, it is possible to identify some being led by the private sector. Through the analysis of the sustainability reports of two leading food retailers in Brazil (Grupo Pão de Açúcar and Walmart), we infer that they are already following the recommendations set out in the fourth Brazilian Code of Corporate Governance as they confront the issue of corporate responsibility in all of their social and environmental projects. Unfortunately, the retail sector appears to follow the governmental National Plan strictly as they focus only on building adaptive capacity through the promotion of sustainable development and neglect any specific adaptive actions necessary to ensure food security in the country.

The South African government similarly has the 2004 Climate Change Response Strategy with sector specific plans for climate change mitigation and adaptation. The Climate Change Policy and White Paper was released at the end of 2011 and is aimed at building on a broad understanding of what a range of stakeholders can do to reduce GHG emissions. This document is focussed on mitigation, which is indicative of the fact that progress is slow at the government level, despite recognition of the importance of taking action on climate change.[17] However, at the business level, much more cutting-edge activity can be discerned. This private sector-led response (in contrast to Brazil's government-centred approach to climate change) has its roots in how corporate governance has developed not only in South Africa, but also on the continent.

There is a widely held belief that good corporate governance can result in economic success and long-term sustainability (Armstrong in Roussouw, 2005). However, in Africa despite the recognition of the need for accountability, transparency and market discipline especially in order to attract foreign investment and join the global community, very few mechanisms are available to instigate this shift. There are few incentives to join stock exchanges, few regulatory frameworks exist and most state-owned enterprises set a poor example of corporate governance- although post structural adjustment privatisation did not have better results (Roussouw, 2005). The solution lay in the establishment of corporate governance codes and the springboard for this came from the 1994 post-apartheid revision of corporate governance in South Africa.

South Africa holds a unique position in Africa because of its relatively better developed and globally integrated business sector, which gives it a leading role in advancing good

[17] Although, since the South African government hosted the 17th COP negotiations, there seems to be much more activity around climate change mitigation than adaption in the country.

corporate governance in the region (UNECA, 2007). One of the key developments in corporate governance in South Africa has been the establishment of the King Code on Corporate Governance (referred to as King I, II and III published in 1994, 2002 and 2009 respectively). This was initiated by the Institute of Directors (IoD) in South Africa and comprises a set of non-legislated principles and guidelines for company reporting in line with the GRI.[18] These are unique because of the distinct situation of governance in South Africa that was situated in a "highly turbulent and fluid context ... where South African companies [needed to meet] international corporate standards without neglecting their allegiance to the African continent" (Roussouw *et al.*, 2002: 301 and see **Chapter 4**). Many of the companies facing the tension between adhering to global standards and models of best practice and the local implementation of these ideas, have established governance mechanisms where the messier network of stakeholders and interests is taken into account (Hamann and Kapelus, 2005). Recognising and responding to this complexity and enhancing the potential for collaboration between a network of interested parties can lead to more sustainable forms of local governance for companies operating under these circumstances (see Hamann and Kapelus (2005) for examples of this from the mining sector which has been at the forefront of such governance shifts).

In the attempt to meet, on the one hand, the requirements of international standards and institutional investors and, on the other, former president Thabo Mbeki's concept of the African renaissance and the transformation of South African society, the King codes formulate an inclusive concept of corporate governance which include non-financial measurements as well as ethical and moral considerations (Roussouw *et al.*, 2002). The King code and its successors has been assimilated into South African corporate culture and the JSE requires all listed companies to provide a narrative statement on how (and if not, why) they have complied with the principles. As a result South African companies are regarded as among the best governed in emerging economies by foreign investors (IoD, 2009).

The institutionalisation of the governance principles in the King report has meant that the code has become a key mechanism for translating new normative conceptions

[18]The GRI is a network organisation that has developed a comprehensive frameworks for sustainability reporting, which is based on consensus from a broad base of participants from global business, academia, civil society, labour and professional institutions. The main aim of the initiative is to mainstream reporting on environmental, social and governance performance. The latest guidelines are G3.1, which were released on 23 March 2011 and has extended the previous guidelines to include gender, local community impact and human rights. More information is available on their website: `http://www.globalreporting.org/AboutGRI/`.

of governance into practical standards implementable by company boards. This is clear in the latest King Report where 'sustainability' was incorporated as one of the three key aspects of the report: "Most importantly current incremental changes towards sustainability are not sufficient- we need a fundamental shift in the way companies and directors act and organise themselves" (IoD, 2009: 9). In our survey of food retailers' sustainability reports, this focus is clearly evidenced with 'sustainability' being incorporated as the 7th corporate value of Woolworths, which was also ranked 18 out of 399 South African companies analysed for their uptake of King III.

However corporate action around climate change and food security in South Africa is not limited solely to the codification of normative principles, but has become action-oriented too. In February 2009, a food security forum that comprised an array of stakeholders from government through to academics, NGOs and business was convened in Johannesburg. This came just after the South African food sector had been rocked by allegations of collusion on bread prices, which led to various companies paying hefty fines after an investigation by the Competition Commission. Combined with the global food price crisis, the issue of food security in the country was brought into sharp focus and the results from the forum showed that a definite shift had occurred in how business recognised its role in ensuring food security in the country. The two retailers that were present (Pick 'n Pay and Woolworths) have shown evident concern to develop their role in promoting sustainable behaviour, not only within their companies, but in the wider community as documented below.

The Tables below highlight some of the projects and governance indicators that have been undertaken by formal retailers in South Africa and Brazil. Table 5.7 is a summary table of some of the key projects being put in place by the leading food retailers in Brazil (Grupo Pão de Açúcar (GPA), Carrefour (CAR) and Walmart (WAL)) and South Africa (Woolworths (WOL), Pick 'n Pay (PNP) and Shoprite Checkers (SCH)). These all indicate a shift of focus towards sustainability issues, however the level of commitment towards adaptive food governance varies between the projects. Table 5.8 presents a more in-depth synopsis of projects relating to specific governance indicators for four of these retailers; Pão de Açúcar, Walmart Brasil, Woolworths and Pick 'n Pay.

Table 5.7: Retailers' actions regarding sustainability

Name	**Classification**	**Governance Trends**	**Concepts of Good Governance***
Sustainability Pact (WAL)	Mitigating, Social, Environmental	Incorporation of environmental and social issues into the business model	Triple bottom line,** Self-regulatory practices, Partnerships
Personal Sustainability Project (WAL)	Mitigating, Social, Environmental	Dissemination of sustainability concepts through their application on a day-to-day basis by the company's employees.	Awareness raising
Sustainability Index (WAL)	Mitigating, Environmental	Establishment of a sustainability index to measure in an objective way de environmental performance of each product. Delegated to Arkansas University.	Triple bottom line, Self-regulatory practices
Door-to-door sustainability (WAL)	Mitigating, Environmental	Partnership with suppliers seeking to reduce environmental impact in the product life cycle (from manufacture to disposal).	Triple bottom line, Self-regulatory practices, Partnerships
Green stores (GPA, WAL, WOL)	Mitigating, Environmental	Construction of stores with less environmental impacts following the LEED (Leadership in Energy and Environmental Design) and USGB (United States Green Building Council) standards.	Triple bottom line
Food banks (CAR, WAL)	Adaptation, Social	Regular donation of food to five food banks that reach 40k people. The goal is to donate to 20 food banks by 2011.	Triple bottom line, Capacity building, CSR
Sustainable Food Initiative (CAR)	Adaptive, Environmental	Creating customer awareness around sustainability issues in the food supply chain.	Awareness raising
Product Development (All)	Mitigating, Environmental	Products from own brand are 'sustainable'.	Triple bottom line
Sustainable Connections (All)	Mitigating, Adaptive, Social, Environmental	Incorporation of environmental and social issues into the business model. Partnership with government	Triple bottom line, Self-regulatory practices, Partnerships

Continued overleaf

Source: Authors own * Modelled on the general concepts of good corporate citizenship and behaviour laid out by UNECA (2007: 18). ** A term coined by John Elkington (1997) to incorporate the three pillars of sustainable development

Table 5.7: Retailers' actions regarding sustainability

Name	**Classification**	**Governance Trends**	**Concepts of Good Governance***
Eco-efficient internal processes (All)	Mitigating, Environmental	Adoption of internal processes that reduce the environmental impact of the company's commercial and administrative activities and reduce usage of natural resources.	Triple bottom line
The Good Business Journey (WOL)	Adaptive, Mitigating, Social, Environmental	Incorporation of environmental and social issues into the business model. Broad engagement with all stakeholders.	Triple bottom line, Self-regulatory practices, Business partner outreach
Eduplant (WOL)	Adaptive, Mitigating, Social, Environmental	Partnership with an NGO (Food and Trees for Africa). Building adaptive capacity in communities through skills provisioning. Focusing on food security holistically and in the long-term. Utilising current sustainability practices.	Triple bottom line, Local capacity-building, Human rights, CSR
Water Neutral Scheme (WOL)	Adaptive, Social, Environmental	Partnership with NGO (WWF). Partnership with government (Working with water programme). Long-term (20 year commitment). Adaptive to climate change as water scarcity is projected to be a key pressure on the region.	Triple bottom line, Local capacity-building, Partnerships
Farming for the future (WOL)	Adaptive, Environmental, Social	Incorporates whole supply chain Empowers farmers. All farmers that supply produce and aren't already organic have signed on to grow all crops in this way by 2012, therefore impact outside their own supply chain.	Triple bottom line, Human capital formation, Business partner outreach
Development Fund (PNP)	Social	Social responsibility initiative developing capacity in the supply chain.	Triple bottom line, Awareness raising, Business partner outreach, Human capital formation, Local capacity building, CSR
Organic Freedom Project (PNP)	Adaptive, Social, Environmental	Stakeholder engagement. Creating customer awareness around sustainability issues in the food supply chain. Long-term impact on supply chain.	Triple bottom line, Local capacity building, Human capital formation, Partnership

Source: Authors own * Modelled on the general concepts of good corporate citizenship and behaviour laid out by (UNECA 2007: 18) ** A term coined by John Elkington (1997) to incorporate the three pillars of sustainable development

Table 5.8: Corporate social and environmental responsibility governance indicators in the four retailers

Governance indicators	Pão de Açúcar	Walmart Brazil	Woolworths	Pick 'n Pay
Company values/"pillars"	Company values: Humbleness, Discipline, Determination and grit, Emotional balance. Pillars: The customer, Our People, Mastery of Technology, A solid capital structure, Sustainability (since 2010)	Values: Respect for the individual, Service to our customers, Striving for excellence.	Values: Quality and Style, Value, Service, Innovation, Integrity, Energy, Sustainability (since 2009)	Values: We are passionate about our customers and will fight for their rights. We care for, and respect each other. We foster personal growth and opportunity. We nurture leadership and vision, and reward innovation. We live by honesty and integrity. We support and participate in our communities. We take individual responsibility. We are all accountable.
Sustainability indicators	UN Global compact signatory, ISO 26000 compliant, GRI 3.12 compliant	GRI compliant	GRI Compliant	
Public-private partnership		Project *Sustentabilidad: Aqui e Agora* with Ministry of the Environment to gauge Brazilian's perceptions of environmental preservation	*Water Neutral Scheme*: In partnership with WWF and the government's Working with water programme, this is a long-term (20 year) commitment to reducing water footprint in the supply chain.	

Table 5.8: Corporate social and environmental responsibility governance indicators in the four retailers

Governance indicators	Pão de Açúcar	Walmart Brazil	Woolworths	Pick 'n Pay
Supply chain	In order to strengthen regional markets, the company invests in local programs with local producers ranging from restructuring the business to making space available in stores for their products and to this end requires that the merchandise meets fair market precepts, even without certification, guaranteeing respect for the environment and sustainable development of the locales of origin. *Project Pirarucu*: sustainably sourced fish from the Amazon based on a technique for counting the fish in the reserve, which only allows for a certain number of fish to be removed without compromising the ecosystem. *Taeq brand*: A brand that is aimed at food security- it traces the entire meat production process to ensure it's sustainable through the TEAR programme in conjunction with the ETHOS institute. Indicators include ethical values, management and governance transparency, respect for the environment and a responsible relationship with the public.	*Qualidade Selecionada, Origem Guarantida*: A programme guaranteeing the origin of products . *E-Solidário*: a project to sell sustainable products by small groups of producers that otherwise would not have had access to markets. There is also a project to build roads to small producers in order to double procurement from small and medium producers by 2015. *Clube dos produtores*: Group of producers that encourages sustainable agricultural practices *Sustentabilidade ponta a ponta*: Partnership with suppliers seeking to reduce environmental impact in the product life cycle (from manufacture to disposal)	*Farming for the Future*: Incorporates the whole supply chain and empowers farmers with knowledge to increase their sustainability. All farmers that supply produce and aren't already organic have signed on to grow all crops in this way by 2012, thereby there is impact outside the company's own supply chain. Focus on integrating smallscale farmers into supply chain e.g. Strandveld Tea Farmers Association Establishment (in conjunction with WWF), the Biodiversity and Wine Initiative the Sustainable Sugar Farm Management System and the establishment of GreenChoice, (also in partnership with Conservation International). All initiatives are aimed at promoting wise resource use throughout the food supply chain with a specific focus on conserving biodiversity. First South African company to become a member of the Roundtable on Sustainable Palm Oil (RSPO).	Projects to leverage enterprise development by smallholders: e.g. The Flower valley project where smallholders supply flowers

Table 5.8: Corporate social and environmental responsibility governance indicators in the four retailers

Governance indicators	Pão de açucar	Walmart Brazil	Woolworths	Pick 'n Pay
Social programmes relating to food security	Regular donation of food that is edible but not suitable for sale for aesthetic reasons to 700 institutions	Food bank donation	*Eduplant*: Partnership with an NGO (Food and Trees for Africa). Building adaptive capacity in communities through skills provisioning. It focuses on food security holistically and in the long-term by utilising current sustainability practices. Surplus food and clothing donation to charities	*Development Fund*: Social responsibility initiative developing capacity in the supply chain.
Product Innovation		In the process of establishing a product sustainability index in conjunction with Arkansas University	Badger-friendly honey, Predator-friendly farming products, Sustainable fishing policy ,	Sustainable packaging focus: 2 percent reduction in packaging in 2010
"Green" stores E.g. recycling etc	Yes	Yes	Yes	Yes
Employee awareness		*Personal sustainability project*: Dissemination of sustainability concepts through their application to day-to-day actions by employees under the categories: my life, my health and my planet.		
Customer awareness	*Well fed programme* provides information on healthy nutrition in-store	*Earth month campaign*: products have their sustainable features posted around the store	*Good Food Journey*: encouraging customers to make healthy and environmentally friendly food choice decisions	*Organic Freedom Project*: Creating customer awareness around sustainability issues in the food supply chain.

Three key points stand out from these two tables. The first is that despite the emphasis on environmental sustainability, most of the projects that have been holistically implemented focus on mitigation, that is, lowering a company's environmental footprint. Although this not negative, it often displaces more holistic and adaptive projects being realised as the 'sustainability' objective has been achieved. The second point is who and what the drivers of change are in these countries. Unlike in Europe, customer demand is not driving the shift to sustainability (Schilpzand *et al.*, 2010). On the contrary, retailers must embark on customer and employee awareness programmes on why the 'green' agenda is actually important. The main driving force seems to be primarily top-down, with most pressure coming from the establishment of international initiatives like the GRI, the World Business Council for Sustainable Development (WBCSD), and sustainability indices on stock exchanges. Finally, the main focus of the projects is on establishing a sustainable supply chain whether by supporting smallholders, building infrastructure or providing local communities with an outlet for their products. These tables provide a cursory look at these initiatives, which also leaves open whether these initiatives are truly a form of adaptive governance or whether they are just examples of green window-dressing. Most of the projects that directly contribute towards food security (e.g. donation to food banks and charities) fall into the category of Corporate Social Responsibility (CSR) and can therefore not count as fundamental shifts towards an agenda that explicitly addresses the food security challenge. However, as indicated in this chapter, the importance of CSR as the starting point for recognising business objectives as being more than the highest financial returns for shareholders cannot be ignored. CSR and its related initiatives can be seen as the first step towards a more holistic overhaul of the corporate governance system towards being more adaptive. The key driver of change for businesses will be for these sustainable initiatives to start reflecting directly on their financials as this will allow these processes to become core corporate strategy in practice rather than just in word. This will, however, require a wider reconfiguration of financial reporting in the international business community that normalises sustainable practices as essential rather than additional.

The final section of this chapter will go into more in-depth analysis of some of these initiatives and look at the driving forces behind some of the shifts towards sustainability in the South African food system and where there is potential for real adaptive governance to make a difference to food security outcomes under climate change.

5.2.4 Conclusions

This paper presents an analysis of governance for food security under environmental change in the retail sectors of Brazil and South Africa where major governance shifts around climate change and food security have been identified in various studies. However, within the companies themselves, the overall issue of sustainability has become an overriding theme. This study reveals that although progressive steps have been taken, much remains to be done in this area.

In Brazil the top three retailers have introduced many projects geared towards environmental issues, but even though food security is one the government's main concerns (e.g. the Zero Hunger Programme), there are fewer private sector projects focussing on this issue. One of the possible obstacles to private sector action in this regard is that the Brazilian government has a dominant hold over adaptation actions in Brazil, as indicated in governmental documents like the Climate Change National Plan as well as the role of CONAMA in the adoption of adaptation measures. On the other hand, in South Africa, although there is still relatively little exchange between the public and private sectors, the private sector is encouraged to take the initiative on social and environmental issues. Progressive legislation (e.g. the National Environmental Management Act of 1998 and the Black Economic Empowerment Act of 2003) has also been instrumental in mainstreaming environmental and social issues in the country, encouraging the development of sustainable business models that take into account these legislative pressures. Although in early stages, the different regimes in South Africa and Brazil can provide an example of the relative benefits of voluntary market-driven mechanisms versus governmental top-down approaches to food governance.

A key conclusion from this brief analysis is how key events or 'tipping points' are critical in the transfer of 'good governance' norms to corporate governance. In South Africa, the intersection of the high international food prices in 2007/08, the competition commission enquiries in 2008 and the King III report in 2009 created a perfect storm for triggering transformative progress around food security in the private sector. However, harnessing the energy generated from such a 'storm' should not result in a narrow response that only seeks to limit the impact of these driving forces, but one that recognises that system-wide adaptation may be required to address some of the wider challenges. The current projects aimed at social upliftment (see Tables 5.7 and 5.8) contribute significantly to overall adaptive capacity within the South African and Brazilian food systems, but as yet do not make the necessary links between various pressures to be seen as systemic

solutions.

The relevance of these observations is not limited to the two countries under consideration. Two of the three major retailers in Brazil, Walmart and Carrefour, are part of a huge global supply chain and as such they are two of the biggest transnational food corporations in the world. These corporations have considerable potential for enhancing food security under climate change, but have still not fully interpreted exactly what adaptation means. They therefore have a lot to learn from achievements elsewhere (e.g. some initiatives in the South African market) that are internationally applicable, with the potential to create industry norms. Further research using more in-depth studies around the opportunities and constraints offered by a systemic approach to climate change and food security is necessary for establishing adaptive governance for food security under environmental change. This study showed that these adaptive trends exist but require refinement before they can be considered normative.

5.3 Adaptive capacity in the private sector

As shown above, there is increasing evidence of the importance of the private sector in achieving food security goals under the added complexity and uncertainty of climate change. The previous section described current projects underway in Brazilian and South African retailers that aim to address some of these issues through a shift towards sustainability and under the umbrella of corporate social responsibility. In this section, the objective is to delve more deeply into the rationale behind these shifts to see whether there is in fact capacity within the private sector that will allow the food system to adapt to climate change whilst ensuring food security. It is based on semi-structured interviews with executives in three South African food companies.[19] These were conducted so as to allow the interviewees freely to discuss issues of adaptation as well as the challenges and constraints on implementing the requisite change. Four areas where the private sector can contribute significantly to building the food system's adaptive capacity to achieve food security were identified and are discussed below. These areas are innovation, raising awareness, procurement and retail as a buffer to food price shocks.

[19] As mentioned in **Chapter 1**, access to Brazilian company executives proved difficult and so this study incorporates only information from South African businesses.

5.3.1 Innovation

Food processing has become the most concentrated stage in the food value chain with relatively few processing and retailing companies compared to the number of producers and consumers at either end of the chain (Reardon *et al.*, 2003; Patel, 2007; Meijerink and Danse, 2009). In terms of governance, processors' strategic role in the food system and high level of market power is complemented by growing liability for food safety in the wake of food scares such as Bovine Spongiform Encephalopathy (commonly known as 'mad cow disease'). At the same time concerns with supply under changing market and environmental conditions reinforce their engagement in new governance. However, processors' role does not stop with the mitigation of environmental change; it has also started to include adaptation to these changes. Although progress has been slow, the importance of increasing adaptive capacity has been recognised by companies, particularly in the developing world, which is likely to suffer the worst impacts of environmental change (Vogel, 2009). Product innovation is one of the key ways in which the adaptive capacity of food processors to global environmental change can be harnessed. Not only is this the area in which processors can respond to adaptive innovation taking place in production (e.g. crop diversification and rotation strategies, organic farming and irrigation), but innovation can also increase adaptation at the consumption end of the commodity chain by providing nutritional alternatives to those vulnerable to food insecurity. Innovation need not only include the development of new food types, but re-inventing more 'traditional' food types that are better adapted to grow in the local system. For example, although it is not an export crop, there is such a market for cassava in Brazil that it can be found not only piled up in local markets (see Figure 5.1), but also in fancy packaging in high-end retail supermarkets (see Figure 5.2). The following section presents a case study of product innovation of traditional crops in the South African food system.

5.3.2 The Tiger Brands case study

Tiger Brands is a food processing and manufacturing company for grains, beverages, and meat based in South Africa with a commercial interest in other African countries. Together with other non-state actors in the South African food system, it has recognised the need to respond to the impacts of global environmental change from both an adaptation and mitigation perspective particularly in light of food security concerns in the country (Gordon Institute of Business Science, 2009). In South Africa the power of the major retailers and processors is key for ensuring food security under GEC impacts in

Figure 5.1: Piles of raw cassava (mandioca in Portuguese) for sale in the local market in Pouso Alegre, Brazil.

the food system because this is the space in which major decisions with regards to product development, procurement and, more controversially, prices are determined. This power became headline news in South Africa in 2007 when Tiger Brands, Premier Foods and Pioneer Foods were charged with collusion over fixing the price of bread. After co-operating with the Competition Commission, Tiger Brands received a lenient fine of ZAR 98.8 million, but their reputation was badly shaken by the public's backlash and the CEO subsequently stepped down. These subsequent events illustrate the importance of maintaining a company's reputation even if they do not deal directly with customers (as retailers do), because once a brand has negative connotations associated with it, it can be hard to reclaim.

One of the greatest environmental changes predicted to impact the South African food system significantly is global climate change (Jones and Thornton, 2003; Easterling *et al.*,

Figure 5.2: Colourfully packaged and processed cassava on display in a Pão de Açúcar store in São Paulo, Brazil.

2007). Projections for South African agriculture under climate change in 2030 show a major decrease in staple crops like maize, but relatively little impact on 'traditional crops' like sorghum (Lobell *et al.*, 2008). The potential benefits of developing the traditional crop sector in Africa are great and more recently the private sector has come on board by providing a market for these crops either in the form of lager beer (e.g. SAB Miller's sorghum-based Eagle beer[20] in Uganda and Zambia and their cassava beer in Mozambique[21], malt beverages (e.g. Milo) and instant porridges (e.g. Morvite) (Taylor, 2003). Some large corporations (including SAB and Tiger Brands) have admitted their role as major water users in drought-prone South Africa and have responded with a corporate commitment to improved water efficiency. On their website Tiger Brands explicitly mentions the risk of climate change to fruit, vegetable, wheat, maize and sugar production in

[20] See `http://www.delta.co.zw/index.php?option=com_content&task=view&id=47&Itemid=90`

[21] More information is available at: `http://www.businessfightspoverty.org/profiles/blogs/graham-mackay-ceo-sabmiller-cassava`

South Africa over the next 30 years.[22] As this illustrates, although corporate objectives often clash with environmental and social goals like sustainability and food security, this does not undermine the potential for achieving these goals through innovation.

Although the adaptation debate has not yet permeated the South African corporate sector (Vogel, 2009) there are indications of companies starting to take notice in the food sector. Tiger Brands' contribution is through the development of products manufactured from crops that are less susceptible to climate change impacts than the staples of wheat, maize and rice. This capacity for adaptation through innovation is exemplified by the product Morvite, which is an instant sorghum-based breakfast cereal. This has the potential to contribute to food security whilst meeting the company's commercial interests.

Morvite was developed in the 1980s as a mid-shaft energy feed in the mining industry, which is why it is still referred to as 'Phuza Amandla' or 'Drink for Power.' Originally it consisted of pre-cooked maize and sorghum, but in order to improve its taste, it became a ready-to-eat sorghum-only product. It is a recognised nutritional food especially for children, sportsmen and mineworkers and contains 11 vitamins and 6 minerals and has now been released in six different flavours. Although the rationale for creating Morvite from sorghum was not related to climate, the company recognises the fact that if sorghum is more adaptive to specific geographic regions than other crops like maize then it would be seen as a grain of preference, especially in the case of an aversion to genetically modified crops (Tiger Brands Interview, 2009). There are certain sorghum cultivars that are preferred by farmers because their higher tannin levels make them more bird resistant. However, tannins have anti-nutritional factors affecting protein digestion and therefore the grain requires processing to remove some or all of the bran (where the tannins are located) so that the product does not lose its nutritional value. It is therefore key to ensure that the correct balance between cultivation, nutrition and processing is struck in order to get the optimum product.

Tiger Brands' core target group for Morvite are LSM groups 1-4[23] and in particular black females between the ages of 25-49 who have children in their care and are looking for affordable, nutritious and filling food. The product is therefore perfectly situated to be a strategic product for achieving food security in southern Africa. It is already very popular in markets such as Kenya. Yet it has not become mainstream in South Africa

[22] `http://www.tigerbrands.co.za/Investor/SocialResponsibility/SocialResponsibility/Content.htm`

[23] LSM refers to the Living Standards Measure, which is a marketing research tool in southern Africa. See `http://www.saarf.co.za/LSM/lsms.htmformoreinformation.`

where it is still seen as a nutrition supplement in areas where people are affected by disease and poverty or in disaster relief situations. In June 2009, it was used in a disaster relief programme for flood victims in Namibia. For the company, such product development complements a socially responsible investment programme through their 'Unite Against Hunger' initiative, which provides food to more than 100,000 orphans and vulnerable children in collaboration with NGOs. However, any direct link to its benefits under climate change as a sorghum-based product are co-incidental although the company recognises that a policy of product development specifically aimed at food security or climate change adaptation that could be foreseeable in the future.

The strategic role that such product innovation can have in building adaptive capacity in an uncertain context needs to be recognised more fully and specifically targeted (as opposed to being a by-product arising from some other pressure). Furthermore, there is a need to create consumer awareness around such innovative products so as to make them more marketable, but also as an incentive for innovation. Certification in the developed world has gone far in fostering an understanding of the value chain that links production processes with consumers (Schilpzand *et al.*, 2010). However, a similar gear-change needs to be effected in the developing world for food products that meet the changing needs of society, but in a way that builds adaptability rather than compromising it. In this regard, it is interesting to note the involvement of many powerful multi-national food-processing companies in initiatives like the 'Business Fights Poverty'[24] forum that aims to bring the business and development communities together to tackle poverty through strategic business initiatives. SABMiller, Cadbury's, Unilever and Coca-Cola have all been actively involved in this initiative since its inception in 2008 through sharing their experiences at events, writing regular blog posts and pioneering projects like the SAB Foundation's Social Innovation Awards[25] that aim to showcase and scale commercialisable pro-poor innovations that address a challenge faced the Foundation's identified beneficiary groups (women, youth, the disabled and people living in rural areas). Creating communities where business works towards development goals can be seen as just such a fundamental shift towards creating a more adaptive governance system that recognises the need for social as well as financial benefit from enterprise.

[24] http://www.businessfightspoverty.org/

[25] http://www.sablimited.co.za/sablimited/content/en/sabfoundation-projects?oid=2917&sn=Detail&pid=2208

5.3.3 Customer awareness and marketing

In a competitive market, demand for products lies at the core of retailers' business strategies because they cannot exist without customers to buy their products. Retailers are therefore sensitive to shifting demands and preferences amongst their customer base. One of the biggest trends that food retailers have identified recently is that customers increasingly demand that foods are available irrespective of the season. As a result, retailers have to invest in a variety of strategies to meet these demands, including technological innovation to slow the ripening process of fruit so that it can be kept for longer or sourcing from producers in different climatic zones.

> "As retailers, we are incessantly forced by our consumers to do things out of the ordinary. So, apples grow January to March predominantly, but are available throughout the year. Why? Because consumers demanded it and other retailers did it and so everyone else had to follow. But the reality is we're doing things to the product to last. I mean you put them in controlled atmosphere chambers and you take the gas out of it so it stops ripening . . . now consumers want nectarines twelve months of the year. We're sitting there saying 'Okay, we can do it, but we will have to fly it in because it has got to be imported' and they say 'No, no, carbon emissions!' So now what we're doing is we're getting involved in Africa and we're going up to Zim (sic) and we're going up to Mozambique and we're actually planting there now to try and use as little carbon emissions- or should I rather say make it closer to us than being in Spain or those different countries." (Pick 'n Pay Interview, December 2009).

At the same time, retailers also wield considerable power to influence consumer preferences and awareness around food issues. "[The] power of the retailer is through creating awareness in staff and customers, they can facilitate millions changing their lives through direct communication." (Pick 'n Pay Interview, January 2010). This element of creating a customer base that is aware of sustainability issues, such as the impacts of climate change, is becoming an increasingly important aspect in retailers' strategies because in order to market a sustainability objective, you need an educated consumer base that understands the positive benefits of such a change in focus.

> "I think more and more we're realising that there is an education element before people can actually understand what we are doing. So some of the stuff

> we talk about there is a big 'so what?' because they don't actually understand what the issue is. So I think we'd like to think that [we have one] of the most educated and demanding customer base in South Africa, but we never get or very seldom get feedback around issues of climate change and water. We get a lot of feedback on packaging, recycling, animal welfare stuff that is more product related or close to peoples' hearts, but they're not thinking about the macro stuff. So we can tell you that climate change and water are much bigger issues than the packaging, knowing that it is still a priority, but people see the immediate thing ... so getting that right and trying to educate people about what the key issues [are]: how food is produced and why is it a good idea to buy from us because we are trying to do something about it [is an important focus]." (Woolworths Interview, August 2010).

The key idea is to reinforce a simple message rather than (in the words of a Pick 'n Pay executive) "doomsday stuff" and to start by getting "your own house in order first," for example by distributing a sustainability newsletter to employees and to work in parallel with suppliers so that everyone is on the same page and they know what is expected of them and why (Pick 'n Pay Interview, January 2010). It is then possible for the message to go out to customers by explaining exactly what is meant by organic or carbon footprint labelling and why there is more local sourcing of food products. The South African food retail system has not yet come full circle, as for example in the UK where it is pressure from the customers themselves that often drives the process towards sustainability or fair trade practices (Schilpzand *et al.*, 2010). It is largely the retailers themselves, picking up on international trends and experiencing difficulties in procurement that are spearheading the movement towards sustainability and taking their customers with them. Whilst at the moment the focus is very much on getting their own house in order first, there has also been a realisation of the need to bring suppliers along through a collaborative process of providing them with information as to what is expected rather than by dictating terms. This can be done through various means, for example through supplier workshops- this then builds local capacity around sustainability from the farm level.

> "Education is critical and engagement along the lines of 'This is our strategy, what can you do?' (And not 'Do this!') will see the change happen slowly, but surely, and with 12000 suppliers, this is a large change. But the change needs to be primarily in the company first and then in parallel with suppliers." (Pick 'n Pay Interview, January 2010).

Many of these companies have realised that 'sustainability' is not just an environmental benefit, but that it has moved out of CER and has become a part of normal business operations because there is a financial benefit: "the green alternative needs to be there when purchasing and if it's not chosen, the question must be why." (Pick 'n Pay Interview, January 2010).[26]

Answering this question lies in making customers aware about their choice of food products and the implications that their food preferences and demands make on the food system. A good example in South Africa is that of avocados, which can be grown successfully in South Africa, but only at certain times in the year. Outside of winter, in order to meet demand, retailers need to import avocados from northern hemisphere countries like Spain. Even though these are more expensive, some people are happy to buy them and so the business meets this demand despite the added impact from, for example, food miles.

> "There is a big bit of work to be done around awareness education as well . . . the other side is also to look at crops that are more resilient and particularly other parts of the country as well . . . We're busy with a project around enterprise development . . . where we're going to get avocado suppliers from other parts of the country to buy into Westphalia, which is our big supplier and we're hoping that by 2012 we won't need to import avos (sic) at all. So, I think in some cases there are solutions, but in other cases we're probably going to have to stop selling in the long-term [because] it will either be too expensive or not viable to grow anymore. I think it's actually an area we need to do more work on." (Woolworths Interview, August 2010).

It is clear that in order to follow international trends and implement successful sustainability initiatives, retailers need to create awareness of environmental and social issues in their customer base. This directly meets the company's own requirements, whilst simultaneously creating a knowledge platform with potential spin-offs into civil society. An environmentally and socially aware customer base extends beyond the confines of the

[26]Turning this idea on its head, Mike Barry, the head of sustainability at Marks & Spencers, a leading UK retailer, recently stated at the Emerge conference (Saïd Business School, Oxford, October 29-30 2011) that the sustainable choice should not be up to the customer, but that there should only be sustainable and ethically sourced products available on the shelf. This is a very interesting point that deserves discussion beyond a footnote as it touches on areas of customer choice, certification and the prices of products reflecting their true cost.

supermarket into society at large where it has the potential to have an exponential effect on consumer choices.

5.3.4 Procurement policies

A primary trigger for retailers to rethink procurement policies is grounded in the impacts that climate change is currently having and is anticipated to have on agriculture in South Africa. Retailers have already experienced the impact of bad weather conditions (the increased frequency of which is projected under climate change) on procurement, particularly on stone fruit, peaches and nectarines that were a month late at the end of 2010 due to a cold snap that hit the Eastern Cape (Pick 'n Pay Interview, December 2010). Retailers have adopted three main responses in terms of their procurement of produce under increasing uncertainty of production.

The first has been to 'spread the risks' in the interim by getting supplies from different provinces.

> "What we do though is we have five suppliers on one product. So we will have one in Hoedspruit, one in Cape Town, one in Durban, one in PE (Port Elizabeth) ... all over the place and it's really about spreading the risk. So we as retailers have no other choice, we have to spread our risk and therefore ... that adds onto the cost of food because if you have one supplier with a pack-house now, you've got to have five suppliers with exactly the same pack-house so it does add, but you're not sure." (Pick 'n Pay Interview, December 2009).

The implications of this are two-fold. Firstly, it shows that retailers are willing to take on some of the risk of procurement in order to ensure the availability of supply (mainly to their urban centres). However, this has direct cost implications, which are then passed on to consumers who then have to pay the price for a surety of supply. On the other hand, this does not build the resilience of the farmers themselves who are affected by environmental stresses. Not only do they face the risk of losing their crop, but they face increasing competition in good years when there is a good supply. It is therefore necessary to understand the full systemic consequences of such initiatives and how to minimise the negative effects.

Linked directly to this is retailer expansion into sourcing from other countries in Africa. This can be quite challenging because the basic infrastructure is not there and there are

data shortages (Pick 'n Pay Interview, January 2010). Woolworths (Pty) Ltd already sources from Zimbabwe and can see that as the country stabilises that it could be a viable option for expansion. Expanding into more arable parts of Africa is even more of an option considering some of the areas in South Africa are becoming increasingly unviable for commercial agriculture: areas like the Eastern Cape that were thought to be fairly good choice from a rainfall perspective, were in a drought in 2010 resulting in a supply shortage (Woolworths Interview, August 2010). The expansion into Africa leads on to the next two responses that retailers have had: building up skills and educating farmers in the most environmentally sustainable practices that could help mitigate climate change as well as prove adaptive.

Pick 'n Pay has started to follow another South African food retailer, Shoprite, in expanding into Africa, but have decided to deal with environmental issues and social upliftment as they do this. For example, Pick 'n Pay has promised the Zambian government that they will employ local people in new stores (and that family stores will be franchised to local owners) and that they will 'upskill' (sic) farmers through an 'outgrowers' scheme that aims to provide local farmers with the skills and capacity to be able meet requirements to supply these stores (Pick 'n Pay Interview, August 2009).

> "So we're going in there in a very different mindset, but we're hoping to get the support and kind of bridge that gap between [our] countries and if Africa can just pull together and we have this commonality between one another ... in essence we become a net exporter of food at some stage down the line." (Pick 'n Pay Interview, August 2009).

At the same time as providing skills in other African countries, the same sort of projects are being implemented domestically in South Africa. Retailers have identified a 'double whammy of uncertainty' that the food system faces in the country from the combined effects of climate change and land reform, which has resulted in many farms collapsing due to a shortage of skills (Pick 'n Pay Interview, August 2009). Building capacity in local farmers is the third response to addressing issues of procurement in South Africa (these projects are listed in Tables 5.8 and 5.8).

Skills development has gone together with an emphasis on sustainable agricultural practices. Water is the most obvious area around which to focus farm management practices because South Africa is a semi-arid country. Despite very good water and other environmental legislation in South Africa (e.g. National Environmental Management Act

of 2008 and National Water Act of 1998 as amended), there is very little enforcement (GWI, 2011). Woolworths found that most of their suppliers were not compliant with legislation— they have therefore emphasised wastewater management practices and reducing over-irrigation (Woolworths Interview, August 2010). They have also established the 'Farming for the Future' initiative (See Tables 5.7 and 5.8), which aims to change farming to shift towards more organic practices through educating farmers about exactly what inputs are required rather than relying on what the fertiliser or chemical suppliers say.

> "That's where it starts tying in with our food security side ... basically we were finding that yields were starting to decrease, I mean for years and years people just [applied] more fertiliser and more chemicals and thought that was the solution for everything and it has proven not to be the case. So I think our bigger response is about changing farming practices to make sure that we have a more *resilient* food supply chain, hoping that will deal with some of the impacts of climate change and food security." (Woolworths Interview, August 2010, my emphasis).

Although Woolworths admits that most of the work has been done with larger suppliers, there is discussion about trying to extend the programmes to include small-scale producers. However, there are a lot of challenges from the capacity perspective: from having access to sufficient resources to be able to finance the crops as well as putting up pack-houses and distribution networks. Therefore, instead of making small-scale producers primary suppliers, the company has matched them with some key primary suppliers. In this sort of "buddy-system", the small-scale farmers have access to the infrastructure that is provided by the primary suppliers including pack-houses and trucks and are at the same time mentored and increasingly brought into discussions. However the benefit of the project is not as direct as Woolworths initially foresaw it would be and so there is a need to revisit the plans, to be flexible to the situation as it is on the ground and to adapt programmes accordingly (Woolworths Interview, August 2010).

The procurement policies of retailers therefore have a significant impact on the food system's capacity to adapt to future climate change and concomitant uncertainty. The food system can be made more resilient by leveraging these processes and ensuring that they occur in as fair and equitable a manner as possible. Retailers' needs for a certain and safe supply, farmers' needs for a certain market to sell their produce and customers' needs

for affordable and nutritious food are theoretically not at odds. Practically, however, this is not the case in the current food system. Only by looking holistically at the system will these needs be aligned and met, but it will require flexible and adaptive governance structures that are can respond to changing circumstances.

5.3.5 Retail as a buffer to access

The recent phenomenon of formal retail moving into rural and peri-urban areas of South Africa was covered in **Chapter 3**. This process has a potential two-fold benefit for local people, but only if managed in a way that ensures local markets are kept viable and where local farmers and entrepreneurs are not marginalised. Many rural communities in Africa in particular are geographically isolated from both selling their products in other markets as well as accessing products from other areas. The result is that they have very little buffering capacity under environmental stresses and rely on outside assistance during tough times, for example, on food aid that has been shown not to have a demonstrably inherent advantage over other forms of assistance (Clay *et al.*, 1998). On the other hand, communities that are in some way integrated with others (i.e. not reliant on them) have an option both to be a source of supply to areas that have experienced a shock (e.g. a flood) and also to have these areas as buffers of supply if they themselves experience a shock.

One of the most interesting aspects of this trend is the formation of local entrepreneurs that then set up in rural areas whilst sourcing products from formal retailers or wholesalers that have set up within a reasonable travelling distance. Entrepreneurs then provide the means for local communities to access a range of different products and in particular, food products that have been processed and can therefore be stored for long periods of time (e.g. tinned fish, maize meal, tinned beans). Furthermore, this also provides a mechanism for innovative products (like Morvite) to be distributed more widely and to communities that can benefit from their nutritional quality. At the same time, retailers can source fresh produce locally, cutting down on their transport costs and providing a market for local farmers who then have cash to buy other products from their stores.

The key aspect of the presence of local food stores is that there is a mechanism through which food can be distributed and exchanged in areas that are often marginalised. As discussed in **Chapter 3**, the stark contrast between local stores that had products to sell and those that did not was quite striking and an indication both of the benefits that local entrepreneurship can bring to an area, but also that it requires capital backing in

order to be sustainable. Local storeowners and managers are convinced that they provide a service to their local community who have all-year access to food and who do not have to travel huge distances themselves in order to buy food. The presence of formal retailers can aid in this process by bringing markets closer to rural communities. In fact, some supermarkets outside of urban areas are franchises. This allows them more flexibility to adapt to local conditions whilst still benefitting from the scale of the larger supermarket apparatus. Although this element of adaptive capacity has not necessarily been incorporated into the strategies of larger companies, the expansion into rural markets is inevitable (Weatherspoon and Reardon, 2003). It is therefore necessary to ensure that this expansion happens to the advantage of the poorest and most vulnerable as well as meeting business objectives. The potential for offering lower prices to local communities by moving into rural areas is another potential advantage of having private sector entities expanding outside of urban areas. However, due to factors like the cost to set-up large stores, the transport constraints of having to bring a full range of commodities into areas often inaccessible by trucks, the likelihood of these large retailers displacing local entrepreneurs in very remote rural areas is unlikely in the short to medium term. There is a need to strike a balance between large, formal and smaller, sometimes informal retail that meets the community's food security needs whilst remaining feasible. The key here is to maintain the diversity of actors in the system as this 'redundancy' will in the long-run lead to resilience.

5.4 Concluding remarks

By setting out to achieve aims 1, 3 and 4, **Chapter 5** formed the part of the study that elucidated the critical role that the private sector can play in building adaptive capacity throughout the food system: from local communities to regional corporations. I do not argue that the private sector will provide all the solutions, and indeed it is the source of much that is wrong with the global food system. However, it would be foolish not to look at how to leverage its inherent characteristics like innovation in order to increase adaptability within the food system to pressures from climate change.

Key question 1- *How is out current understanding of food security under climate change aided/constrained by models?* was answered in *Section 1.1.* by showing how, given the complexity of processes in the food system (especially around pricing), modelling is not an adequate means of analysing vulnerabilities that are entrenched within

the food system. This opened up the space to start including other actors (e.g. business) and means of understanding the food system (e.g. through qualitative interviews) in a national-to-regional analysis of the food system. The rest of the chapter was therefore dedicated to answering key questions 3- *What role does the private sector play in achieving food security across scales and levels?*, 5- *What are the implications of these findings for adaptive food governance?* and 6- *What mechanisms for adaptive governance can be identified in the food system?* The private sector is a major actor at all levels and across multiple scales of the food system, but it is not studied as a potential source of adaptive capacity under climate change. *Sections 2 and 3* expressly looked at how international trends around sustainability have forced many food companies to 'self-organise' along more sustainable and socially equitable lines and their annual reports showed evidence of such projects. Empirical evidence from interviews was then used to delve into the real thinking behind such initiatives and their objectives. This analysis illustrated the key areas of potential private sector contribution towards building the adaptive capacity of the food system under climate change and what mechanisms are already in place that can be harnessed to enhance this behaviour.

The next chapter is the concluding chapter and sets out to bring all the multi-level case studies together in order to achieve aim 4- *To analyse food system dynamics across scales and levels.* It provides a final discussion of this study's primary findings by providing an overview of the Brazilian and South African food systems as they have been described in the previous chapters and identifying some common drivers and responses that can be used to answer key questions 7- *What are the drivers of adaptation across scales and levels in the food system?* and 8- *What broader conclusions about food system futures can be drawn from this analysis?* It ends with a discussion of where future research is needed and expands on some other important factors, like land, that need to be addressed in an adaptive food governance.

Chapter 6

Discussion and Conclusion

The main problem addressed in this study was how to research adaptation to future changes in a system that is complex, uncertain and operates across multiple levels. More specifically, it employed a Complex Adaptive Systems (CAS) approach to understand the problem of climate change impacts on the food systems in Brazil and South Africa, with particular emphasis on private sector governance and how this relates to other spheres of the food system. As such, the study had four key aims (See Page 5): to move beyond an understanding of food security as dependent on agricultural production, to ground the theoretical aspects of complex adaptive systems with empirical data, to investigate the potential role of the private sector in food system futures and then finally to analyse food system dynamics across multiple scales and levels.

There are three main challenges in conducting such a study: The first is how to cope with the uncertainty regarding the exact impacts that the system is expected to face. The second is the multi-level interconnectedness of actors and processes in the food system, which makes it difficult for case studies to capture the intricacies of such relationships. Finally, the complexity of the system and especially the multiplicity of actors with a say in its governance, is particularly problematic to navigate. With this in mind, there are 8 key questions that the study set out to answer in order to break the ambitious 4 core aims into smaller chunks that could be adequately handled in the different chapters. These are briefly outlined below.

1. How is our current understanding of food security under climate change aided/constrained by models? *Chapters 1 and 5 (Section 5.1)*

2. How does a complex adaptive systems (CAS) approach complement our current understanding of food system futures? *Chapters 1 and 2*

   Implementing a research project like this requires both an understanding of the substantial work that had previously been done in the area of climate change, food security and governance as well as a theoretical approach that could be used to fill in the gaps of these previous approaches. This background was provided in **Chapters 1 and 2**. The use of modelling as an approach to understanding food security under climate change is critiqued in **Chapter 1**. I note that whilst quantitative models are extremely useful from an explanatory perspective- where their assumptions and uncertainties are explicit- when it comes to modelling a complex system like the food system, their predictive powers are not useful. As such, a novel approach is needed for looking at food system futures. I therefore propose using the GECAFS socio-ecological systems framework by Ericksen (2008*a*), that drew from complex adaptive systems (CAS) theory and could be used to address the issue from multiple disciplinary areas- thereby utilising expertise across the academic spectrum to inform governance rather than settling for a one-size-fits all model. In **Chapter 2** I provide an extensive literature review as to why this approach is the most useful because it draws together a variety of different disciplinary perspectives (including Economics, Organisational Studies, Physics, Ecology, Development Studies and Environmental Change) on how to cope with uncertainty and complexity. The remainder of the thesis therefore uses a complex adaptive systems framework for the empirical studies.

3. What role does the private sector play in achieving food security across scales and levels? *Chapters 3 and 5*

4. What evidence from the private sector shows that the food system is complex and adaptive? *Chapter 4*

5. What are the implications of these findings for adaptive food governance? *Chapters 4 and 5*

6. What mechanisms for adaptive food governance can be identified in the food system? *Chapters 3 and 5*

In order to answer these questions, the case studies comprising the thesis needed to be narrowed into units that were small enough to research adequately, but that nevertheless fit into the larger schema of the project. The case studies forming **Chapters 3, 4 and 5** met the requirements of being sufficient to stand alone, but could still be knitted together in order to illuminate our understanding of the food system in the two countries. The case studies were therefore not designed to coalesce into a single storyline, but when combined, could offer snapshot insights into the workings of the food system and how its governance could be made more adaptive in the face of future challenges arising from environmental and socio-economic changes. All three case studies were designed so as to be able to answer all 4 questions, but from different levels and perspectives of the food system, thereby achieving Aims 2-4. As noted in *Section 1.3.2*, Brazil and South Africa are highly appropriate national case studies because both are developing economic regions, facing similar future challenges, but with different driving forces of change playing out more forcefully than others (this will be further discussed in *Section 6.3* around issues of land). Limiting the overall scope of the thesis to the regional rather than the global level was also beneficial as this has already been identified as a useful level of analysis for adaptation (Liverman and Ingram, 2010). It also complements the 'working downwards' from the regional to the local approach that forms the basis of how the case studies relate and link to each other across the different levels (See Figure 6.1).

In **Chapter 3** I show that in rural South Africa, deagrarianisation is affecting the food system's ability to meet the food security outcome of availability and so buying food from local stores has become an important rural food security strategy. As such, the importance of local storeowners in the provision of food security services has increased and this shift needs to be taken into consideration when designing policy for the area. Furthermore, the study shows that buying and/or growing a variety of nutritional foods is limited by socioeconomic status and this inequality is another issue to be addressed. Finally, grocery collectives amongst rural women are an adaptive strategy for meeting food security needs, but are also limited by socio-economic status and are therefore not a complete solution to the problem of accessing food in rural areas.

Building on **Chapter 3** and the role of the private sector in food security strategies, in **Chapter 4** I scale this analysis up to the national level. In this chapter the various forms of governance of the South African food system were analysed and

different approaches to governance reviewed. The conclusions that could be drawn were that in order to meet food security objectives, governance of the food system needs to become more inclusive and flexible. There is evidence that outside formal governmental structures, the process of 'self-organisation' is occurring amongst different actors in the food system to address pressures that they are starting to face. For example, there is evidence of multi-stakeholder workshops and partnerships being forged between the corporate and NGO sectors. There are two main findings: 1- that in order to proceed, this new form of 'adaptive food governance' needs greater inclusion of the state (also evidenced through interviews with the Department of Agriculture in 2009) and 2- that there needs to be more mainstream awareness of the different types of governance that will be necessary in order to adapt to uncertain future drivers of change.

Chapter 5 is the final empirical chapter and as such expands the view of the study to include the food system in Brazil for comparative purposes (as mentioned in *Section 1.4* there is a bias towards the South African food system due to limited access to Brazilian retailers, however the Brazilian analysis is included in **Chapter 5**). This chapter paints an interesting picture of the similarities and differences between the food systems in the two regions. It starts by returning to the initial problem set out in **Chapter 1** of the difficulty of modelling relationships in the food system. By conducting an econometric analysis grounded in historical data, the analysis shows that sometimes the assumptions made in larger analyses need to be re-evaluated using disaggregated data and that there can be important nuanced differences between regions, commodities and over temporal scales. The evidence of this small case study reinforces the findings in **Chapter 1** that the fixation with modelling the food system in order to *predict* the future is not useful, especially at the aggregated level, but that modelling can be useful in an *explanatory* sense to frame issues and to create a tangible output of a thought experiment around which to open up opportunities for dialogue. Recognising both the limitations of quantitative models as well as their importance in building 'the bigger picture,' I then analyse the role of actors that play an important role in articulating some the macroeconomic relationships in the food system.

The private sector in both the Brazilian and South African food system are interesting units of analysis[1] and the results of this study form the initial basis of what needs

[1]The private sector is important for three main reasons:

to be known about how these actors approach issues of change in the food system. The main findings from this study are that national trends around governance play an important role in configuring how companies respond to issues of sustainability from a social and environmental perspective. Their incentives to change and become more 'sustainable' are also interesting to note. In Brazil, responding to international trends seems to be the major driving force of change for retailers whereas in South Africa, it is the fact that they are facing real impacts in their own value chains as well as international pressure. These companies are being forced to respond to change, but as the table of their projects shows (See Tables 5.7 and 5.8), these are focussed in particular areas depending on the company. Geographically speaking, the projects also reflect how much work is being done by the government in the form of social programmes (like the *Bolsa Família* in Brazil). Brazilian companies are involved in far fewer social upliftment programmes than their South African counterparts who operate in a business environment that has been made especially socially conscious after apartheid. Understanding these historical and political differences is critical for developing adaptive food governance in these systems. In essence, this chapter shows the importance of comparing governance systems, strategies and incentives to change for these important actors because their adaptive role in the food system is still relatively unknown.

The remainder of the discussion section is designed to answer the final two questions.

7. What are the drivers of adaptation across scales and levels in the food system? *Chapter 6, but drawing from evidence in Chapters 3,4 and 5*

8. What broader conclusions about food system futures can be drawn from this analysis? *Chapter 6*

In the next section, I bring the results of the different chapters together to analyse what knowledge has been gained about the food systems with particular emphasis on

a) They are often left out of academic discussion around climate change adaptation in favour of either national governments or local communities (See *Section 2.1*).

b) Despite this, their power in the food system means that they have huge potential to be agents of transformation (e.g. See Figure 1.4)

c) Finally, they operate across levels in the food system and are therefore perfect examples of 'Boundary organisations' (Cash and Moser, 2000) that make it easier to conduct research across these multiple levels.

some key responses to the drivers of change that the food system is facing in the two countries. This is followed by a concluding section that highlights the contribution of this thesis and in particular how the CAS approach to governance can be used to strengthen the resilience of the food system to enhance food security, whilst at the same time ensuring its adaptability to uncertain future stresses (e.g. climate change). It brings together all the key elements of a CAS approach that were highlighted in **Chapter 2** and applies it to the evidence of the empirical chapters in order to draw wider conclusions about the food system. The final section opens up the study to important issues facing the food system besides climate change and focuses in particular on contestations around land. This brief analysis provides 'Further considerations' for work in this field.

6.1 Drivers of adaptation in the Brazilian and South African food systems

During this study a variety of different processes of change in the food system and responses to these were identified and referred to by stakeholders. Figure 6.1 maps those that were most relevant to this study and that can be used to shed some light on how the food systems in Brazil and South Africa function. Since the food system exists across multiple levels, many of the drivers of change overlap across multiple levels and so Figure 6.1 organises them accordingly: from the local to the national and then international level. The responses also occur across levels, but a more important aspect of this study was to show that multiple actors respond to these drivers of change thereby influencing activities in the food system and causing feedbacks to the original socio-economic and environmental change drivers. These responses are often not confined to just one set of actors, but require co-ordinated responses between different types of actors. This study also shows that there is very little direct cause and effect in the food system and so there are no arrows signifying direct linear relationships between different drivers of change and responses. Instead, they are similarly mapped relative to the processes and responses that most directly relate to them. This schematic is an abstraction of the complexity within the food system, but it provides a useful visual aid to the discussion that follows. Below, the cross-level drivers of change in the Brazilian and South African food systems are discussed together with the responses that were highlighted in the study findings.

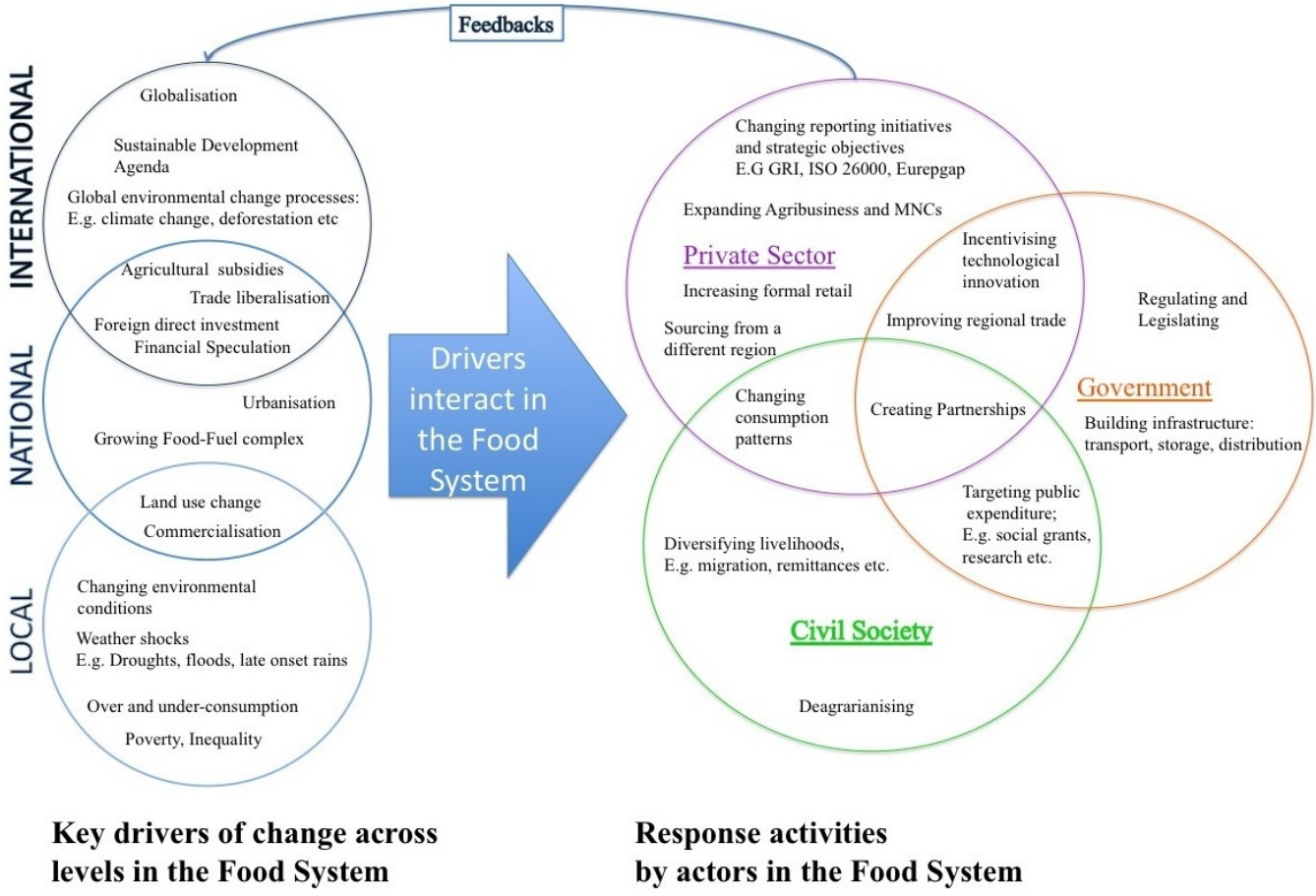

Figure 6.1: Double exposure drivers of change across multiple levels of the food system and the activities by various actors in response to these changes that were identified in this study. These activities then feed back into the system, forming a dynamic loop. (Source: Author's own)

6.1.1 The Brazilian food system

6.1.1.1 The Local level: agriculture, poverty and changing environmental conditions

Brazil has a heterogeneous landscape ranging from being extremely infertile in parts to areas of expansive, fertile lands suitable for agriculture. Recently, food production has become a key economic priority area. However, the Brazilian programme of agricultural expansion has a trade-off with the environment as agriculture encroaches into other important ecosystems like the Amazon (Chatterjee *et al.*, 2011). Despite the existence of legislation requiring farmers that move into the Amazon to set aside 80 percent of their farm for forest conservation, this law is being revisited as a result of pressure to expand

farming in the under-developed region. Furthermore, at the local level, this pattern is reinforcing the gap between successful and unsuccessful farmers, which is not necessarily a commercial versus smallholders divide (as Brazilian agriculture is more heterogeneous than that). In Brazil there is more of a geographical inequality where on the one hand a small, family farm in Minas Gerais is perfectly integrated in the agribusiness complex, and on the other, a similar sized farm in less arable areas (for instance the semi-arid areas of the Northeast), is much worse off partly due to more adverse climatic conditions (in particular water scarcity) and these farms survive thanks to public policy initiatives (Interview Buainain 2010).

Agricultural development in the Northeast is particularly problematic. From the 1990s there has been a focus on fruticulture as a key sector for job creation, because the area is seen to have a comparative advantage in the production of irrigated fruticulture when compared to other similar regions. This sector has also been expanded in order to solve balance of payments issues by becoming a significant exporter of fruit, not just a producer (Marsden and Cavalcanti, 2001). According to Marsden and Cavalcanti (2001), on September 26, 1997 the Jornal do Commercio published an important front page referring to the government's plan for the development of the fruticulture industry in the Brazilian Northeast, emphasising its ability to transform the Northeast of Brazil into a Tropical California, by sharing 25 percent of the annual world fruit market (of US$ 18 billion), by the year 2007. This drive towards an export-oriented market has meant that some enterprises have succeeded in scaling up their enterprise to ensure quality and origin control that meets both international standards as well as those of the big retailers. For example, the enterprise Uvale, in the São Francisco valley exports 25 percent of its seedless grape harvest, sells 25 percent directly to Carrefour and the remaining 50 percent goes to the large cities of São Paulo, Recife and Natal (rather than to the local people) (Marsden and Cavalcanti, 2001). However, despite some success stories, there are more negative reactions to these shifts. Large, commercial farms seem to be benefitting at the expense of smaller farms (where the original plan was to benefit them) and fewer jobs have been created than was initially anticipated (only 2 per hectare) whilst increased mechanisation and use of technology has resulted in women being excluded from the workforce as their jobs are taken over by machines (Marsden and Cavalcanti, 2001). The commercialisation and export-orientation in the Northeast is thus clearly inadequate for attaining food security goals for the local population in a region where poverty and environmental variability have contributed to malnutrition for the best part of last century (Gillone and Gadano, 1982). It is necessary to learn lessons from what has gone right and what has gone wrong

in stimulating rural development around agriculture as a means of meeting food security needs (as opposed to balance of payments) where the food grown on the land goes first to feed the people that work it.

In this case study, Marsden and Cavalcanti (2001) highlight the vital importance of the state in providing the necessary infrastructure to shape the expansion of the sector. According to them, the increasing tensions between the state, the market and the local population have resulted in growing social inequality and the state is required to provide more securities to minimise the effects of market forces. There are significant lessons to be learnt from this small case study for rural development in South Africa. The AHDSS in **Chapter 3** has a similar competitive advantage in fruticulture (evidence in the abundance of citrus farms in the nearby regions), however it is also a water scarce area where irrigation systems would be required for full commercialisation of the sector. Similar problems to those being faced in Northeast Brazil could occur in the future if the area does enter into commercial agriculture and it is important for policy to be cognisant of this.

In terms of environmental drivers of change at the local level, a changing climate has historically affected agricultural production and is projected to impact on it in the future (see **Chapter 5**). Farmers have therefore been seen to make the conscious decision to shift their production to more suitable regions of the country as a response to adverse climatic conditions. This dynamic shifting geography of agriculture is not a new phenomenon in Brazil. During the 1960s and 1970s, São Paulo and Paraná states were the most important coffee growing centres in the country until the 1980s when this shifted into the central-West states of Minas Gerais and Espirito Santo. Farmers in general, are highly mobile in Brazil and can respond to changing conditions. This mobility can partially be attributed to the extent of unoccupied land still available in the country.

> "This was largely driven by climatic factors because every four years or so, farmers would lose a crop due to the cold. The shift to more suitable areas resulted in greater efficiency gains and also meant that sugarcane production could move into São Paulo state, which is now the base of all sugarcane production in the country." (Interview Buainain 2010).

The greater process of agricultural expansion in Brazil is not just in response to climatic factors, but also as a response to increasing economies of scale and a burgeoning export market. Agriculture has already successfully moved into the cerrado, which now

contributes 70 percent of the country's total production (Economist, 2010). The other option of responding to adverse climatic conditions at the local level is through crop diversification. In his interview, Buainain gives an example in Campo Grande where having lost the crop three years in a row due to insufficient rain, the farmers faced the choice of investing in irrigation or switching to cattle farming. The owner of a big farm (15 000 hectares), having identified the risky areas, changed from cropping soybeans and wheat to a rotation system with cattle, which is now extremely efficient. However, this was only possible because the family had access to sufficient resources to make that decision: this is a key focus area for developing adaptive capacity. Provided they have access to resource, Brazilian farmers are very responsive to market signals. This strategic flexibility could indicate high adaptive capacity: since farmers are not protected by subsidies as in many developed economies (Lopes, 2010), they need to be flexible in order to survive financially and so they change strategies depending on their access to resources. The responsiveness of Brazilian farmers to market signals is also captured in the econometric analysis in **Chapter 5** where the domestic price of maize significantly affected the amount of land put into production.

6.1.1.2 The National level: state expenditure, access to infrastructure and the expansion of agribusiness

At the national level, public expenditure on the agricultural and rural development sectors has had important impacts on people's food security. One of the biggest successes of the *Fome Zero* programme to eradicate hunger and poverty has been the *Bolsa Família* — a conditional cash transfer programme that improves poor people's food security by improving their access to food (see World Bank 2012 and **Chapter 5**). Investment in technological innovation has also reaped its rewards for the country as Embrapa has become a leading research institute focussed solely on the sustainable development of Brazilian agribusiness, working on crosscutting issues. They have recently also started a Brazil-Africa agricultural marketplace initiative that partners African and Brazilian organisations to help smallholders through innovation and the transfer of technology thereby forging a significant south-south relationship between the two regions.

This national investment in the agricultural sector has resulted in improved domestic and international markets, making agribusiness a key contributor to GDP in Brazil with estimates ranging between 23 percent and 33 percent over the past decade (USDA figures). Concurrent with this is the consolidation of corporate agriculture at the other end of the

scale. In Mato Grosso, 'mega-farms' now take up 20 percent of the arable land in the province as opposed to 9 percent five years previously (Economist, 2010). However, with the rapid expansion of large-scale agriculture at the national level, infrastructure has often been lagging behind with the result that pioneering farmers are often left without access to markets due to a lack of adequate transport infrastructure (lack of roads, few railways, under-utilised river-ways and expensive ports) (Economist, 2010). This highlights a lack of co-ordination between processes happening at the local level where farmers make micro-decisions to move onto new land as a livelihood strategy, but where there is no concurrent development of the necessary infrastructure from the national sphere (Interview Buainain 2010). This is an ongoing issue in developing markets and was also highlighted as an impediment to developing a viable local market in the Agincourt study in South Africa (see **Chapter 3**). Although industry often follows the farmers, this response can be hampered by bad logistics and a lack of infrastructure: what has been termed a "huge systemic inefficiency" (Interview Buainain 2010). Despite this, there are some success stories such as the shift in poultry production from the Southeast to the Central states. In Goiás, the poultry industry made a conscious decision to follow poultry farmers inland and made huge investments to ensure the success of the industry (Interview Buainain 2010). What this shows is that the combined reaction of farmers, the public sector and industry is required if successful adaptation is to occur.

6.1.1.3 The Global Level: the sustainable development agenda, FDI and the food-fuel complex

At the global level, there are two drivers highlighted during this study and dealt with in **Chapter 5**. The first is an increase in foreign direct investment in the Brazilian agribusiness sector and the second is the related, but separate international trend towards corporate social and environmental responsibility and sustainability reporting that has spawned the advent of the GRI and ISO 26000. The impacts of FDI are clearly evidenced in the food retailing sector where Brazil's top three retailers are either foreign owned (Walmart and Carrefour) or partially foreign-owned (Pão de Açucar by the French group Casino). This development of the formal retail sector has profoundly changed the Brazilian food system, particularly in urban areas where these shops are easily accessible. A wide range of food products across a wide range of price ranges and preferences are now on offer, impacting consumption patterns and transforming the food system in other as yet unknown ways. Furthermore, most retailers have started to develop sustainability

initiatives over the past couple of years and many are following GRI reporting guidelines. However, in spite of these trends, a commitment to large-scale transformation of the food processing and retail system in Brazil is not foreseeable in the near future as the major actors are not yet facing sufficient pressure to enact all-encompassing changes (Interview da Veiga 2010).

As well as spurring corporate social and environmental awareness, opening up to foreign markets has allowed Brazil to become a leading agricultural exporter, topping the global list for beef, sugar, coffee, orange juice, ethanol, tobacco and chicken and ranking second in soybean exports. From April 2010 to March 2011, Brazil saw record growth in agribusiness exports with a 19.7 percent increase year-on-year, which is unprecedented in its history (Ministério de Agricultura 2011).[2] Such economies of scale have invigorated the rural economy and Brazil is a success story that many African nations, like Mozambique, with similar natural assets, hope to emulate (Interview Walters 2010). Considering Brazil's still vast untapped agricultural potential, the popular media is certain that this trend is likely to continue with views of Brazil feeding the world under increasing worries about climate change affecting productivity elsewhere (Economist, 2010).

However a more critical view of the future would hesitate to make such bold claims, especially considering the expansionist aspect of Brazilian agriculture and the strong links between food and fuel. Brazilian agriculture is currently sustainable given the amount of virgin land and clean water, but Brazil faces similar global pressures to conserve and protect its natural environment, most especially the Amazon rainforest as an important climate regulator and carbon sink. As mentioned in **Chapter 5**, Brazil's commitment to the REDD+ initiative does not translate into its expansionist agricultural agenda and as a successful producer of bio-ethanol, the competition between sugarcane and other food crops is likely to become more acute in the years to come, given the recent high growth of the sector. The future holds tough decisions for Brazil to make: on a macro-scale in the trade-off between development from agricultural expansion (both extensification and intensification) and fulfilling an international environmental agenda of which it has often been an advocate (Chatterjee *et al.*, 2011), on a micro-scale it is important to ensure that the effects of choices made at the international and national levels do not negatively impact people and the environment at the local level. The internal contradictions of the term sustainable development become starkly apparent in the case of land use changes in Brazil and the future of its agricultural sector depends largely on how these trade-offs

[2] `http://www.agricultura.gov.br/comunicacao/noticias/2011/04/brasil-tem-novo-recorde-de-exportacoes-do-agronegocio`

are internalized.

6.1.2 The South African food system

South Africa faces a similar, yet nuanced, set of issues to Brazil, but the overall drivers of the system are similar. At the international level, the key process driving change identified in this study has been the impact of environmental change on agricultural production both now and projected future changes. South Africa already faces environmental challenges to its agricultural potential, most notably from water stress, which has been identified as its main weak spot by various food and beverage companies. This water stress will only get worse under climate change: "if climate change is the shark, water is the teeth" (Woolworths Interview, 2010). Unlike in Brazil where the pressures from climate change are still seen only in models, in South Africa they have become a reality for farmers and those who source from them, alike.

6.1.2.1 The Global level: CSER, trade and the financial system

As with Brazil, the international drive towards sustainability reporting and corporate social and environmental responsibility is also having a transformative effect on companies as they are forced to tackle issues of both environmental protection and social upliftment whilst increasing their profit margins. This is requiring the development of a new way of doing business. These trends are being internalised into corporate strategies, but it remains to see what long-term impacts this will have on the food system and whether the process of self-organisation into inclusive forms of 'adaptive governance' will bring about the necessary adaptive capacity in the system (see **Chapter 5**). The future role that the South African government will play in this process is also not yet clear. The repercussions on the other countries in the region where South African food companies operate are also unknown. With increasing pressure for regional integration, especially from the aspect of the food commodity market (COMESA, 2010), a regional strategy seems to be the most sensible route to take. This means regional dissemination of novel strategies and successful projects, like the development of the cassava market in Zambia and its concomitant investment in researching traditional crops (FAO, 2008*a*).

International food price volatility (caused by a range of possible triggers, including financial speculation (Mittal, 2009)) has also had serious implications on food security in the region by affecting poor people's lack of access to food, as most producers still buy staples. Furthermore, higher international prices have not translated into higher prices

for smallholder farmers, at least not in the long-term. This stasis in farm-gate prices can be attributed to a variety of causes, including policies muting the transmission of prices to farmers, the lack of integration with global markets, the lack of resources to intensify production to take advantage of higher prices and often the high cost of transporting food (Wiggins and Levy, 2008). Many of these agricultural problems are attributed to agricultural subsidies in Europe and the United States (Stiglitz and Charlton, 2005), but trade liberalisation could have equally dire consequences for those countries that benefit from preferential trade agreements with Europe (Maxwell, 2001). The breakdown of the global trade system with regards to meeting food security needs is most evident in years of price crises like that of 2008 (Pereira, 2009), but even outside years of 'crisis' most smallholder farmers are price takers anyway, due to the lack of information regarding markets and an absence of storage that would allow them to save some produce and sell it outside of harvest time. The state of smallholder agriculture is therefore a contrast to that of Brazil where some small-scale farmers have been able to integrate into markets. However, for those that are marginalised, the effects are the same and food insecurity is the net result.

6.1.2.2 The National level: social grants, commercialisation and weather shocks

Similar macroeconomic drivers that create winners and losers from those rural communities integrated with global markets and those that are isolated have bottom-up proxies. In South Africa, at the local level, social grants have the effect of keeping local markets functioning (despite many problems) as some people have access to money on a regular basis (see **Chapter 3**). This guarantees a market for those farmers and entrepreneurs who attempt to make a living from the food system and also builds food security because the social grants go towards feeding all the mouths associated with the grant receiver. However it is not a viable, long-term adaptive strategy for the effective functioning of the rural food system to be reliant on external funding. Although this will always be an important safety net, rural markets need to be more integrated with other markets without fully exposing themselves and thereby losing the resilience that comes from maintaining an element of self-sufficiency. This will require the essential step of investing in agriculture throughout the region (see Mucavele, 2010).

In this study, many of the multi-level forces coalesce at the national level as evidenced in **Chapter 4**. From the perspective of food retailers, on one level there is the global

pressure from climate change affecting production and making sourcing difficult together with international trends towards sustainability. Combined with this is the pressures on the food system from the government around job creation, skills development and land reform. At the same time, creating products that meet these objectives will still require an educated customer base that recognises the value of these initiatives and is willing to pay for them; building customer awareness is therefore also a priority.

The first step towards meeting these challenges will come from harnessing the potential that southern Africa has as a region rather than as a collection of countries. Much of the adaptive capacity that Brazil has is due to the diversity of options that its expansive landscape offers. Mozambique has similar agricultural potential to Brazil, but not the same access to export markets that makes its agricultural sector scalable. Building a viable market with its neighbours is the first step to scaling up the agricultural sector. South Africa and in particular South African retailers have an opportunity to use their own capacity to build regional resilience in the food system (See **Chapter 5**). South Africa already sources from Zimbabwe and has expanded into Zambia, but this is more of an *ad hoc* private sector expansion initiative rather than a strategic move to build regional resilience. At the governmental level, talks about a free trade region for staple foods and other food security related trade initiatives have not gotten off the ground due to political inertia and differing agendas (COMESA, 2010). However, with combined backing from public and private sector entities and civil society, links can be forged that could provide the necessary diversity of options that adaptation requires.

6.1.2.3 The Local level: poverty, commercialisation and infrastructure

The conclusion above does not mean to say that South African farmers must be ignored. Rather, it is an imperative to build their capacity — both so that they are resilient to external pressures from elsewhere in the system by not being wholly reliant on flows from outside, but also that they can be a source of buffering capacity when other parts of the system fail due to, e.g., droughts or floods. The key is to start with tangible projects in areas where there is already an informal network. The study site in **Chapter 3** provides a good example of a rural South African community with tight links across the border with Mozambique due to both physical proximity, but also the large amount of Mozambican (legal and illegal) immigrant families that live in the area. Rather than these links being of immigrants trying to cross the border, there is the potential for a trade network. Mozambique has vast swathes of agricultural land with little to no market access whilst

the AHDSS has very little local production (often due to environmental stresses as well as constraints on the amount of available land) and so entrepreneurs source staples and processed foods from wholesalers further away (who are themselves at the end of a supply chain that comes from the urban areas like Nelspruit and sometimes even Johannesburg). Exchanging goods and skills across a network that already exists could provide a flexible solution with positive knock-on effects for both areas. This will not be a simple process, as agriculture in most parts of rural Mozambique is not geared towards commercialisation even at a small scale. Many rural areas suffer from seasonal fluctuations.[3] These cyclical variations are especially acute where communities are isolated and there is little market integration and little use of inputs (Handa and Mlay, 2006). Furthermore, Handa and Mlay (2006) showed that the distance to the nearest road had a significant impact on a community's food consumption patterns. In the AHDSS, however, spaza shops were seen to mitigate some of these issues of community isolation as food could be bought from within the village, but this passed the issue of accessibility onto the storeowners themselves.[4] Although some of these immediate solutions seem beneficial (e.g. cross border trade in fresh produce building local entrepreneurial capacity), they need to fit into broader national and regional policies around, for instance, trade and immigration policy. The lessons from other geographic regions (e.g. Northeast Brazil) must also be remembered.

6.1.3 Brazil and South Africa

The story of how Brazil got it right in terms of harnessing its agricultural capacity and generating flexible, scalable smallholder agriculture provides interesting lessons for regional adaptive capacity in Southern Africa. Brazil can similarly learn from South Africa, in particular, how to integrate public and private interests through collaboration with civil society and local communities. Furthermore, some areas of Brazil suffer from exactly the same issues troubling southern Africa, e.g. lack of infrastructure connecting rural areas to viable markets and some regions, like the semi-arid Northeast, also face serious environmental stresses, which are projected to become more acute under climate change. Brazil therefore also needs to start taking a holistic (and more realistic) approach to adaptation that goes beyond its current technological-fix and expansionist approach. The work by Embrapa goes a long way to look at what the potential impacts may be,

[3]This results in the preferred crop, maize, being consumed in the good, wet season with cassava being alternated during the dry season (Handa and Mlay, 2006).

[4]Overcoming infrastructural barriers is therefore crucial in South Africa as well as in Brazil.

but this work needs to be internalised into the food system psyche in a similar way to what has happened in South Africa. What has worked in the past may not be as successful into the future and it is imperative to maintain the flexibility that has strengthened their position thus far. Southern Africa could benefit much from building regionally resilient cross-border, rural communities, where the strengths of one area can compensate for the weaknesses of another area and vice versa. However, this type of solution must be cautiously implemented so that it complements rather than contradicts other policy areas.

Although on the surface the Brazilian and South African food systems may not seem to be comparable, there are some useful similarities between the two. This comparative study brings some of these elements to the fore, particularly with respect to how food is bought and sold in the two countries (and their wider regions). As Figures 6.2 and 6.3 illustrate, the private sector is very much a part of the food system even if outside of big urban centres it is not as formally organised into formal retailing structures like supermarkets. Delving more deeply into this phenomena yields promising solution towards developing the the food system's capacity to adapt.

Figure 6.2: Fresh produce piled high in the main food market of Pouso Alegre, Brazil..

Figure 6.3: Fresh fruit and vegetables on sale in the informal market outside the Shell petrol station in Hazyview, South Africa.

6.2 Conclusions: Complex Adaptive Systems and the Future of the Food System

In **Chapter 2** I identified the challenge of dealing with what organisational studies refer to as 'Turbulence' or 'Wicked problems' i.e. situations or environments that are complex in nature and that therefore generate unanticipated problems or problems that reinforce each other and become 'concatenated crises' (Homer-Dixon, 2006). Embedding these complex situations within Gunderson and Holling's (2002) concept of adaptive renewal

cycle adds a multi-level aspect to these problems. An unexpected stress in one part of the system can lead to unanticipated changes in other parts of the same system or in the systems connected to it (hence 'concatenated' or 'linked together'). Adding the concepts of vulnerability and resilience into this messy interconnectedness leads to certain aspects of the system having 'teleconnected vulnerabilty' (Adger *et al.*, 2009). This means that some parts of the system are more vulnerable to certain stresses than others because they are more tightly linked to other parts that are themselves vulnerable. The most fitting example of these characteristics in the food system is the strong link between food prices across multiple levels. Shocks arising from any level in the system (e.g. a decrease in production at the local level or a regional level recession) can be translated through to other levels in the system because prices are so closely linked- or teleconnected.[5] This was the case during the 2008 food price crisis, which also highlighted how some people (mainly in poor, net food importing countries) were more vulnerable to this concatenated escalation in food prices than others in richer countries.

This non-linear reaction stemming from interconnectedness is a key characteristic of a CAS and can be explained best through the concept of 'Emergence.' The system is more than the sum of its parts; therefore it is not helpful to understand how the system works by looking at components in isolation. Understanding systems in this way offers new governance mechanisms for building adaptive capacity. Governance in complex systems cannot address problems from a linear perspective, but needs to be embedded within a framework that understands emergent properties and the possibility of non-linear feedbacks leading to concatenated crises. Appreciating these characteristics helps to frame responses; just as problems can be concatenated, so responses can have non-linear positive impacts on other parts of the system. For example, a sustainability initiative instituted to lessen environmental impacts whilst maintaining yields like Woolworths' 'Farming for the Future' (see **Chapter 5**), has had knock-on effects by increasing recycling by farmers, reducing the use of fossil fuels (i.e. mitigation) and educating customers who buy these products in store about sustainability.[6] Furthermore, a CAS approach to governance brings with it understanding that the 'collapse' or the 'backloop' of an adaptive renewal cycle is not necessarily negative. Rather it is a necessary process of change that reduces the system's overall vulnerability to larger impacts by maintaining its diversity and therefore its flexibility. The less diverse a system, the more vulnerable it is to com-

[5] As **Chapter 5** showed, the causal links that determine prices also do not follow a set of predictable rules.

[6] See `http://www.woolworthsholdings.co.za/media/news/news_display.asp?Id2=467`

plete collapse. Maintaining an environment that is conducive to 'creative destruction' (Schumpeter, 1943) or 'collapse' requires increasing competition by providing an enabling environment to sustain a variety of actors. This is in direct contrast to focussing solely on building efficiency through streamlining processes and vertical integration into monopolies. Ensuring that there is sufficient diversity and redundancy in the system enables the key functions of the system to survive the reorganisation stage and builds a resilient system. For example, from the retail perspective, relying solely on one large, supplier (arguably more efficient in terms of e.g. infrastructure investment) that then undergoes a shock (e.g. a pest outbreak) means that the whole system breaks down. However, ensuring the viability of multiple suppliers- big and small- means that the collapse in one smaller sub-system from a shock does not translate through the system. The interview data in **Chapter 5** shows that some South African retailers have realised this and are implementing policies accordingly. However, ensuring the recovery of the farm that suffers a shock requires equal flexibility and redundancy in that smaller system.

Applying CAS to issues of governance in the food system has three important implications.

- The first is that in a complex system, it is necessary to maintain diversity (or conversely, not to dampen variability). This can translate into including a multiplicity of viewpoints in order to reflect the full range of available decision-making options. By incorporating this multiplicity, there is a greater suite of possible responses and the governance system becomes more flexible. The thesis illustrated the importance of this diversity in food retail by focussing on different private sector actors at different levels of the food system: **Chapter 3** focussed on small entrepreneurs like spaza shops and general dealers in rural areas, **Chapter 4** looked at national retail chains in South Africa and their relationship with other actors in the food system like NGOs and government whilst **Chapter 5** discussed retailers as MNCs that operate nationally, regionally and internationally. Each set of actors is equally important at their level, therefore allowing MNCs to enter a local community and outcompete smaller retailers will not ensure resilience of the food system because if that retailer were to fail, there would be no redundant structures to maintain the function of food provision. Rather a loss of efficiency allows greater systemic resilience.

- Secondly, adapting to climate change and other environmental and economic pressures will require a shift in mind-set that embraces the uncertainty of the future:

managing for it rather than against it. It is necessary to have a plan, but to realise within this plan that the future is uncertain and that this requires flexibility. Uncertainty is inherent in socio-ecological systems and creating rigid management structures that are built up around a single, 'certain' understanding of the future based on how things have worked in the past will only further limit our capacity to adapt. Instead of wasting resources on trying to eliminate uncertainty, adaptive food governance would encourage managers to appreciate it. By building on the diversity and complexity of the food system, adaptive food governance would not plan using a fixed idea of the future, but would maintain flexibility in key areas of uncertainty. This would facilitate the capacity to be able to respond quickly to sudden shocks and the effects of positive feedback loops. Training managers and leaders in this understanding is critical for adaptive governance in the future.

- The third implication for governance is the need to understand the complex interplay of multiple interlinking processes and drivers that function across many levels and sometimes have exponential positive feedbacks. Using the concept of fractals (where similar processes play out across different levels) is helpful for understanding how macro-trends can be reinforced and their effects amplified down to the local level. Therefore issues of inequality at the global level are reinforced no matter the level of analysis. CAS helps to elucidate these interactions and knock-on effects thereby allowing us to build governance structures and institutions that nudge the process of self-organisation towards achieving the adaptive system that we want (through concatenating effects), rather than entrenching stasis and rigidity (the business-as-usual approach). Adaptive governance is an iterative process, but as more is learnt and more information is retained in the system, the more likely it becomes that beneficial processes develop and are reinforced. These processes can lower inequality and increase food security as opposed to processes that entrench the current inequality in the food system.

The CAS approach in this study has also allowed for some concrete examples of what adaptive governance may look like in practice.

1. There is need for closer synergy between the public and private sectors around areas like product development and distribution that includes an emphasis on enhancing food security under climate change. These include areas such as product development and distribution. Some examples of this were given in **Chapter 4**, including

the creation of partnerships between the private sector and NGOs as well as the establishment of the Food Security Forum that brought a wide range of stakeholders around the table to talk about food security in South Africa. Another important aspect of this is the role that a key actor or person can play in leading this charge (or nudging the system to self-organise in a particular way). As mentioned in **Chapter 2**, Bohle *et al* (2009) refer to adaptive systems of governance self-organising as social networks with actors that can draw on multiple knowledge systems. The head of sustainability at Woolworths (Woolworths Interview, August 2010) can be seen as a key actor in the South African food system as can the research group at the University of Cape Town that set up the Food Security Forum. Their actions could have a concatenating effect that results in a more adaptive and sustainable food system in the country.

2. The inclusion of smallholders and local entrepreneurs is vital in building adaptive capacity. It is at the local level that the impacts of climate change are ultimately going to be felt. So including this group of stakeholders is vitally important, yet, except for a few local capacity development projects, they have been left out of discussions about the future. The collaboration and partnership arising between businesses and NGOs (see **Chapter 4**) is an encouraging trend towards inclusivity and the recognition of a need for diverse expertise in addressing this complex issue, but including local communities is the next piece of the puzzle. Using scenarios as a means of incorporating their viewpoints about the future of the food system is a useful tool that needs to be applied more widely. All of these processes will need to include the public sector since both Brazil's and South Africa's governments have strongly emphasised the role of agriculture and rural development as part of economic growth in their countries (See South Africa's New Growth Path mentioned in **Chapter 4** and the social assistance programmes for food security in Brazil in **Chapter 5**). If these goals are to be achieved, it will require the buy-in from farmers across the spectrum (from subsistence plots to commercial enterprises) as well as the private sector and civil society. No rural development will occur without the concomitant establishment of local markets and the supporting infrastructure that will enable rural communities to integrate with ever-expanding urban centres that also need to be fed.

3. There is a chance with the food system to put into action all the talk about how business can help in achieving development goals (Maxwell, 2008; Ashley, 2009).

The key message for the private sector is that having an adaptive governance structure will make you competitive in the long-term. As everything in the food system is so interconnected, in order to build the company's resilience it will be necessary (and wise) to build the adaptive capacity of the system as a whole. Evidence that companies are realising this was shown in **Chapter 5**, but as ever, it needs to be built on and developed in such a way that the needs of the poorest are met and not swallowed up into the black box of the industrial food complex. It will also entail making the system less vulnerable to some drivers of change as well as maybe less resilient to other, more useful drivers of change- a shift in governance mindset away from linear thinking.

6.3 Further considerations

6.3.1 Land as a key issue

Although there are a number of important issues associated with the food system (e.g. water, infrastructure, trade, health etc.), land is a prominent issue cross-cutting both the South African and Brazilian food systems and extends into their regional food systems. Furthermore, it will be difficult to sort out many of the other issues without addressing the complex issue of land in these two countries first. I therefore propose that the issue of land and food security could benefit from a CAS approach because depending on how this problem is approached, it will aid or constrain adaptive processes in other parts of the food system.

A brief look at the history of agriculture and hunger in Brazil shows what a rapid transformation the food system underwent at the end of the last century. Statements such as "the backwardness of Brazilian agriculture" and "Brazil's food production has never come close to meeting its actual needs" (de Campos, 1977: 181) that were true up to the end of last century (along with statistics of malnutrition and diet-related diseases) can no longer be held to be accurate. Brazil, as a burgeoning Latin American economy, has a viable agricultural sector. However, what is still evident is Brazil's "two systems:" an economically prosperous South founded on "capitalist ideals" (and spurred on by the coffee boom and gold rush) and the North, suffering from its colonial heritage of sugar plantations creating an "agrarian feudalism" (de Campos, 1977). Up until recently, Brazil suffered from a legacy of colonial economic development that has the ability of creating partial development, limited to those sectors of the economy that are most profitable to

speculative capital and ignoring the other sectors that are indispensable for social progress (de Campos, 1977). Similarly, de Campos (1977: 167) argued that the nation's hunger was a direct result of

> "the State's inability to arbitrate between public and private interests and in particular its ineptitude in protecting national interests from exploitation by foreign monopolies".

According to Paixão (in de Campos 1977: 188) the "Brazilian agrarian problem" consisted of:

1. The domination of great expanses of land by a class of capitalist farmers and landowners (large, commercial farms).
2. The existence of a heterogeneous mass of landless peasants who are generally poor and to gain access to land must work as hired labour.
3. Social frictions over land between large landowners and the landless rural masses (where even smallholders come into conflict with large landowners).

In his description of Brazil's "agrarian problem," Paixão could have been referring to South Africa's dual economy in agriculture as a legacy of apartheid policies. As pointed out in **Chapter 3**, South Africa's rural areas are characterised by the systematic displacement of the black population from productive land into "homelands" comprising 13 percent of the country's land area (Aliber, 2003). Despite the transition to democracy in 1994, these inequalities have not yet been fully addressed and in 1999 the former homelands were home to 32 percent of the population (Adams *et al.*, 1999). South Africa's agricultural system is therefore as distorted as the Brazilian system described above; where a white minority owns the bulk of the productive land at the expense of the black majority. Despite land reform being on the government's agenda since transition, the process has been tainted with the slow process of land redistribution, its failure to impact the land tenure systems on commercial farms and that, where redistribution has taken place, it has not resulted in improved agricultural productivity or livelihood benefits (Lahiff, 2008). The lack of communication about the process of land reform has left the private sector jittery about the uncertainty of what the proposals are going to be and how this will affect their business strategies and partnerships (Pick 'n Pay Interview, 2009). In the meantime during this time of uncertainty, financial institutions like commercial banks, investment

funds and asset management companies are moving in and buying up agricultural land thereby creating new models of agricultural production in South Africa (Anseeuw and Ducastel, 2012). Tensions over equitable land reform that maintains sufficient production for meeting food security requirements need to be resolved so that the economic productivity of the land is equally distributed for the benefit of the entire community and not concentrated in the hands of a few- whether they be national or international actors.

6.3.2 Looking ahead

The geographic inequality of land ownership in Brazil and South Africa is striking and is not unique to these two countries. As the land invasions of white-owned Zimbabwean farms in the 2000s showed,[7] issues of land ownership, once they reach a tipping point, can reshape the agricultural and food system and have political repercussions. These tensions are now playing out on a global level. Given the social, political and environmental pressures the food system is facing, there has been renewed interest in farmland internationally (Deininger and Byelee, 2011). 'Land grabs' have become headline news: although Brazil has a law limiting foreign ownership of land, in many African countries, foreigners are welcomed in under the promises of increased production, local job provision and increased food security for local communities- although these do not always come into fruition (Hall, 2011). It is also not just foreign, wealthy nations involved, but the emerging economies nations themselves entering in a form of south-south colonialism. Issues arising from these types of pressure have the ability to push the food system to a tipping point and so any decision of adaptive governance would need to take these broader, but not yet fully understood, processes into account. Given the conclusions of this study, the next big question to ask is how adaptive governance would tackle the contentious issue of land- and in particular, what it would mean for those in society who are already food insecure.

[7]See for example a BBC article in 2000, 'Violence flares in Zimbabwe': `http://news.bbc.co.uk/1/hi/world/africa/720887.stm` and an article in The Economist in 2009, 'Out with those white farmers': `http://www.economist.com/node/14465671`

Appendix A

List of interviews

1. Backsberg Wine Estate, 2010. Interview with CEO of Backsberg wine estate, Paarl, South Africa. January 2010.

2. Bata, O. 2010. Interview with FEWS NET representative, Maputo, Mozambique. January 2010.

3. Buainain, A., 2010. Interview with Economics Professor at Campinas University. Campinas, Brazil. March 2010.

4. Da Veiga, J.E. 2010. Interview with Economics Professor, University of São Paulo. São Paulo, Brazil. March 2010.

5. Department of Agriculture 2009. Panel interview with members of the Food Security Directorate, Department of Agriculture, Pretoria, South Africa. August 2009.

6. Donovan, C. 2010. Interview with senior researcher from Michigan State University, Maputo, Mozambique. January 2010.

7. Kirsten, J. 2009. Interview with Professor of Agricultural Economics at the University of Pretoria, Pretoria, South Africa.

8. Pick 'n Pay, 2009. Interview with the head of fresh produce at Pick 'n Pay, Johannesburg, South Africa. December 2009.

9. Pick 'n Pay, 2010. Interview with senior manager of sustainable development at Pick 'n Pay, Cape Town, South Africa. January 2010.

10. Tiger Brands, 2010. E-mail correspondence with the Managing Executive- Jungle and King foods at Tiger Brands. March 2010.

11. Tiger Brands, 2009. Interview with head of corporate sustainability at Tiger Brands, Johannesburg, South Africa. September 2009.

12. Walters, J., 2010. Interview with Technoserve's Mozambique country director, Maputo, Mozambique. January 2010.

13. Wilkins, J. ,2010. Interview with a Professor at the Environmental Science Laboratory, Federal University of Rio de Janeiro, Brazil. March 2010.

14. Woolworths, 2010. Interview with the head of sustainability at Woolworths, Cape Town, South Africa. August 2010.

Figure A.1: Mozambican woman selling fish in the main market of Maputo..

Appendix B

Questionnaires

Questionnaire No.: |_____| Checked by supervisor: |_____|

Comments by supervisor: _____

_____

SCAFS Pilot Study
SUCSES

The University of the Witwatersrand
United States Department of State Fulbright Program

Ext ID #:_____ Stratum:_____

Name of HH head:_____ Village:_____

1) Fieldworker: _____

2) Date of visit: ____ / ____ / 20____

3) Household still in existence?

1 Yes
2 No

4) Appointment for revisit?

i) Date: ____ / ____ / 20____ Time: ____:____

ii) Date: ____ / ____ / 20____ Time: ____:____

5) Informed consent obtained?

1 Yes
2 No

6) Completed successfully?

1 Yes
2 No

SECTION A: RESPONDENT/HOUSEHOLD INFORMATION

Respondent should be person primarily responsible for preparing food in the household.

1 Gender of respondent:

1 Male (*does he prepare the food?*)
2 Female

2 Position in household:

1 Household head (HH)—resident
2 Household head (HH)—absent
3 Wife or partner of HH
4 Son or daughter of HH
5 Father or mother of HH
6 Brother or sister of HH
7 Grandparent of HH
8 Grandchild of HH
9 Brother- in-law or sister-in-law of HH
10 Father-in-law or mother-in-law of HH
11 Other family (please specify): _____
12 Other non-family (please specify): _____

3 How many people live permanently in this household (eat meals together at least 4 days per week)?

4 What is the highest level of education you have completed?

1 No education
2 Some primary school
3 Some secondary school
4 Secondary school degree
5 Some tertiary school
6 Tertiary school degree

5 In which country were you born?

1 South Africa
2 Mozambique
3 Zimbabwe
4 Lesotho
5 Other: _____

SECTION B: SOCIAL CAPITAL

6 I'd like to start by asking you about the groups or organizations, networks, and associations to which you or any member of your household belong. These could be formally organized groups or just groups of people who get together regularly to do an activity or talk about things. As I read the following list of groups, please tell me if anyone in this household belongs to such a group. If yes, tell me which household member is most active in this group, and whether he/she participates actively in the group's decision making.

#	A) TYPE OF ORGANIZATION OR GROUP	B) NAME OF ORGANIZATION OR GROUP	C) CODE OF MOST ACTIVE MEMBER (USE CODES FROM QUESTION #2)	D) HOW ACTIVELY DOES THIS PERSON PARTICIPATE IN THE GROUP'S DECISION MAKING? 1 = Leader 2 = Very Active 3 = Somewhat Active 4 = Does not participate in decision making
A	Farmer group or livestock group			
B	Grocery group for bulk ordering food			
C	Cooperative or other production group (e.g., firewood-gathering group)			
D	Traders or Business Association			
E	Professional Association (e.g., doctors, teachers, veterans)			

F	Trade Union or Labor Union			
G	Neighborhood/ Village Committee (e.g., Community Development Forum)			
H	Religious or spiritual group (e.g. church, informal religious group, religious study group)			
I	Political group or movement			
J	Cultural group or association (e.g., *xibelani*, *muchongolo*)			
K	Burial or funereal society			
L	Finance, credit, or savings group (e.g., *stokvel*)			
M	Education group (e.g., school governing board)			
N	Health group (e.g., home-based care or VCT)			
O	Water and waste management group			

P	Sports group			
Q	Youth group (e.g., LoveLife)			
R	NGO or civic group (e.g., Foster Care)			
S	Ethnic-based community group			
T	Other groups			

7 Compared to five years ago, do members of your household participate in more or fewer groups or organizations?

1 More
2 Same number
3 Fewer

8 Of all the groups to which members of your household belong, which are the four most important to your household in order of importance, with 1 being the most important? *Check how many groups the respondent indicated before. If he/she indicated four or more groups, the spaces below should all be filled. Write the responses next to groups 1-4 in the table below.*

		a) How many of the group's meetings do you attend? 1. None 2. A few 3. Some 4. Most 5. All	b) How well do you think the group works? 1. Poorly 2. Below average 3. Average 4. Above average 5. Very well
A	Group 1 (***most important***):		
B	Group 2:		
C	Group 3:		
D	Group 4 (***least important of 4***):		

Now I will ask you some questions about the MOST IMPORTANT group listed above

9 Thinking about the members of this group, are most of them of the same...

1 Yes
2 No

		Group 1
A	Neighborhood/village	
B	Family or kin group	
C	Religion	
D	Gender	
E	Age	
F	Ethnic or language group	
G	Nationality (e.g., South African, Zimbabwean, Mozambican)	

10 Do members mostly have the same...

1 Yes
2 No

		Group 1
A	Occupation	
B	Educational background or level	

11 Are some members richer or poorer than others, or do they all have mostly the same income level?

1 Mixed rich/poor
2 Mostly same income level

12 In the past five years, has membership in the group declined, remained the same, or increased?

1 Declined
2 Remained the same
3 Increased

13 Does this group work or interact with other groups *in* the village/neighborhood?

1 No
2 Yes, occasionally
3 Yes, frequently

14 Does this group work or interact with other groups *outside* the village/neighborhood?

1 No
2 Yes, occasionally
3 Yes, frequently

15 What is the most important source of funding of this group?

1 From members' dues
2 Other community sources
3 Sources outside the community

16 How many close adult relatives live within your village?

17 About how many *close* friends do you have these days? These are people you feel at ease with, can talk to about private matters, or call on for help.

18 If you suddenly needed a small amount of money [e.g., R 150], are there people beyond your immediate household, close relatives, and moneylenders to whom you could turn and who would be willing and able to provide this money?

1 Definitely
2 Probably
3 Unsure
4 Probably not
5 Definitely not

19 If you fell sick, could you count on your neighbors to make errands (e.g., shop for groceries) for you?

1 Definitely
2 Probably
3 Unsure
4 Probably not
5 Definitely not

20 If you suddenly had to go away for a day or two, could you count on your neighbors to take care of your children?

1 Definitely
2 Probably
3 Unsure
4 Probably not
5 Definitely not

21 If you suddenly faced a long-term emergency such as a harvest failure or the loss of your house, how many people beyond your immediate household (excluding moneylenders) could you turn to who would be willing to assist you with a large sum of money (e.g., R 5000)?

1 No one
2 One or two people
3 Three or four people
4 Five or more people

22 [IF NOT ZERO] Of those people, how many do you think are currently *able* to assist you?

23 If there was a water supply problem in this community, how likely is it that people will cooperate to try to solve the problem?

1 Very likely
2 Somewhat likely
3 Neither likely nor unlikely
4 Somewhat unlikely
5 Very unlikely

24 Would you say that most people can be trusted, or that you need to be careful in your dealings with other people?

1 Most people can be trusted
2 You need to be careful

25 Do you agree or disagree with the following statements?

		1. Agree strongly 2. Agree somewhat 3. Neither agree nor disagree 4. Disagree somewhat 5. Disagree strongly
A	Most people in this village/neighborhood can be trusted.	
B	In this village/neighborhood, one has to be alert or someone is likely to take advantage of you.	
C	Most people in this village/neighborhood are willing to help if you need it.	
D	In this village/neighborhood, people generally do NOT trust each other in matters of lending/borrowing.	
E	This is a tight village/neighborhood where people generally know one another.	
F	People in this village/neighborhood generally do NOT share the same values.	
G	People in this village/neighborhood generally do NOT get along with each other.	

26 Now I want to ask you how much you trust different types of people. On a scale of 1 to 5, where 1 means a very small extent and 5 means a very great extent, how much do you trust the people in that category?

		1. To a very small extent 2. To a small extent 3. Neither small nor great extent 4. To a great extent 5. To a very great extent
A	People from your ethnic or language group (e.g., Tsonga/Shangaan)	
B	People from your racial group who are outside of your ethnic group (e.g., Zulus, Xhosas)	
C	People from other races (e.g., White, Indian)	
D	Social workers	
E	Local government officials	
F	Central government officials	
G	Police	

27 If a community project does not directly benefit you, but has benefits for many others in the village/neighborhood, would you contribute time or money to the project?

A. Time ☐

1 Would contribute time
2 Would not contribute time

B. Money ☐

1 Would contribute money
2 Would not contribute money

28 In the past 12 months, have you worked with others in your village/neighborhood to do something for the benefit of the community?

1 Yes
2 No → skip to question 30

☐

29 How many times in the past 12 months?

☐

30 Suppose something unfortunate happened to someone in the village/neighborhood, such as a serious illness, or the death of a parent. How likely is it that some people in the community would get together to help them?

1 Very likely
2 Somewhat likely
3 Neither likely nor unlikely
4 Somewhat unlikely
5 Very unlikely

☐

31 In the past three days, how many times have you made or received a phone call?

☐

32 Lots of people find it difficult to get out and vote. Did you vote in the last local election?

1 Yes
2 No

☐

33 What are the three most important sources of information about what the government is doing (such as agricultural extension, workfare, family planning, etc.)?

1 Relatives, friends and neighbors
2 Community bulletin board
3 Local market
4 Community or local newspaper
5 National newspaper
6 Radio
7 Television
8 Groups or associations
9 Business or work associates
10 Political associates
11 Community leaders
12 An agent of the government
13 NGOs
14 Internet

34 How many times have you traveled to a neighboring village or town in the past month (30 days)?

35 There are often differences in characteristics between people living in the same village/neighborhood. For example, differences in wealth, income, social status, ethnic background and race. There can also be differences in religious or political beliefs, or there can be differences due to age or sex. To what extent do any such differences characterize your village/neighborhood? Use a five point scale where 1 means to a very great extent and 5 means to a very small extent.

1 To a very great extent
2 To a great extent
3 Neither great nor small extent
4 To a small extent
5 To a very small extent

36 Do any of these differences cause problems?

1 Yes
2 No → go to question 39

37 [IF YES] Which two differences most often cause problems?

1 Differences in education
2 Differences in landholding
3 Differences in wealth/material possessions
4 Differences in social status
5 Differences between men and women
6 Differences between younger and older generations
7 Differences between long-term and recent residents
8 Differences in political party affiliations
9 Differences in religious beliefs
10 Differences in ethnic background/race
11 Differences in nationality
12 Other differences

38 [IF YES TO QUESTION 36] Have these problems ever led to violence?

1 Yes
2 No

39 a) Are there groups of people in the village/neighborhood who are prevented from or do not have access to any of the following?

	1. Yes → 2. No	b) [IF YES] How many are excluded? 1. Only a few 2. Many people, but less than half the village/neighborhood 3. More than half the village/ Neighborhood
Education/schools		
Health services/clinics		
Water		
Justice		
Transport		

40 In the last MONTH, how many times have you met with people in a public place either to talk or to have food or drinks?

41 Are the people you meet and visit with mostly…

		1. Yes 2. No
A	Of DIFFERENT ethnic or language group/race/	
B	Of DIFFERENT economic status	
C	Of DIFFERENT social status	
D	Of DIFFERENT religious group	

42 How safe from crime/violence do you feel when you are alone at home?

1 Very safe
2 Moderately safe
3 Neither safe nor unsafe
4 Moderately unsafe
5 Very unsafe

43 How happy do you consider yourself to be?

1 Very happy
2 Moderately happy
3 Neither happy nor unhappy
4 Moderately unhappy
5 Very unhappy

44 Do you feel that you have the power to make important decisions that change the course of your life? Rate yourself on a 1 to 5 scale, where 1 means being totally unable to change your life, and five means having full control over your life.

1 Totally unable to change life
2 Mostly unable to change life
3 Neither able nor unable
4 Mostly able to change life
5 Totally able to change life

45 In the past 12 months, how often have people in this village/neighborhood gotten together to jointly petition government officials or political leaders for something benefiting the community?

1 Never
2 Once
3 A few times (≤5 times)
4 Many times (>5 times)

PART C: FOOD SECURITY

Ask respondent if there has been anything unusual about the household's eating habits over the past 24 hours. If yes, make appointment to return to the house in the future to complete question 46 and skip to question 47.

46 Now I would like to ask you about the types of foods (prepared or consumed at home) that you or anyone else in your household ate over the following periods of time (24 hours and 14 days). *Read the list of foods. Place a **one (1)** in the box if anyone in the household ate the food, place a **zero (0)** in the box if no one in the household ate the food.*

#	QUESTIONS AND FILTERS	CODE	
		A) 24 HRS	B) 14 DAYS
A	Any pap, bread, mealies, pasta (e.g., macaroni), vetkoek (*mafeti*), buns (*magwinya*) biscuits, cookies, cake, or any other foods made from millet, sorghum, maize, rice, or wheat?	|___|	|___|
B	Any potatoes, sweet potatoes (*mihlata*), madumbes (*marhupi*), cassava roots (*mitsumbula*) or any other foods made from roots or tubers?	|___|	|___|
C	Any vegetables? This includes cassava leaves (*mathapi*), tomatoes, cucumber, lettuce, butternut (*swikwembana*), carrots, onions, garlic, beetroot, cabbage, peppers (*sovori*), common pigweed (*cheke*), African cabbage (*bangala*), African cucumber (*nkaka*), wild jute (*guxe*), and others.	|___|	|___|
D	Any fruits? These include mangoes, bananas, pawpaw (*popo*), oranges and naartjies (*lamula* and *swigwavulana*), peaches (*mapechisi*), litchis (*magamekhulu*), guava (*magwava*), marula (*nkanyi*), jackalberry (*tintoma*), monkey orange (*msala, mkwakwa*), and many others. Canned fruit is included.	|___|	|___|
E	Any beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats? Grasshoppers/locusts (*tinjiya*), termites (*majenje*), flying ants (*tintlwa*), mopane worms (*matomana*), guinea fowl (*mhangela*), and other wild animals and insects?	|___|	|___|
F	Any eggs?	|___|	|___|
G	Any fresh, dried, or canned fish or shellfish?	|___|	|___|
H	Any foods made from beans, peas, lentils, or nuts? This includes soya (e.g., *imana*), nuts (*timongo*), jack bean (*tindoji*), bambara nut (*tindluwa*), cow pea (*tinyawa*), and others.	|___|	|___|
I	Any cheese, yogurt, sour milk (e.g., *amasi*, inkomazi), milk or other milk products?	|___|	|___|
J	Any foods made with oil, fat, or butter?	|___|	|___|

K	Any sugar, honey, or sweets?	|____|	|____|
L	Any other foods, such as herbs, spices, tomato sauce, mustard, coffee, tea?	|____|	|____|

47 For each of the following questions, consider what has happened in the past 30 days. Please answer whether this happened never, rarely (once or twice), sometimes (3-10 times), or often (more than 10 times) in the past 30 days;

#	QUESTION	RESPONSE OPTIONS	CODE
A	Did you worry that your household would not have enough food?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
B	Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
C	Did you or any household member eat just a few kinds of food day after day due to a lack of resources?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
D	Did you or any household member eat food that you do not enjoy because of a lack of resources to obtain other types of food?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
E	Did you or any household member eat a smaller meal than you felt you needed because there was not enough food?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
F	Did you or any other household member eat fewer meals in a day because there was not enough food?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
G	Was there ever no food at all in your household because there were not resources to get more?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
H	Did you or any household member go to sleep at night hungry because there was not enough food?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|
I	Did you or any household member go a whole day without eating anything because there was not enough food?	0 = Never 1 = Rarely (1 or 2 times in past 30 days) 2 = Sometimes (3-10 times in past 30 days) 3 = Often (› 10 times in past 30 days)	|____|

PART D: ECONOMIC AND ENVIRONMENTAL SHOCKS

48 Now I would like to speak with you about hardships the household has faced in the last 3 years. *Place a **ONE (1)** in the box if **YES** and a **TWO (2)** in the box if **NO**.*

Shock (S)	a) Did S occur in the house in the last 3 years?	b) What was the decrease in monthly household income from S (amount)?	c) How long did the S last (number of months, specify if ongoing)?	d) How much did it cost the household in total (*excluding* earnings)?	e) After it occurred, did the household: 1 Sell assets or use savings?	2 Borrow money?	3 Take children out of school?	4 Reduce the amount of food purchased or buy cheaper food?	5 Get help from others?	6 Use insurance?
A. Death of household member										
B. Serious illness or injury disrupting normal activity										
C. Loss of regular job of household member										
D. Cutoff or decrease in remittances to household										
E. Cutoff of government grants										
F. Abandonment or divorce										
G. Financial assistance to another household										
H. Theft, fire, or destruction of household property										
I. Crop failure or loss of livestock										
J. Failure or bankruptcy of business										
K. Other:										

PART E: SOCIAL SUPPORT

49 In the last 30 days, how many times have you asked neighbors, friends or relatives for food because you did not have enough food for the household?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

50 In the last 30 days, how many times have your children eaten dinner at other homes because you did not have enough food for the household?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

51 In the last 30 days, how many times have you made trades involving food with neighbors, friends or relatives?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

52 In the last 30 days, how many times have you received help from neighbors, friends, or relatives with harvesting?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

53 In the last 30 days, how many times have you borrowed money from neighbors, friends, or relatives?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

54 In the last 30 days, how many times have you been given a ride to a market or to a place where you could collect natural resources from neighbors, friends, or relatives?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

55 In the last 30 days, how many times have you received food from social services or home-based care groups?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

56 In the last 30 days, how many times have you received food from a church or community organization?

1 Never
2 Rarely (once)
3 Sometimes (2-3 times)
4 Often (specify total number of times): _____

PART F: LIVELIHOOD STRATEGIES

57 How many members of this household currently contribute income from permanent jobs (including members not living at home)?

□ Don't Know

58 How many members of this household currently contribute income from temporary jobs and piece-jobs (including members not living at home)?

□ Don't Know

59 How many members of this household currently contribute income from a welfare grant (e.g., pension or child grant)?

□ Don't Know

60 [IF YES] How many of the grants are child grants versus pensions?

Child grants: Pensions:

61 How many members of this household currently contribute income from informal activities or self-employment (e.g., selling tomatoes, clothes, fuelwood, etc. or doing building, welding, fixing cars, etc.)?

☐ Don't Know

What type of activity? _____

62 Have you ever applied to receive food from social services?

1 Yes
2 No

63 [IF YES] Have you ever received food from social services?

1 Yes
2 No

64 Do you cultivate crops in a homestead garden?

1 Yes
2 No

65 What crops do you grow (list crops separated by a comma)?_____

_____

_____

66 Do you cultivate crops in fields outside of your homestead yard?

1 Yes
2 No

67 What crops do you grow (list crops separated by a comma)?_____

_____

_____

68 In the last year, have you lost crops because of a neighbor's livestock overgrazing?

1 Yes
2 No

69 [IF YES] Did you seek compensation for these damages, through bringing a claim in front of the *induna*, for example?

1 Yes
2 No

If not, why not? _____

70 I will now read you a list of natural products that are used in this area. For each product, please indicate how often you use the product—never, rarely, sometimes, or often—and how you got it (did you collect or buy them or were they given to you by someone else?).

#	RESOURCE	a) How often do you use this product when it is in season? 1) Never 2) Rarely → 3) Sometimes → 4) Often →	b) [IF NOT NEVER] Did you collect or buy them or were they given to you by someone else? *Tick ALL that apply*		
			COLLECTED	BOUGHT	GIVEN
A	Muroho (e.g., *guxe*, *nkaka*, *cheke*, *bangala*)				
B	Wild fruit (e.g., *tintoma, mkwakwa, masala*)				
C	Edible insects (e.g., locusts, termites, *maxonja*)				
D	Wild birds for meat				
E	Wild animals for meat				
F	Fish from local dams or rivers				
G	Honey from the bush				
H	Fuelwood				
I	Hand brooms made from grass				
J	Hand brooms made from twigs				
K	Traditional medicine				
L	Other (list):				

QUESTIONNAIRE IS OVER. THANK THE PARTICIPANT FOR HER TIME.

AGINCOURT Health & Population Unit
School of Public Health - University of the Witwatersrand
MRC/Wits Rural Public Health and Health Transitions Research Unit

Food Security Status Form

CEN-FDSCY-R13-V1

Village: | | |
Dwelling: | | | | | A |
Fieldworker: | | | | |
Visit Date: | Y | Y | Y | Y | M | M | D | D |

1	How has your household obtained Maize (Mealies / Mealie meal) over the last year? (Fill in all that apply)	Grown in own garden or homestead plot	1.1	○
		Grown by household members outside of own garden or homestead plot	1.2	○
		Purchased	1.3	○
		Borrowed	1.4	○
		Get it free (Food Aid/Food Parcel)	1.5	○
		Other	1.6	○
	If Other specify: 1.7			
2	What staple foods other than Maize (Mealies / Mealie meal) does your household often consume? (Fill in all that apply)	Rice	1.1	○
		Bread	1.2	○
		Potatoes	1.3	○
		Other	1.4	○
	If other specify: 2b			
3	Has your household grown food crops other than mealies in a **garden** on your homestead plot over the last year?	**Y** = Yes; **N** = No	3	A
4	**If Q3 = "Y"** which crops? (Fill in all that apply)	Fruit	4.1	○
		Vegetables	4.2	○
		Other	4.3	○
	IF other specify 4.4			
5	Has your household grown food crops other than mealies in a **field** outside of your homestead plot over the last year?	**Y** = Yes; **N** = No	5	A
6	**If Q3 = "Y"** which crops? (Fill in all that apply)	Fruit	6.1	○
		Vegetables	6.2	○
		Other	6.3	○
	IF other specify 6.4			
7	Have your fields/gardens produced enough crops to feed all the members of your household over the whole of the last year?	**Y** = Yes; **N** = No	7	A
8	**If Q7 = "N"** Why Do your fields/gardens not produce enough crops to feed all the members of your household? (Fill in all that apply)	Our fields/gardens are not large enough to produce enough food	8.1	○
		We do not have enough fertilizer	8.2	○
		We do not have enough water (rainfall)	8.3	○
		No-one available to work on the field/garden	8.4	○
		Other	8.5	○
	IF other specify 8.6			
9	**If Q7 = "N"** How do you supplement your food requirements? You may select more than one option. Write all numbers in the box. (Fill in all that apply)	Buy food from the market	9.1	○
		Relatives, friends or neighbours bring food	9.2	○
		Food aid from the government	9.3	○
		Gather food from the bush	9.4	○
		Gather edible wild foods from plot or field(e.g. guxe, mice)	9.5	○
		We manage with the food we have	9.6	○
		We sell household goods e.g. furniture to buy food	9.7	○
		We sell livestock to buy food	9.8	○
		Borrowed money to buy food	9.9	○
		Other	9.10	○
	IF other specify 9.11			

10	**If Q9.4 or Q9.5 marked** What do you gather and how regularly in season?		Number of time (1, 2, 3, etc.)	**W** = Week; **M** = Month; **Y** = Year	
	Wild Herbs (e.g. Guxe)	**10.1**	1 1		A
	Wild Fruit e.g. (Marula)	**10.2**	1 1		A
	Wild insects etc. (e.g. locust, flying ant, mopani worm)	**10.3**	1 1		A
	Bush meat (e.g. Rabbits,mice, birds etc.)	**10.4**	1 1		A
	Other	**10.5**	1 1		A
	IF other specify **10.6**				
11	Has your household not had enough food to eat in the last month?		**Y** = Yes (hunger); **N** = No	**11**	A
12	**If Q11 = "Y"** How often in the last month did your household **not** have enough to eat?		**V** = Very Often; **O** = Often; **S** = Sometimes; **R** = Rarely; **N** = Never	**12**	A
13	Has your household not had enough food to eat in the last year?		**Y** = Yes; **N** = No	**13**	A
14	**If Q13 = "Y"** In which season (Fill in all that apply)	Summer		**14.1**	○
		Winter		**14.2**	○
15	**If Q13 = "Y"** For what reason(s) (Fill in all that apply)	No money available at home		**15.1**	○
		Did not receive pension / grant / food aid on time		**15.2**	○
		Did not receive expected money from other family members.		**15.3**	○
		Food did not grow in homestead / poor harvest		**15.4**	○
		Unexpected new household members		**15.5**	○
		Other		**15.6**	○
	IF other specify **15.7**				
16	How regularly does your household eat the following?		Number of time (1,2,3, etc.)	**W** = Week; **M** = Month; **Y** = Year	
	Chicken	**16.1**	1 1		A
	Fish	**16.2**	1 1		A
	Red Meat	**17.3**	1 1		A
	Eggs	**16.4**	1 1		A
	Vegetables	**16.5**	1 1		A
	Maize(Mealies / Mealie meal)	**16.6**	1 1		A
	Bread	**16.7**	1 1		A
	Potatoes	**16.8**	1 1		A
	Edible wild herbs and fruits(e.g. guxe, marula)	**16.9**	1 1		A
	Rice	**16.10**	1 1		A
17	How many meals does your household normally take in a day?	Maximum number of meals for male adults		**17.1**	1
		Maximum number of meals for female adults		**17.2**	1
		Maximum number of meals for children		**17.3**	1
18	How many meals did your household take yesterday?			**18**	1
19	How do you expect the amount of food available to your household to change in the coming year?		**1** = We will have more food; **2** = Same amount of food; **3** = We will have less food;	**19**	1
	Comments:				
20					

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