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Sustainability, resilience and  
governance of an urban food system: a  
case study of peri-urban Wuhan

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## **Abstract**

While it is clear that urban food systems need to be made resilient so that broader sustainability goals can be maintained over time, it has been a matter of debate as to how resilience should be conceptualised when applied to social-ecological systems. Through a case study of peri-urban Wuhan, this research develops and applies a resilience based conceptual framework for peri-urban food systems analysis in order to explore the potential for an enhanced understanding of resilience that can contribute to promoting sustainability in urban food systems.

The evidence of this thesis suggests that the current approach to governance of Wuhan's peri-urban vegetable system is building an increasingly exclusionary pattern of resilience. It is a form of resilience building which is likely to undermine broader normative sustainability goals around social justice and environmental integrity and have mixed future implications for food system resilience as a whole, particularly in relation to livelihood outcomes for peri-urban farmers and food safety outcomes for urban consumers in general.

The key lessons from this research are that the concept of resilience can be used to support either a narrowing down or an opening up of normative framings of system outcomes and can contribute to obscuring or revealing the multiple processes of change unfolding across the levels of system context, structures and actors. These dualities in the way that resilience thinking can contribute to normative and analytical framings need to be explicitly acknowledged if serious unintended consequences of resilience building interventions are to be avoided. Six important principles for conceptualising resilience in urban food systems are suggested: to 1) disaggregate system outcomes, 2) differentiate function and structure, 3) analyse positive and negative resilience, 4) identify external and structural shocks and stresses, 5) analyse resilience in relation to multiple and multi-scale processes of change and 6) recognise the impacts of those processes on marginalised system actors. Finally, a heuristic framework is presented for guiding the design of resilience analyses of human dominated social-ecological systems.

**UNIVERSITY OF SUSSEX**

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**DPHIL SCIENCE AND TECHNOLOGY POLICY**

**SUSTAINABILITY, RESILIENCE AND GOVERNANCE OF AN URBAN FOOD  
SYSTEM: A CASE STUDY OF PERI-URBAN WUHAN**

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<sup>1</sup> Thesis title: ‘Manifestations of the Dead: Investigating ghost encounters among the Tsachila of western Ecuador.’ Oxford University, 2013.



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## List of abbreviations

BSZ	Baishazhou Wholesale Market (白沙洲批发市场)
CMA	China Ministry of Agriculture
DLLE	District Level Leading Enterprise
DX	Dongxihu district (东西湖区 dong xi hu qu)
FAO	Food and Agriculture Organisation
FD	Food distributor
FGV	Fast growing vegetables (快生菜 kuai sheng cai)
FSC	Farmers Specialised Co-operative (农民专业合作社 nong min zhuan ye he zuo she)
FWD	Fieldwork Diary
GY	Industrial district (工业区 gong ye qu)
H-01	Household (interview)
HAB	Hubei Agriculture Bureau
HN	Huanong University (华中农业大学)
HP	Huangpi district (黄陂区 huang pi qu)
ICLEI	Local Governments for Sustainability
IDS	Institute of Development Studies
JX	Jiangxia district (江夏区 jiang xia qu)
NLLAE	National Level Leading Agricultural Enterprise
OSV	Off-season vegetables (反季节菜 fan ji jie cai)
SES	Social-ecological system
SF	State farm
SPRU	Science Policy Research Unit
STEPS	Social, Technological and Environmental Pathways to Sustainability
SV	Staple vegetables (大路菜 da lu cai)
T-01	Trader (interview)
VA	Vegetable Association
WAB	Wuhan Agriculture Bureau
WATSC	Wuhan Agricultural Technology Service Centre
W-DXH	Wuhan, Donxihu district government
WH	Wuhan Almanac (statistical publication)
WSB	Wuhan Statistical Yearbook
XZ	Xinzhou district (新洲区 xin zhou qu)

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# Chapter 1. Introduction

A key aspect of the Chinese government's goal for sustainable urbanisation is the development of peri-urban vegetable production systems which contribute to urban food security, poverty reduction and environmental integrity while being resilient to the impacts of extreme weather, economic volatility and the effects of climate change (CMA, 2012). The unique structure of urban administration in China – in which city governments govern large areas of the surrounding agricultural land and have the responsibility to secure vegetable supplies to urban residents – has created a situation in which peri-urban food systems with an emphasis on developing peri-urban vegetable production have become a focal part of national and local government policy for urban food security (CMA, 2012; WAB, 2012).

There is a growing movement among researchers and policymakers towards building resilient urban food systems in support of sustainable cities. Food systems are understood as social-ecological systems and this systems approach helps to highlight the interconnected dynamics of social and ecological processes which influence food system outcomes. However, the danger is that, if taken up uncritically into policy and planning processes, this idea of 'building resilient (urban) food systems' may contribute to a potential blind spot in food system governance. If a more flexible, adaptable and innovative food system is seen as being an unambiguously good thing for everyone then the normative sustainability goals for food system outcomes and the interventions required for enhancing their resilience may be framed in ways that obscure the costs borne by marginalised groups of system actors whose roles are often not formally recognised. In short, resilience of one set of outcomes defined at the system-level may not necessarily be positively linked to the resilience of every other outcome throughout the system structures down to the actor-level. Thus, an uncritical emphasis on system-level outcomes may often obscure the interests and involvement of marginalised groups of actors and, as a result, efforts to build resilience at system-level may not only lead to negative impacts on particular marginalised groups but also inadvertently undermine the features of the system upon which those outcomes depend.

In the Chinese context of high inequality and rapid, large-scale socio-economic change the risk of neglecting the interests of significant groups of actors and promoting a narrow set of outcomes from the urban food system is particularly high. Under such circumstances the interactions between food system outcomes as experienced by different groups of actors can generate feedbacks which have important implications for how the urban food system functions and evolves as a whole. Vital to achieving China's goal of building a 'harmonious society' is the development of effective strategies to enhance the resilience of urban food systems which take into account the linkages and trade-offs between livelihood, environmental and food security outcomes and which foreground the need to negotiate equitable trade-offs between the

interests of diverse actors, particularly the most marginalised. This is a challenge which is increasingly recognised by many city governments across the world.

## **1.1 The scope and aim of the thesis**

In recent years there has been growing interest from local governments across the world in developing resilient urban food systems with a particular emphasis on the role of peri-urban agriculture (see FAO, 2011; ICLEI, 2013b; Thomas and Escudero, 2014). The commonly stated objectives are to enhance urban food security, reduce poverty, improve city-regions' environmental credentials and to increase the capacity of city-regions to adapt to the effects of climate change. The emphasis on building resilience at the level of a city-region/urban food system represents a growing recognition that social and environmental change are best understood in terms of dynamic co-evolving systems with multiple cross-scale interactions and that enhancing the ability of those systems to withstand and adapt to disruptions should be a key policy goal. However, it also raises a set of normative and analytical challenges for policy making.

The normative difficulty arises from how the resilience of a food system should be defined when the object of analysis includes a diverse collection of actors facing a broad range of opportunities and constraints and with very different interests. The question 'resilience of what against what and for whom?' may have many contrasting answers and those answers are also likely to be different depending on the temporal and spatial scale being considered. If resilience building is to contribute to greater sustainability in the broader sense of enhancing environmental integrity and social justice along with economic and food security goals then the following analytical challenge is to generate a broad and detailed enough picture of the system in question in order that the policies developed to build system-level resilience are not undermined by a failure to take into account all the relevant actors and socio-economic drivers of change and their potential influence over the system as a whole.

There are also opportunities hidden within these challenges. Drawing a wide range of actors into the policy making process may create the potential for aligning diverse interests around common goals, discovering new avenues for co-operation and integrating a broad base of knowledge which can guide policy making. The central issue of interest in this thesis is one of equity. That is how system-level resilience can be promoted in such a way that it is inclusive of the interests of marginalised groups. Directly related to this issue is the question of how the role of marginalised groups impacts the resilience of the system as a whole through environmental and socio-economic feedbacks. The failure of policymakers to recognise that role may undermine the success of resilience building policies as well as limit the possibility for developing opportunities for greater inclusiveness.

The case presented in this thesis provides an opportunity to explore these issues in the context

of a Chinese peri-urban vegetable system in the midst of a policy-led transition. Urbanisation in China has long involved cities governing their semi-rural hinterlands and it will inevitably continue to include policy interventions in peri-urban vegetable production. China's large and medium sized cities (with population over 1 million) have been instructed by central government policy makers to develop plans for upgrading the infrastructure and organisation of peri-urban vegetable production (CMA, 2012, pp. 20, 29). Of these cities, the 36 largest are particularly charged with increasing their self-sufficiency in peri-urban production and the stability of vegetable supplies to the city (CMA, 2012, p. 8). Among these cities is Wuhan, the capital city of Hubei province in central China, with a population of approximately 10 million at the end of 2011 (WSB, 2012, p. 17). It is the industrial and commercial hub of central China, a rapidly developing second tier city with a large peri-urban vegetable industry producing for both local consumption and national markets.

Wuhan's municipal government has a long history of governing a city-region food system with an emphasis on peri-urban vegetable production. In recent years, policies have specifically addressed the need to make the vegetable supply to the city secure against extreme weather conditions and economic variations. The system is currently in the midst of a policy-led change from a largely informal system towards a more formal, standardised and modernised one. This thesis explores the diverse implications of this transition for the different groups of actors involved in the system with a particular focus on the most marginalised producers. It also analyses the feedbacks and trade-offs between livelihood, environmental and food security outcomes with reference to those different actors and the implications of these feedbacks for system resilience. The conclusions then form the basis of policy recommendations and a critical reflection on how the concept of resilience and associated approaches might help or hinder the promotion of more sustainable urban food systems in China.

The central research question is:

*What are the implications for peri-urban producers of government policies to promote food system resilience and what are the lessons for enhancing sustainability and resilience in urban food systems?*

The following section 1.2 introduces the concept of resilience and describes how it has been recently applied to urban food systems policy. Section 1.3 briefly outlines the importance of peri-urban agriculture in discussion of urban food systems resilience and section 1.4 shows how these issues are dealt with in the Chinese policy context.



## **1.2 A growing emphasis on resilient urban food systems**

The recent emphasis on ‘resilient systems’ in policy around urban food security and urban sustainability has its roots in the broader context of the discussion of social-ecological resilience in relation to development and adaptation to environmental change. Becker (2012) comments that “During the last decade, the concept of social-ecological systems (SES) has become central to an increasingly widespread international discourse on human/nature interactions. In this discourse, the Resilience Alliance, a Stockholm-based research association that includes several important institutes, has played a leading role, in defining both the concepts and the aims of research on social-ecological systems.” (Becker, 2012, p. 1). He argues that the related concepts of resilience and social-ecological systems have both become boundary objects as they are viewed increasingly as representing a general perspective or approach to complex systems and have become weakly defined and malleable concepts applied in various ways across a large variety of different fields (Becker, 2012, p. 2).

The resilience approach designed by the Resilience Alliance conceptualises resilience as an emergent property of social-ecological systems (SESs) using the term to refer to “the magnitude of change or disturbance that a system can experience without shifting into an alternate state that has different structural and functional properties and supplies different bundles of the ecosystem services that benefit people.” (Resilience Alliance, 2010, p. 5). They offer an approach to assessing resilience based on the interaction between resources, stakeholders and institutions and the impact of those interactions on how the SES responds to disruption by maintaining or switching between alternative system states (Resilience Alliance, 2010).

The general concept of SESs is well established in debates on adaptation to environmental change in which the SES concept is used to define the unit of analysis as coupled social and ecological systems when human communities and ecosystems are closely connected. As discussion of resilience in the context of communities, cities and in particular SESs has continued across diverse disciplines a range of theoretical concepts, methodologies and policy practices have become encompassed within the ‘resilience approach’ (Miller et al., 2010, p. 2). However, the application of these concepts specifically to urban food systems is relatively new and employs a slightly different version of the SES concept than that used by the Resilience Alliance.

The concept of SESs in the Resilience Alliance framework envisages a spatially bound ecosystem (or ecological landscape) as a natural resource which provides a set of ecosystem services to human users who interact with and manage that ecosystem to varying degrees mediated through institutions (Resilience Alliance, 2010). This could be considered an ecosystem-centric SES and includes examples such as fisheries, grazing land, forests etc. The boundaries of the SES are largely determined by the spatial boundaries of the ecosystem itself.

Agri-food systems are somewhat different in that they are human-dominated or human-constructed systems with ecological, social and technical components organised around the production of a specific set of goods often connected with local, regional and global markets. The boundaries of the food system can be drawn according to whatever level of analysis is of interest from that of the small rural village through to city-region food systems and the global food systems for particular agricultural products. However, because agri-food systems are characterised by close interactions between social and ecological elements the concept of SESs has been adapted to help understand their dynamics (see Ericksen, 2008, 2007; Misselhorn et al., 2012; Thompson et al., 2007). This then opens the door to analysing resilience at the level of the food system in relation to how well the system maintains a specified set of outcomes which not only include the eco-system functions highlighted in the Resilience Alliance approach but also emphasise aspects of food security and social welfare (Ericksen, 2008, 2007; Misselhorn et al., 2012). These outcomes which may often be contested by different stakeholders and in mutual tension are supposedly brought together under the banner of building a resilient food system capable of aligning social, environmental and food security goals. The unwritten assumption, which this approach allows, seems to be that a more resilient food system will, by definition, maintain a desirable set of outcomes for most or all stakeholders involved; that normative sustainability goals will necessarily be enhanced by building system-level resilience so long as a ‘systems approach’ guides research and policy. The promise of such an approach for providing city and city-region governments with strategies for enhancing urban food security, reducing urban and peri-urban poverty and improving their sustainability credentials has proved very potent. Thus the notion of building resilient food systems has been imported into the field of urban planning as an important policy goal along the road to creating sustainable cities.

One of the most recent advocates for prioritising the promotion of resilient urban food systems in the name of pursuing sustainability is the ‘ICLEI – Local Governments for Sustainability’ (from here on ICLEI) which was founded in 1990 as an association of local governments working together to promote sustainable development. By 2006 it had 500 members and by 2008 it had reached 1,000 members including mega-cities, super-cities and urban regions as well as smaller cities and towns, spread across 86 countries (ICLEI, 2014a). Quoting Misselhorn et al. (2012, p. 7) ICLEI refers to food systems as “the networks of actors involved in the supply of, and demand for, food and their activities and interactions at multiple levels across spatial, temporal, jurisdictional and other scales, together with the network’s food and nutritional security outcomes over time” (ICLEI, 2014b; Misselhorn et al., 2012, p. 7). The term ‘urban food system’ thus includes the activities of agricultural production, processing, distribution and consumption centred on a city region as well as the social and environmental outcomes of the interactions between these activities as they are conditioned by the context of

environmental and socio-economic change.

In 2010 ICLEI launched their ‘Resilient Cities Congress Series’. At the 2011 congress resilience was defined in relation to communities – “the capacity and ability of a community to withstand stress, survive, adapt, bounce back from a crisis or disaster and rapidly move on.” (ICLEI, 2011, p. 1). The key themes related to resilience building were water, energy, food security, ecosystem services, vulnerable communities and the urban poor. The 2012 congress directly addressed urban agriculture as a necessary part of urban resilience through its contribution to food security, livelihoods, local economy and ecosystem services. It also recognised the need for a systems approach to building resilience and the importance of working with the most vulnerable groups. This was followed up a year later when the ‘Resilient Cities 2013’ group held a special forum on ‘Resilient Urban Food Systems’ (ICLEI, 2013a, 2013b). In the forum report, it is argued that urban food systems need to be understood at the scale of the city-region and as coupled social-ecological systems. The report advocates “holistic ecosystems-based approaches for city-region food systems that ensure food security, contribute to urban poverty eradication, protect and enhance local level biodiversity and that are integrated in development plans that strengthen urban resilience and adaptation.” (ICLEI, 2013b, p. 2). The concept of resilience had now been applied beyond the level of a community and instead to the city as a whole and specifically at the level of a city-region food system which implicitly includes urban and peri-urban agriculture.

### **1.3 The importance of peri-urban agriculture**

Peri-urban agriculture has long been part of discussions around urban sustainability but it is only in recent years that such ideas have been framed in terms of urban food systems and resilience. In the 1980s and 90s researchers in development theory explored the significance of urbanisation and rural-urban linkages for poverty reduction and urged governments of developing countries to focus specifically on investing in rural sectors and agriculture on the urban fringe (Adell, 1999; Lipton, 1977; Tacoli, 2006, 1998; Unwin, 1989). More recent work in the field of human geography has addressed the importance of understanding peri-urban areas and conceptualising the peri-urban for urban planning and policymaking (Allen, 2003; Browder et al., 1995; McGregor et al., 2006; Phillips and Williams, 1999; Simon, 2008). This literature highlights the potential for peri-urban agriculture to enhance urban sustainability through reducing poverty and limiting environmental impact while contributing to urban food security.

Maintaining urban food security in the face of rapid urbanisation and environmental change is vital to social stability and a central component of any kind of vision for sustainable cities. Increasingly, international institutions such as the UN and World Bank have used the rhetoric of ‘resilient cities’ in relation to adaptation to environmental and socio-economic change and a key part of these approaches to enhancing the resilience of cities is creating resilient urban support

systems such as urban food systems.

A recent FAO report ‘Food Agriculture and Cities’ argues that resilient food systems built on close integration of rural and urban areas will benefit small farmers and the urban poor (FAO, 2011, p. 6). These three outcomes – urban food security, poverty reduction and enhancing ecological integrity – are all highlighted as key components of sustainable urban food systems and the language of resilience and adaptation refer to the maintenance of these system outcomes over time and in the face of shocks and stresses from within the system and the external economic and environmental context. According to this approach, “a resilient food system is able to withstand economic and environmental shocks and stresses at different temporal and spatial levels,” yet must also include a measure of equity in how the benefits and burdens of the system are distributed (Misselhorn et al., 2012, p. 12).

This new rhetoric of resilience reflects a move from a traditional understanding of sustainability as an ideal state of equilibrium towards a more dynamic view of change and a recognition of the economic and environmental uncertainties involved in governing complex social and ecological systems, issues particularly relevant to agri-food systems (see Thompson et al., 2007). The shift in the understanding of sustainability is coupled with a renewed emphasis on the importance of rural-urban linkages and the role of the peri-urban interface in urban sustainability (see also McGregor et al., 2006; Tacoli, 2006; Marshall et al., 2009) which also appears to play a key role in Chinese urban food policy.

## **1.4 Chinese characteristics**

In China, with an urban population of over 700 million in 2012 (World Bank, 2014), guaranteeing access to safe and affordable food for the majority of urban citizens is a prerequisite for social stability and has been high on the political agenda for several decades. China too has put increasing emphasis on rural-urban linkages, particularly in relation to linking urban food security and efforts to bolster farmers’ incomes, through encouraging farmers on city fringes to switch from grains to cash crop production – most notably vegetables (Gu, 2009).

In peri-urban contexts one of the most important sectors of agriculture is vegetable production. The intensive cultivation of such high value crops with a low tolerance for storage and transportation is most suited to land with easy access to the large markets provided by urban areas. Consequently, peri-urban vegetable production is integral to Chinese urban food security policy. In addition, China’s urban spatial system of ‘city administering county’ and a long running emphasis on developing the vegetable industry to enhance urban food security has led to an increasingly important role for peri-urban vegetable production in urban food systems in China (CMA, 2012).

In many of China's large and medium sized cities, peri-urban vegetable production is critical

to urban food security. In many cases it is also an important source of employment and economic growth. Despite its importance as a component of the broader urban food system, peri-urban vegetable production is constantly under threat from urban expansion. Land under vegetable production is particularly vulnerable to redevelopment as it often lies close to urban markets, providing the quick access necessary for highly perishable vegetables. The intensive cultivation of vegetables in peri-urban areas also causes pollution of waterways, soil degradation, bio-diversity loss and depletion of ground water. The cultivation of land near factories, roads and other sources of industrial and residential waste increases the risk of contamination of foods which creates a general threat to consumer health. Industrial, residential and agricultural pollution also directly affect the health of the peri-urban farmers themselves who live and work in these polluted environments. In many developing countries the lack of policy specifically addressing the peri-urban interface means that peri-urban agriculture is often unregulated and exists within informal institutional arrangements. However, in China, government policy specifically addresses peri-urban vegetable production as a key component of urban food security and has created composite urban-rural regions through the 'city leading county' system which puts large areas of rural land under the control of central cities. Chinese government policy sets out a strategy for developing peri-urban vegetable production and distribution systems to provide secure vegetable supplies to urban citizens while at the same time increasing farmers' incomes and balancing economic growth and environmental protection. These goals are strikingly similar to those identified by plans for resilient urban food systems noted above. Although the Chinese government does not specifically use the language of resilience in this case the goal of enhancing food security in the face of environmental and economic threats through system-level changes can be seen as adaptation to achieve a certain vision of a resilient food system: one in which food security – however it is defined – is supposed to be resilient against a specific range of disruptions.

## Conclusions

China's spatial governance structure linking urban and urban-fringe rural areas combined with a focus on developing secure and stable urban food systems (emphasising peri-urban vegetable production) are both approximately equivalent to the two shifts in approach to urban sustainability reflected in the FAO and ICLEI rhetoric which emphasise a food systems perspective centred on city-region food systems. Common to these policy goals is the sense of peri-urban agriculture performing a set of functions which contribute to the food security of urban residents while at the same time balancing the need to protect farmers' livelihoods and the ecosystems upon which agriculture depends. Despite the fact that Chinese policy does not use the term 'resilience', the emphasis on stability and security of supply implies that the goal of policy is to protect certain food system outcomes from disruption in a way which is clearly

equivalent. Both the ICLEI approach and Chinese policy represent a vision of governance for city-region food systems to promote the properties necessary to generate resilient outcomes while also promoting some measure of equity for the key stakeholders. However, in the context of rapid change, uncertainty and socio-economic diversity, achieving these goals in practice depends in large part on the interaction between interventions to promote system-level outcomes and the diverse interests of different groups of stakeholders which may or may not be aligned with policy goals. The problems associated with applying the concept of resilience to such a context are the focus of much recent debate. Chapter 2 presents a literature review which outlines these debates, discusses how resilience has been applied specifically to food systems analysis (particularly by Polly Ericksen) and explores the limitations of this approach when applied to the context of peri-urban China. This discussion sets the stage for developing a conceptual framework capable of providing answers to the research question through analysis of the case in question guided by a set of sub-questions. Chapter 3 describes the research design and fieldwork strategy which leads directly into a discussion of the policy and institutional context of the case study in chapter 4. Chapters 5, 6 and 7 present the empirical data and analysis followed by an holistic analysis of the system trajectory and changing pattern of resilience in chapter 8 which synthesises the data presented in previous chapters. Finally, chapter 9 discusses the conceptual implications for enhancing sustainability and resilience of urban food systems, presents the policy recommendations and suggests priorities for further research.

## Chapter 2. Literature review and conceptual framework

This chapter reviews three key areas of literature: 1) the various critiques of the resilience approach; 2) approaches to analysis of resilience/vulnerability of food systems; 3) research on the peri-urban interface with particular reference to the Chinese context. Drawing on these literatures, a framework for analysis of peri-urban vegetable production systems is developed in section 2.4. This framework emphasises the diversity of interests and perspectives of the system and its outcomes, takes into account the trajectory of change in system structures and explores the connections between different outcomes and the resilience of the system.

### 2.1 Resilience

#### *Origins and criticisms of its application to development issues*

The concept of social-ecological resilience was developed by Holling (2001, 1973), Walker (2004), Berkes and Folke (1998) and others from a background in ecosystems research and has since become increasingly important in discussions of adaptation in coupled social and ecological systems (see Adger and Kelly, 2001; Boyd et al., 2008; Christopherson et al., 2010; Duit et al., 2010; Ericksen, 2008; Fussel, 2007; Leach et al., 2010; Nelson et al., 2007). Gallopin (2006, p. 294) argues that the social-ecological system is the “natural analytical unit for sustainable development research” and defines an SES as “a system that includes societal (human) and ecological (biophysical) subsystems in mutual interaction”.

In the context of research on social and ecological adaptation to environmental change, ‘resilience’ is itself a contested concept just as sustainability is also notoriously flexible and broad in its definitions. Davoudi et al. state: “It appears that resilience is replacing sustainability in everyday discourses in much the same way as the environment has been subsumed in the hegemonic imperatives of climate change... Yet it is not quite clear what resilience means, beyond the simple assumption that it is good to be resilient.” (Davoudi et al., 2012, p. 299).

The term ‘resilience’ has long been used in the field of psychology (Harris, 2011, p. 5) to refer to the ability of an individual to survive adversity. In ecology, it has been applied in various ways to ecosystems to denote properties such as the capacity of an ecosystem to recover from stresses and shocks, adapt to changing conditions and even transform (see Davoudi et al., 2012, pp. 300–302). In these broad uses of the term, the subject of resilience is a clearly defined empirical unit (human individual or ecosystem), the ongoing survival of which is unambiguously valued. The same cannot be said for a system which incorporates diverse actors with contrasting interests and produces a complex set of positive and negative outcomes for different groups. Hence, Levine et al (2012) highlight the dangers of uncritically thinking about resilient ‘systems’ rather than people.

Levine et al. observe that the notion of ‘building resilience’ is becoming a new “organising principle” in mainstream development practice and the term ‘resilience’ is being used to reframe the challenges of sustainable development and vulnerability etc. in terms of ‘systems’ rather than people (Levine et al., 2012, p. 1). They argue that the emerging resilience paradigm brings dangers as it is translated from an ecological context to the social world:

“Ecological resilience appears value-free because only the ‘system’ is valued, not the wellbeing of individual creatures. Indeed, in judging the health of an ecosystem, hidden value judgements may be made about which species’ survival matter. The paradigm encourages value-free analysis by focusing on outcomes and symptoms of resilience, avoiding looking at the power relations that are at the root of much vulnerability. The quest for objectivity remains an illusion, though, because exploitation too can be resilient, so any ‘scientific’ analysis still has to judge which is resilience-to-be-supported and which is resilience-to-be-fought.” (Levine et al., 2012, p. 2).

This highlights the risk that interventions to promote resilience at the system-level might implicitly promote the interests of particular stakeholders at the expense of others when the resilience-to-be-supported is aligned with the interests of the powerful and may simultaneously be seen by others as resilience-to-be-fought. One of the fundamental differences between ecological systems and social systems is, as Hornborg puts it, that “trajectories [of social systems] are generally propelled by individuals and groups struggling to maximise their power and affluence, yet there is no mention of power or contradiction in the so-called ‘analytical framework’ for understanding social-ecological systems.” (Hornborg, 2009, p. 254). The mistake is essentially to conflate the integrity of system structure with the interests of the individuals living and acting as part of those structures.

However, despite these criticisms of applying the concepts of ‘resilience’ and ‘social-ecological systems’ to development issues, there are important insights which can be gained from such approaches which recognise the dynamic and systemic nature of social-ecological change. The key issues are the ways in which the system in question is framed: which actors, structures and outcomes are valued and over what timescales and how system-level resilience is defined as a result.

### ***An approach defining resilience as a dynamic property of sustainability***

The STEPS Centre<sup>2</sup>, a global research and policy engagement centre based at IDS<sup>3</sup> and SPRU<sup>4</sup> at the University of Sussex, has developed a distinctive ‘pathways approach’ to development challenges which builds on the concept of social-ecological systems and addresses these issues of framing and diverse definitions of sustainability and resilience (Leach et al., 2007; Thompson et al., 2007). This approach begins with the idea of a ‘non-equilibrium perspective’ of reality. It argues that many of the most significant contexts for development and

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<sup>2</sup> Social, Technological and Environmental Pathways to Sustainability

<sup>3</sup> Institute of Development Studies

<sup>4</sup> Science Policy Research Unit



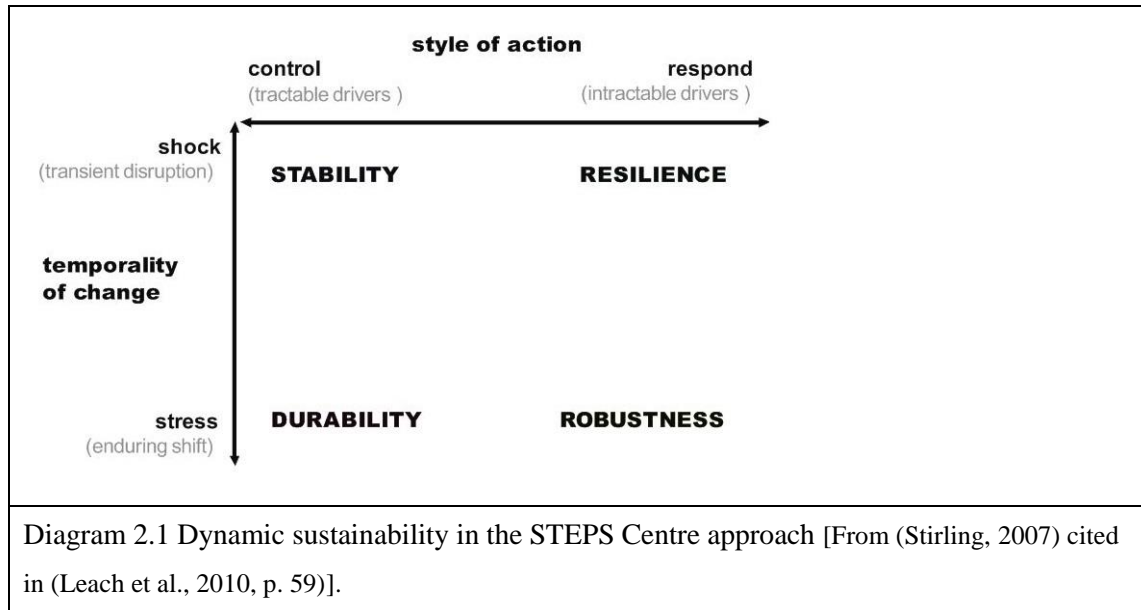
collective action in the world today are dominated by complex dynamics which result in constant change, non-linear processes and unpredictability (Leach et al., 2010). Reviewing a range of academic literature from the science of complexity, ecological systems and socio-technical systems as well as policy and management literature dealing with complexity and dynamics, Leach et al. conclude that “There is a common recognition of the need to move away from the analytical assumptions of equilibrium thinking, centred on linearity, predictability, homogeneity and simplification, to ones that encompass non-linearity, complexity, heterogeneity, uncertainty, ambiguity and surprise.” (Leach et al., 2010, p. 34). The world does not behave like a simple closed system which can indefinitely maintain a state of equilibrium once such a state has been defined and attained. Rather, it often behaves in a way more akin to a complex system of systems, constantly changing in often unpredictable ways. The recognition of these complex systemic interactions implies an analytical framework based on a dynamic systems approach.

As an analytical object, a dynamic system consists of “social, institutional, ecological and technological elements interacting in dynamic ways” (Leach et al., 2010, p. 43), defined by its boundaries, structures and functions and situated in an environment. The structures “concern the ways in which the system and its boundaries are constituted, its internal and external relationships and the patterns in which its processes unfold.” (Leach et al., 2010, p. 43). The functions of the system are the ‘outcomes’ delivered by the system: services, outputs and consequences for different groups of stakeholders (both human and non-human). Boundaries refer to the type of system and the scale at which it is constituted.

Sustainability of such a system then includes two features which need to be explicitly acknowledged and distinguished. First, it includes the normative qualities of each outcome – for example how they contribute to poverty reduction and environmental protection. Second, it refers to the maintenance of these normatively defined system outcomes in the face of shocks and stresses.

In the STEPS approach the maintenance of system outcomes is described in a two-by-two matrix with two axes – temporality of change and style of action. Temporality of change is categorised into “transient disruptions” (shock) and “enduring shifts” (stress) (Leach et al., 2010, p. 59). Style of action ranges from control (of tractable drivers of change) to response (to intractable drivers of change). In this context, sustainability refers to the ability of the system to maintain certain outcomes and/or structures in the face of such disruptions and this is what Leach et al. term the “dynamic properties of sustainability” (Leach et al., 2010, p. 59). In these terms it can be said that: a) **stability** refers to the ability to mitigate a transient disruption by targeting its driver; b) **resilience** is the ability to adapt system structures to limit or negate the impacts of a transient disruption which is not susceptible to direct mitigation; c) **durability** is

the ability to resist the impacts of an enduring shift through exercising some level of control over that shift; d) **robustness** then describes the ability to adapt or transform system structures to mitigate the effects of an enduring shift which is beyond the realm of direct influence.



The above definitions of sustainability and resilience help to show how these concepts can be understood in terms which distinguish between system structures and functions (or outcomes). This also provides a way of talking about both terms together while recognising that the normative aspects of sustainability should not be ignored in the name of promoting resilience as a goal in itself. However, when the language of social-ecological systems and resilience is translated into the policy context of urban planning and urban food systems, definitions become stretched and often detached from their theoretical basis so that meanings become less clear. In order to develop the conceptualisation of resilience adopted in this thesis it is, therefore, helpful to discuss alternative definitions of resilience common in policy contexts and how these might be helpful for understanding the dynamics of peri-urban food systems.

### ***Conceptualisations of resilience in planning and policy***

The discussion of resilience from a planning perspective by Davoudi et al (2012), is highly relevant for understanding how the concept might be applied in a variety of ways to urban food systems. This is because the context for policy making at the level of urban or peri-urban food systems is that of urban planning. Davoudi et al identify three main understandings of resilience which are embedded in recent planning literature: engineering resilience, ecological resilience and evolutionary resilience (Davoudi et al., 2012). A similar distinction can be found in papers by Seeliger and Turok (2013) Thapa et al. (2010, p. 6) and Béné et al. (2012).

At the level of a system, engineering resilience is the ability of the system to bounce back to

its normal state of equilibrium after a disturbance. In contrast, ecological resilience recognises multiple possible equilibrium states and includes the ability not simply to bounce back but also to adapt in order to maintain the present equilibrium or bounce forward to an alternative equilibrium state. While these two definitions of resilience are rooted in a “Newtonian world view which considers the universe as an orderly mechanical device” (Davoudi et al., 2012, p. 301) the concept of evolutionary resilience (also referred to as ‘social-ecological resilience’) embraces the idea of change being inherent within the system such that no stable equilibrium exists, but rather the evolving system is continually undergoing the linked processes of flexing, adapting and transforming at different spatial and temporal scales (Davoudi et al., 2012, p. 304) (see also Christophe Bene et al., 2012, pp. 20–24; Davoudi et al., 2012, pp. 302–304; Miller et al., 2010, pp. 3–4; Nelson et al., 2007, pp. 299–401). Resilience is thus seen “not as a fixed asset, but as a continually changing process; not as a being but as a becoming.” (Davoudi et al., 2012, p. 304).

Research on social-ecological resilience as defined in the terms above, sees resilience as referring to “the ability to maintain system structure and function in the light of both shocks and stresses in the wider environment” (Berkes et al., 2003; cited in Smith and Stirling, 2010; see also Walker et al., 2004, p. 6, and 2006, p. 14). This most obviously involves the ability of the system to absorb the impacts of transient shocks and bounce back to its original state in terms of both structure and function. However, this ability to ‘bounce back’ is just one aspect of a range of responses required to either maintain or attain a “desired system regime” as the system and the disruptions it faces continue to change and evolve in often unpredictable ways.

Walker et al. (2004, 2006) use the three terms resilience, adaptability and transformability to describe this range of system-level responses. Resilience refers to the ability to bounce back while adaptation is characterised as involving the ability of system actors to manage resilience in response to and anticipation of change and thus “avoid crossing into an undesirable system regime or succeed in crossing into a desirable one” (Walker et al., 2006, p. 15).

Transformability is then “the capacity to create a fundamentally new system when the existing system is untenable” (p. 15). According to this conceptualisation it could be said that social-ecological resilience (or evolutionary resilience) is dependent upon these three abilities or ‘capacities’ and how they are managed by system actors and policy makers.

The first thing to note is that the ability to bounce back from the impacts of shocks, described simply as resilience by Walker et al., corresponds closely to the idea of ‘engineering resilience’ described by Davoudi et al. and others. This is significant because, according to Seeliger and Turok engineering resilience is “by far the most common meaning of resilience in the popular discourse and in government policy” (2013, p. 2112). Importantly, it is also the understanding of resilience implicit in the ICLEI approach and in the goals of Chinese policy outlined above.

In order to engage with policy makers it seems necessary then to explicitly recognise the engineering definition as important and relevant but to then explore how to develop a more complex understanding of resilience appropriate to analysis of the peri-urban food system by drawing on insights from broader conceptualisations of resilience. In addition to the emphasis of evolutionary resilience on the recognition of dynamics of adaptation and transformation as integral to resilience, a further insight into how resilience is best understood is found by returning briefly to the STEPS approach which argues for the necessity of distinguishing between system structure and function.

### ***Functional resilience and structural processes***

The STEPS understanding of resilience in social-ecological systems includes, as one of a subset of four dynamic properties of sustainability, an equivalent to engineering resilience in that it denotes the ability of the system to flex in response to short term disruptions but then return to its original state once the disruption has passed, at the same time as maintaining the desired system functions. However, this property labelled ‘resilience’ is one of four which also include adaptive and transformative system-level responses. One significant difference between the simple engineering definition of resilience and the extended definition developed in the STEPS approach is that in the latter these four dynamic properties are defined specifically with reference to system functions while a clear distinction is made between system function and structure. Indeed, one criticism of the social-ecological resilience literature is that it often fails to clearly distinguish the two:

“If structures are synonymous with functions, as might conceivably be the case when ecological systems are viewed as subject to natural processes of dynamic stability, then this need not pose problems. However, as attention expands to include social and technological systems and to contemplate transformations in social-ecological systems as they stand, the point is often precisely that resilient structure can undermine the functions being sought. Thus, critical questions arise as to whether the object of resilience is structure or function. Definitions of resilience that explicitly conflate the two can become seriously problematic.” (Smith and Stirling, 2010, p. 4)

On the other hand, thinking in terms of functional resilience and making a clear distinction between system structures and functions opens up important possibilities for how a more dynamic conceptualisation of resilience can be developed. First, it allows for an outcome-specific understanding of resilience such that different system outcomes can be seen to be resilient in different ways to different disturbances. This also means that the normative characteristics of those specific system outcomes can be more readily taken into account when considering whether their resilience is something that should be supported or fought against. Second, it keeps the definition of resilience relatively simple and close to its everyday usage which ensures that it retains a close connection to policy goals.

Third, it makes the contrast between responses to shocks and stresses explicit because the ability to maintain a particular outcome or set of outcomes in response to shocks (i.e. resilience)

depends on different structural properties than those necessary to respond and adapt to long term stresses (a response which the STEPS approach calls robustness). These contrasting responses can be understood as distinct yet also closely related. Just as Walker et al see adaptation as the ability to manage resilience, it is possible to interpret ‘robustness’ as encapsulating the ability to continually renew or enhance functional resilience over time through the processes of adaptation and transformation of system structures. Thus ‘dynamic functional resilience’ implies a combination of ‘engineering’ (bounce-back) responses to shocks and ‘evolutionary’ (dynamic) responses to stresses.

It follows that different properties are required of the system structure to achieve functional resilience to shocks on the one hand and to ensure that resilience is renewed and enhanced in the face of longer term stresses on the other. For resilient system functions the structure must be persistent – flexible and/or diverse enough to absorb shocks, cope with disruption and return to normal quickly. In order for resilience to be dynamic the structure must be adapted (to make incremental changes in response to long term stress) and sometimes transformed, depending on the nature and magnitude of the stress. In other words the structure must be pliable so that it can be re-organised to take advantage of new opportunities, remove negative feedbacks, adopt and diffuse new technologies and techniques etc.

Given the context of continuous change – that any social-ecological system is travelling along a trajectory (Smith and Stirling, 2010, p. 13) – it should be expected that the system structures are characterised by ongoing processes of flexing (persistence), adaptation and transformation operating at different scales and speeds while also being shaped to varying degrees by power relations and politics. These processes all contribute in different ways to enhancing or undermining the resilience of various system outcomes. From a policy perspective, the goal of adaptation and transformation is precisely to create a kind of persistence which is continually being renewed and upgraded to match changing circumstances and thereby promote the resilience of specified functions in response to and anticipation of both shocks and stresses.

Applying these ideas specifically to peri-urban food systems in such a way that they provide a deeper understanding of the potential interactions between system-level resilience and actor-level interests requires a clear definition of food systems as social-ecological systems. Polly Ericksen’s approach to conceptualising food systems and analysing their vulnerability/resilience provides the starting point for such a definition (Ericksen, 2008, 2007). The following section discusses Ericksen’s approach and how it is relevant to this case study of a peri-urban vegetable production system.

## 2.2 Food systems analysis

### *Defining food systems and outcomes*

Agriculture systems and food systems research has a long history but more recent literature has sought to specifically address issues of resilience, vulnerability and adaptation to climate change in food systems. This literature is the most relevant for this research and one of the key thinkers in this field is Polly Ericksen.

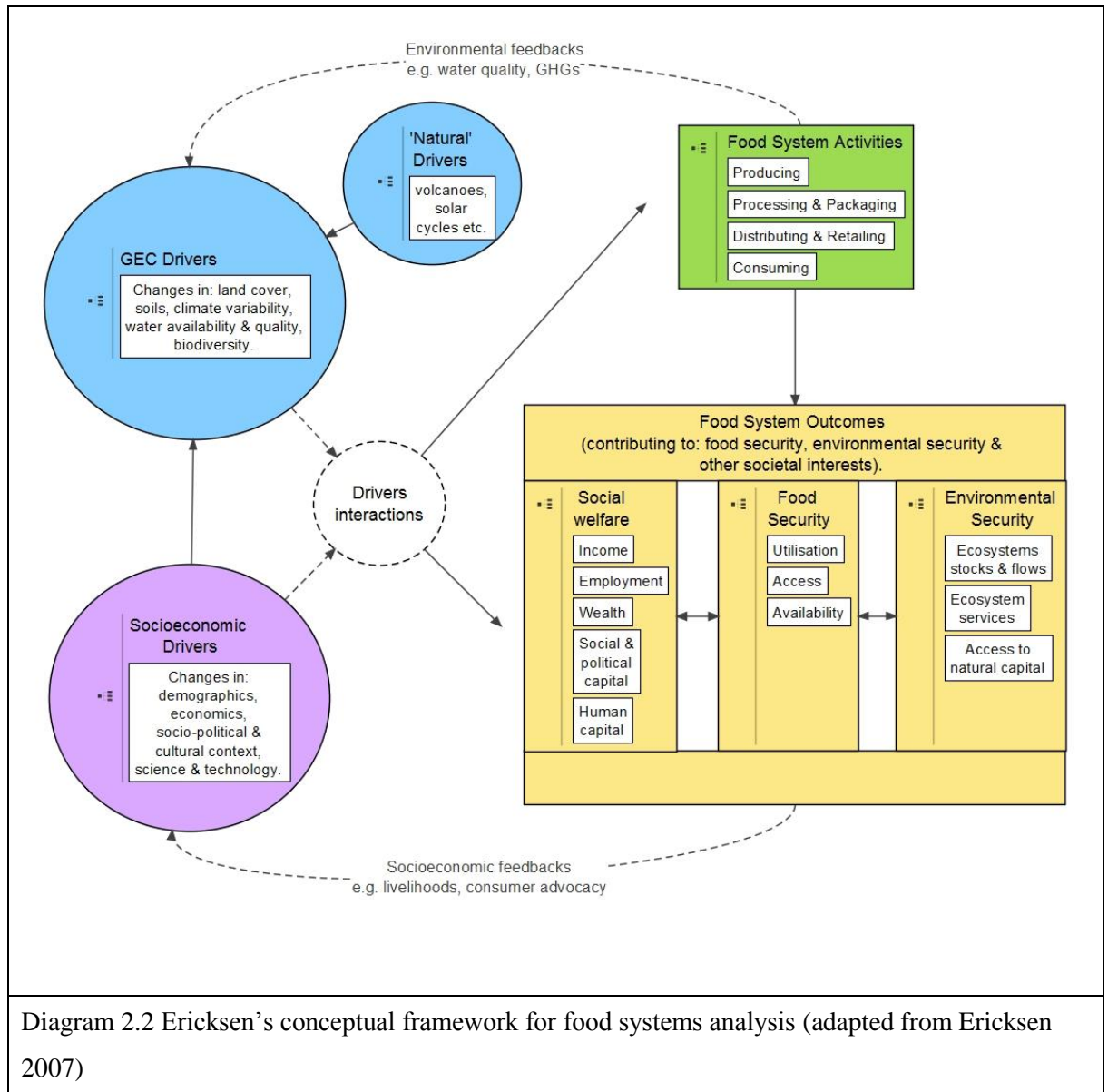
Ericksen takes a systems approach to analysing food systems which deals with social-ecological interactions while also acknowledging the role of socio-economic conditions and institutional factors in determining their outcomes in terms of food security, ecosystem services and social welfare (Ericksen, 2008, 2007). Drawing on Norgaard (Norgaard, 1984) on agricultural systems and the work of Berkes, Folke and Holling (Berkes and Folke, 1998; Folke et al., 2003; Holling, 2001) on social and ecological systems and resilience, Ericksen sees food systems as coupled social-ecological systems in which the ecological and social components are co-evolving and mutually dependent, “heterogeneous over space and time and replete with non-linear feedbacks” (Ericksen, 2007, p. 4). This informs her understanding of food security as a system outcome and its interactions with the other system outcomes: environmental security and social welfare.

Ericksen argues for a broad definition of food systems which includes not only the four types of activities – production, processing and packaging, distribution and retail, and consumption – but also the “interactions between and within biogeophysical and human environments” which determine those activities (Ericksen, 2007, p. 1). She identifies food security, environmental security and social welfare as the key food system outcomes (functions) which are each mediated by socio-economic, institutional and environmental factors.

At the same time she recognises the complexity of defining those system outcomes in contexts of competing interests.

“The three categories of outcomes considered in this framework—food security, environmental security, and social welfare—are often those amongst which decision makers at different levels (household, district, nation, or region) make conscious or unconscious choices. Food systems and food security are highly contested topics, as are the conflicts between economic growth and the protection of environmental services. There are many ways in which these outcomes can be evaluated, depending upon the perspective or objectives of the evaluator, which are shaped by the political and social context.” (Ericksen, 2007, p. 9).

Nevertheless, she develops a generally applicable definition of food security at the level of a food system which includes specific dimensions that can be interpreted and emphasised differently depending on the food system context. Ericksen’s conceptual framework is summarised in the following diagram (2.2) which combines two of her own diagrams into one.



### ***Food security***

Discussions of food policy and food security have moved to include issues of entitlement following the work of Sen and Dreze (Dreze and Sen, 1989; Sen, 1981), the vital role of economic and political factors (Devereux, 2000) and the interplay between food security and livelihoods (Swift and Hamilton, 2001). The most widely used definition of food security is a “situation that 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).

Ericksen draws on these themes and the work of Maxwell and Slater (Maxwell, 2001; Maxwell and Slater, 2003) to build a concept of food security which consists of three components:

“Food security can be analysed for any unit, from an individual to a nation. Food *availability* refers to the amount, type and quality of food a unit has at its disposal to consume. *Access* to food refers to the ability of a unit to obtain access to the type, quality, and quantity of food it requires. Food *utilisation* refers to individual or household capacity to consume and benefit from food” (Ericksen, 2007, p. 5) (author's emphasis).

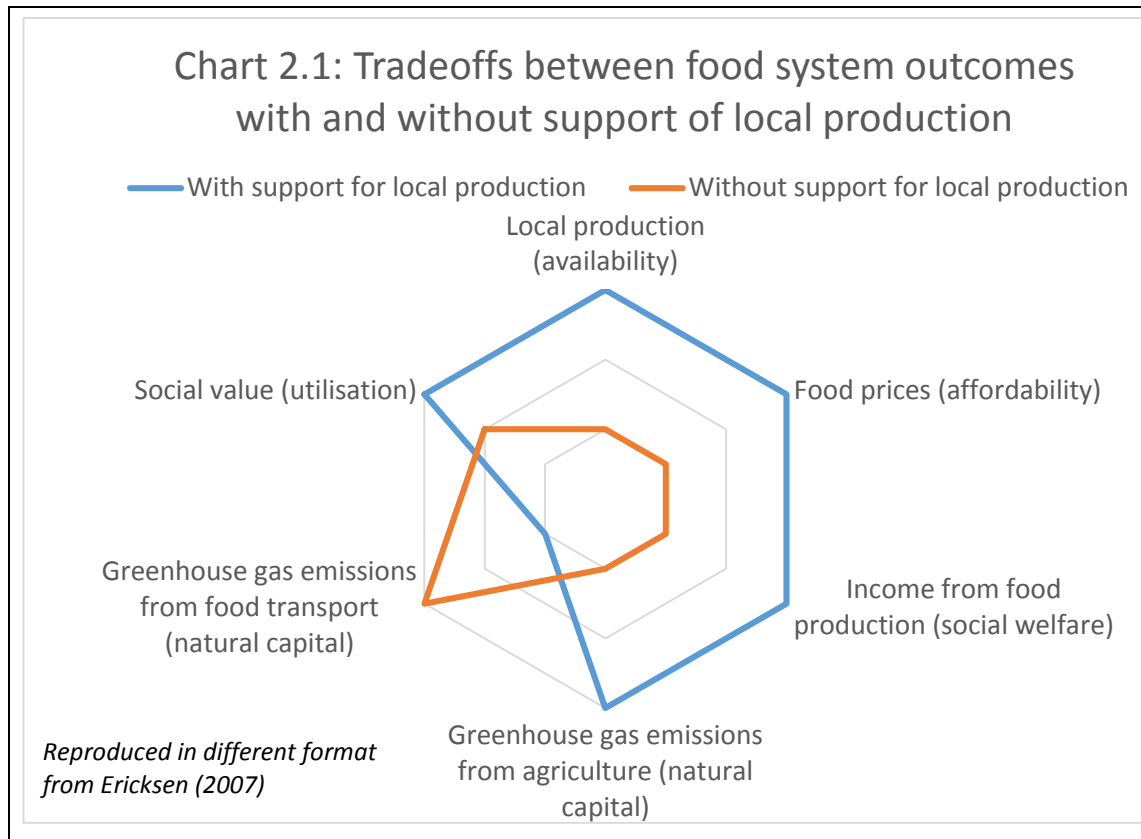
The first, food availability, depends upon the features of production, distribution and exchange. The second, access to food, includes affordability, allocation and preference. Finally, utilisation involves nutritional value, social value and food safety. Each of these are determined variously by environmental resources, socio-economic conditions and institutional arrangements.

### ***Social welfare and environmental security***

Interactions and feedbacks also operate between outcomes. Social welfare outcomes (income, employment, social and political capital and human capital) influence the various aspects of food security as well as being impacted by them. Similarly, environmental outcomes often have feedbacks to particular food security outcomes. For example, degradation of soil and water resources due to intensive cultivation may lead to long term declines in crop yields and pollution from agriculture may lead to contamination of foods. Thus, trade-offs are common between various environmental, food security and livelihood outcomes (Ericksen, 2008, 2007).

In her paper, Ericksen (2007) provides a stylised example of evaluating the trade-offs between food system outcomes in the form of a radar diagram. It is reproduced here (chart 2.1) in the form of a radar chart.





She explains:

“Here the potential tradeoffs among six different food system outcomes are shown in a radar diagram, and compared between two different hypothetical systems. In the first system, local production of food is supported, resulting in high agricultural incomes but also high food prices. Greenhouse gas emissions from agriculture are higher than those from transporting food. In the second system, without the support for local food production, food prices are lower but agricultural incomes suffer. Food transport is now the major source of greenhouse gas emissions.” (Ericksen, 2007, p. 9).

The three categories of system outcomes are thus explicitly linked to the food system activities upon which their resilience depends. Once these outcomes have been defined and the connections between outcomes and system activities have been identified, the adaptive capacity and hence vulnerability (or resilience) of the food system as a whole can be analysed with reference to specific threats. This analysis is based on applying the concepts of vulnerability, resilience and adaptive capacity to the food system and the following section explains how Ericksen does this.

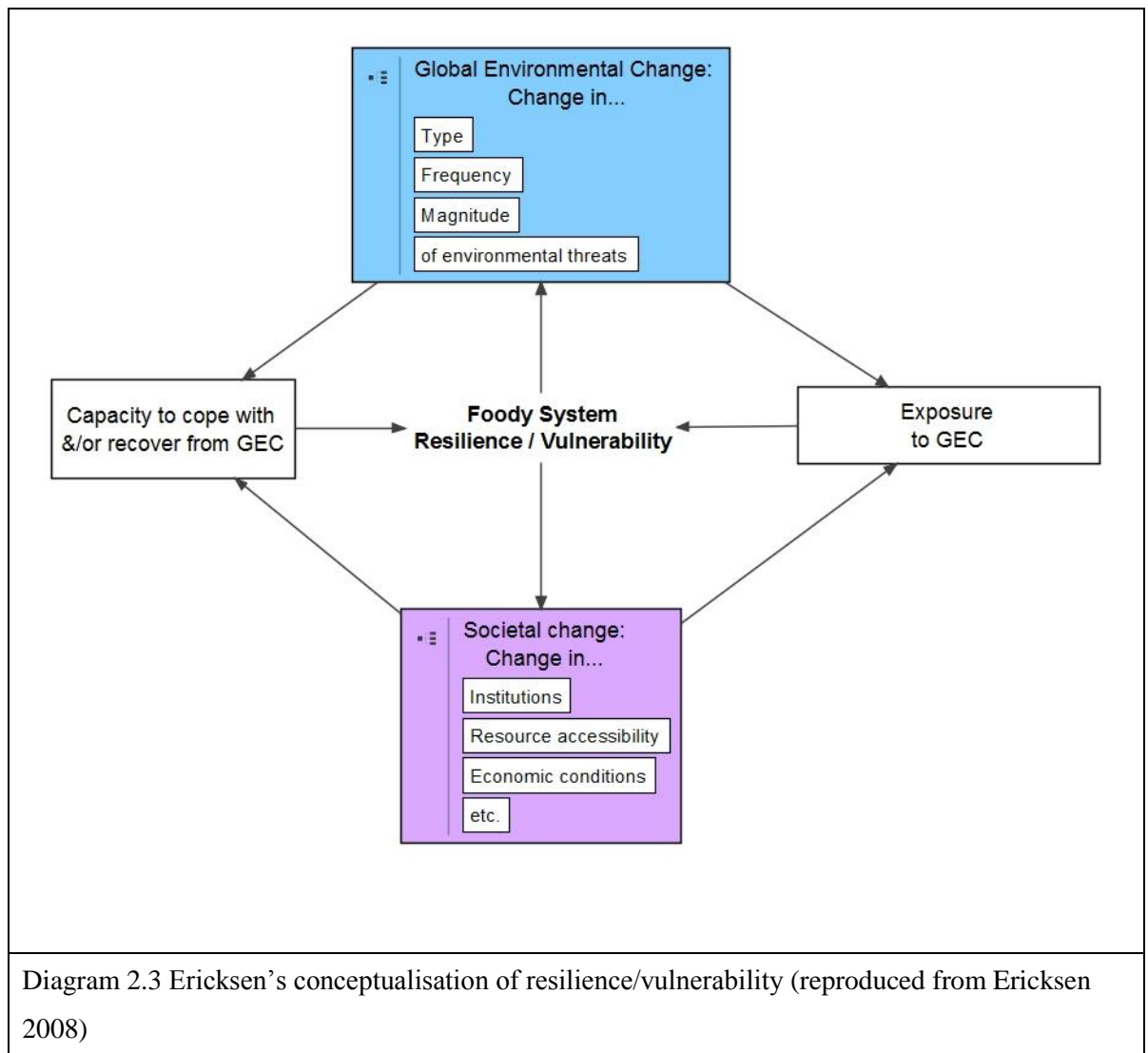
### ***Determinants of food system vulnerability/resilience***

Ericksen draws on a wide range of literature spanning food security, vulnerability, resilience, and social and ecological systems approaches, in order to construct a framework for assessing both food security and the vulnerability of food systems to global environmental change.

Her framework offers a way to assess the vulnerability of a food system by bringing together

insights from resilience approaches with concepts linked to social vulnerability. She argues that failure – or potential future failure – to deliver food security as well as negative impacts on ecosystem services and social welfare outcomes are all indicators of system vulnerability and that economic shock, institutional failure, actors in conflict, or environmental change are all potential stressors for food systems.

The key concept central to this framework is adaptive capacity. Ericksen bases her own framework on Ingram and Brklacich's (2002) generic diagram to "explain vulnerability to environmental change as a function of exposure to an environmental hazard, which is mediated by social factors and institutions, which combine to determine the adaptive capacity and hence the overall vulnerability of the food system" (Ericksen, 2008, p. 6) (see diagram 2.3 below). In this way, combined with the concepts of exposure and sensitivity, the system-level property of adaptive capacity becomes the key determinant of the resilience (or vulnerability) of food system outcomes.



The generally accepted definition of vulnerability - when used in reference to the social vulnerability of individuals or groups - includes exposure, sensitivity, coping capacity and adaptive capacity. Exposure is a function of both the type and scale of shock as well as the contributing impacts of other changes that interact with the shock. For example drought caused by lack of rain may be made worse by declining ground water. Sensitivity implies that different components of the system may be sensitive to the shock to different degrees and in different ways. For example farmers growing crops sensitive to drought will be more sensitive than farmers growing drought tolerant crops. Coping capacity refers to the combination of the resources available to people and their ability to use those resources to cope with the impacts of a shock and to get life back to normal. Adaptive capacity refers to the ability to modify current practices in response to shocks and stresses and also in anticipation of future threats in order to reduce exposure and sensitivity in the future (Ericksen, 2008).

When applying these concepts at the system-level, the objects exposed and sensitive to shocks are the key components of food system outcomes, i.e. those aspects of food security, environmental security and social welfare which are valued by the evaluator or decision maker. With reference to food security these might be, for example, production, allocation, affordability and nutritional value. The purpose of analysis is then to identify the key determinants of these components of food security, the sensitivity of these determinants to particular shocks and stresses and the sources of adaptive capacity for each determinant. For example, perhaps production depends on availability of irrigation which is fed by surface water; decline in irrigation water puts stress on production; alternative irrigation is expensive to install so adaptive capacity is low (Ericksen, 2008).

Adaptive capacity in this context is identified mainly in terms of the diversity and replaceability of the determinants of key food system components, i.e. how easy it is to find alternative means of supporting their role in maintaining the valued food system outcomes. The researcher can then characterise the vulnerability of each component of food security to a particular shock which provides an overall picture of food system vulnerability so that action can then be targeted at the most vulnerable system components (Ericksen, 2008).

By conceptualising food systems as coupled social-ecological systems she aims to provide new insights into their functioning which will contribute to social learning and adaptive management and thus help policy makers and managers of institutions to promote more resilient food systems (Ericksen, 2007, p. 10). She argues:

“to understand a system holistically it is necessary to describe and analyse not only the component parts and actors, but the interactions among these parts and actors that produce variable outcomes. A goal of the system’s description is thus to explain the patterns of interactions among the activities, external drivers, and the outcomes, so as to fully assess any emergent properties, as well as cause and effect. Thus, while I accept the inherent complexity of integrated food systems, I believe that a systematic approach

to their analysis, through the use of case studies, can reveal critical processes and factors that govern them.” (Ericksen, 2007, p. 10).

Ericksen’s framework provides a helpful definition of food systems which includes activities, outcomes and drivers (both environmental and socio-economic) and offers a way of exploring the systemic processes which link these food system components and actors and contribute to the resilience/vulnerability of food system outcomes. Although the purpose of this approach is to analyse the impacts of global environmental change on food systems, the conceptualisation of food systems can be adapted to analyse peri-urban vegetable production, albeit with some modifications.

### ***Limitations of the approach for a peri-urban context***

There are a number of limitations of this framework when applied to the case in this thesis. First, it considers a more or less singular system while the context of this research suggests the co-existence of multiple formal and less formal sub-systems. Second, the outcomes are expressed in terms disconnected from the potential inequalities in how those outcomes are experienced - i.e. which social groups benefit most from them. Third, it assumes a somewhat more static context than the peri-urban interface will allow - one in which the interactions between food system outcomes and activities are continually changing.

The reason for these issues is that Ericksen’s approach links the outcomes of food security, social welfare and ecosystem services by applying the concept of adaptive capacity in a way which does not need to distinguish clearly between the adaptive capacity of individuals or groups and that of the system and its structures. This is because the food system envisaged by the framework is a rural one in which the producers are also the main consumers, or at least there is considerable overlap between the components of production and allocation. This means that the vulnerability of producers is closely linked to the vulnerability of food security outcomes because declining incomes of people whose incomes depend at least partly on agriculture impact on their ability to afford to buy food. Thus, if farmers become vulnerable, their interests are taken into account through the analysis of food security outcomes because food security is framed in terms which includes them.

However, a peri-urban vegetable production system presents a very different context in that the activities of production are located at the peri-urban interface while the other activities – distribution, markets and consumers – are decidedly urban. This contrasts with more common local, national or global levels of food system analysis. The following section explores the implications of the peri-urban context for understanding food systems drawing on the literature around rural-urban linkages and peri-urbanisation. The review of this literature identifies a lack of empirical research on the peri-urban interface in the Chinese context and also shows that a central feature of Chinese peri-urban food systems has not previously been identified: namely the role of internal migrants.

## 2.3 Peri-urban interface

### *Peri-urban interface with Chinese characteristics*

Recent peri-urban literature focuses on African and South Asian cities (see for example Dupont, 2005; Friedberg, 2001; McGregor et al., 2006; Narain and Nischal, 2007). This literature includes a diversity of new and rapidly changing empirical contexts accompanied by a wide variety of definitions of ‘peri-urban’ as a place, a process or a concept (Marshall et al., 2009, p. 3). As a place it refers to the geographical edge of cities. As a process, the transition from rural to urban and the flow of goods and services between places. Finally, as a concept, “an interface between rural and urban activities, institutions and perspectives” (p. 3) and Marshall and Waldman et al. define the peri-urban as a situation in which there is a juxtaposition of urban and rural activities and institutions (p. 12).

The literature within development theory on rural-urban linkages (Adell, 1999; Lipton, 1977; Tacoli, 2006, 1998; Unwin, 1989) is also very relevant to conceptualising the peri-urban interface (see Allen, 2003) and highlights the importance of thinking beyond the immediate peri-urban context in understanding the processes behind peri-urbanisation and urbanisation. Tacoli discusses the relationship between rural-urban interactions and the “growing social polarisation in both towns and countryside” (Tacoli, 1998, p. 154). She sees these interactions as flows of people, goods, wastes, and sectoral interactions (rural activities in urban areas, urban activities in rural areas and a concentration of rural and urban activities in peri-urban areas). Each of these types of flows and interactions can have both positive and negative implications for sustainability and the task of governance is to promote these positive interactions (Tacoli, 1998, p. 160).

David Simon’s (2008) review of peri-urban issues around the world highlights the growing global importance of peri-urban contexts in relation to urban sustainability. This is not just in terms of the issues faced within such areas and the growing concerns about enlarged urban/peri-urban ecological footprints, but also in relation to the opportunities for what Simon calls “holistic and systems-oriented planning” (Simon, 2008, p. 170) which could include the peri-urban interface within co-ordinated, enlarged, well resourced metropolitan planning systems. However, while the problems and opportunities associated with the peri-urban interface are increasingly recognised there remains an urgent need to develop approaches to harness those opportunities to improve social justice and environmental integrity in urban and peri-urban contexts (Marshall et al., 2009, p. 1). Chinese cities face this same urgent challenge but present researchers with political, economic and institutional contexts which are quite distinct from other countries and which have a significant impact on the nature of the peri-urban interface.

The literature on urbanisation in China is extensive and growing. However, the explicit attention given to the peri-urban interface and peri-urbanisation is relatively limited compared to

that for African, South Asian and Southeast Asian contexts (Hudalah et al., 2007, p. 504; Webster, 2002, p. 6). More recently David Simon (2008) included a section on in-situ urbanisation in China in which he cites a small number of key researchers including John Friedmann (2005), T. G. McGee and G.C.S. Lin (McGee et al., 2007), Webster (Webster, 2002; Webster and Muller, 2002; Webster et al., 2003) and Hudalah et al. (2007) all of whom have written about China's urban transition and the institutional and political context of urbanisation and peri-urbanisation in China.

Hudalah et al. (2007) provide a review of the literature on peri-urbanisation in East Asia and attempt a comparative analysis between Indonesia, China, Thailand and the Philippines based on that literature. They note the current literature's neglect of East Asia in favour of Africa and South Asia and argue that East Asian peri-urbanisation has contradicted the traditional view of peri-urban areas as it is characterised by formal, and often large scale, land development influenced by "growing networks of global capitalism" (p. 506).

Their approach echoes that of Phillips and Williams (1999), Simon (2008) and Webster (2002) in that they emphasise the process of peri-urbanisation over the characteristics of peri-urban areas, acknowledging that these characteristics are highly diverse and transitory. However, they go further by linking East Asian peri-urbanisation to institutional changes at various scales from local to global which they define as the "restructuring of both formal and informal rules, procedures, cultures and other types of social framework that constrain and enable actors' decisions and behaviour" (Hudalah et al., 2007, p. 509). These are identified as follows (Hudalah et al., 2007, pp. 509–511). First, the rise of global capitalism which involves the attraction of global capital to peri-urban areas. Second, an expanding middle-class which drives a culture of high consumption. Third, a strengthening "clientelist governance tradition" characteristic of East Asian countries in which a small number of property developers hold a disproportionate amount of economic power and political influence. Fourth, the changing roles and relationships of central, regional (i.e. sub-national) and local governments have a large impact on the form of peri-urbanisation. Decentralisation has often led to the fragmentation of institutions and the emergence of powerful municipal and weakened regional governments combined with less influence by central government on strategic spatial policies. Thus, the surrounding districts of urban centres can become the focus of conflict between different levels of government leading to uncoordinated spatial development.

The literature reviewed above sees China's peri-urban interface – the "interface between rural and urban activities, institutions and perspectives" (Marshall et al., 2009, p. 3) – as characterised most significantly by the influence of global capital flows. These are linked to and channelled through powerful coalitions of local government and real estate developers aggressively seeking to exploit the increasing demand from China's rising urban middle class

consumers created by the nation's long term rapid economic growth. However, there is another type of rural-urban interaction which is not foregrounded in this account but which is, as this thesis will show, a central feature of peri-urban agriculture and thus a key feature of China's peri-urban interface. This interaction is the internal migration of people to what one could call the 'peri-urban districts' governed by large cities. This internal migration is the result of a complex set of socio-economic conditions linked to China's rapid and uneven development and is shaped by a unique system of registration called the '*hukou* system'.

### ***The hukou system and internal migration***

The *hukou* system is an institution unique to China, with a history going back over 1,500 years, and in its modern form it still plays a very important role in structuring society and regulating migration from rural to urban areas (Young, 2013).

The *hukou* system is a system of population and migration management which records "the identity and location of residents/households in clearly defined '*hukou* zones' (户口区) as any census system does... But China's *hukou* system is not merely a registration system. It also functions to restrict the settlement patterns of Chinese citizens through a complex system of urban quotas limiting the number of *hukou* residency transfers to urban areas and therefore restricting access to the rights and privileges associated with *hukou* status." (Young, 2013, pp. 47–48).

"'*Hukou* status' (户口类别) and '*hukou* location' (户口所在地) are determined through family lineage (historically on the mother's side) in the same way international citizenship in most nation-states is. Like international citizenship in the more prosperous nation-states of the world, obtaining an urban *hukou* in a developed region of China is highly sought after by those institutionally excluded by birth. This is because varying levels of development in China mean that state infrastructure and benefits vary widely from east to west and rural to urban.... Obtaining an 'urban residential *hukou*' (城市居民户口) is costly, complex, limited by quotas and conditions and is consequently far beyond the reach of most rural migrants." (Young, 2013, p. 48).

Between 1958 and 1978, as China established the project of socialist industrialisation centred on the urban economy, the *hukou* system provided a way of exercising strict control over the behaviour of urban and rural populations and maintaining tight restrictions over internal migration. It perpetuated and institutionalised the division between rural and urban populations creating two separate classes of citizen with starkly differing rights. City residents were registered as "*shimin*" (市民) with 'non-agricultural *hukou*' (非农业户口) and enjoyed the benefits of the urban social system including: access to fixed priced food; subsidised state built housing; labour and health insurance and free or subsidised access to state run medical facilities

and the state supported education system; full employment through urban labour bureaus. On the other hand, rural residents were registered as '*nongmin*' (农民) with 'agricultural *hukou*' (农业户口) and were compelled to live in agricultural collectives without any access to the same benefits accorded urban residents. They produced their own food, constructed their own houses, bore their own medical and elderly care costs under the 'cooperative medical system'; paid for their own lower quality of education facilities (with no higher education); were tied to the land to work in communes or production teams in their own *hukou* zones without the freedom to leave (Young, 2013, p. 42).

As well as dividing China into rural and urban classes, the *hukou* system also allowed the government to control migration such that the urban project of socialist modernisation "hinged on the division of rural and urban areas" and was "literally fed by the rural populace". "The role of rural areas was to produce agriculture and act as a 'population sink' for the majority of the population not required or selected for socialist modernisation and socialist transformation." (Young, 2013, p. 39). By setting strict conditions on the transfer of *hukou* status from rural to urban and from one *hukou* zone to another, as well as setting quotas to limit the number of transfers, the government was able to tightly control migration and even to move people around by forcibly reassigning *hukou* status to suit regional labour requirements and development policy goals. This effectively made it impossible for rural residents to move to urban areas unless sanctioned by the government. Without an urban *hukou* they would be unable to access urban services, unemployable by legitimate means and would actually be illegal immigrants in their own country who, if caught by the police, would be sent back to their original *hukou* zone.

Until 1978 migration was limited to state planned migrations which involved an official change of *hukou* status. Through state control, millions of people migrated between provinces and from rural to urban areas but these numbers were planned to serve China's economic development and modernisation goals, were capped by quotas and often involved forced relocation and could also be used as a means of monitoring and punishing dissenters (p. 45).

From the 1980s following market reforms, internal migration increased rapidly and it became much easier for people to migrate without going through the difficult process of transferring their *hukou*. Although still illegal, it was now possible to live and work in the cities as an agricultural *hukou* holder because basic resources were now more accessible through legitimate and black markets, despite the fact that access to the normal privileges of urban citizens remained out of reach. It became progressively easier to transfer one's *hukou* but it still remains much easier for some people than others so that there are now millions of, mainly agricultural, *hukou* holders living in urban and suburban areas as non-*hukou* migrants with non-local agricultural *hukou* status (p. 48-49).

Although the *hukou* system no longer imposes such a large division between the rights and



privileges of urban and rural citizens it still makes a difference for non-local *hukou* holders (p. 49). There are now three classes of Chinese citizen with urban residents (*shimin*, 市民) at the top, rural residents (*nongmin*, 农民) second, and at the bottom of the pile, the unofficial non-*hukou* migrants (*nongmingong*, 农民工) who have no or limited access to local public goods and services such as medical insurance, housing benefits, educational provision, bank accounts (p. 49) and face discrimination, social exclusion, insecurity of rights, low wages and poor working conditions.

The *hukou* system plays an important role, not just in structuring the rights of *hukou* and non-*hukou* migrants to the large urban centres (the well-known and much researched *nongmingong* 农民工) but also in shaping China's peri-urban interface. The impact of the *hukou* system on the peri-urban interface in China is as yet less known. One of the contributions of this thesis is to begin to shed light on this.

To understand the relationship between the *hukou* system and the peri-urban interface it is important to recognise how it maps onto China's urban administrative structures. China's medium to large cities are divided administratively into districts. The central city districts are usually completely urban, the populations of which consist almost totally of non-agricultural *hukou* holders (urban residents). Surrounding these central districts are others with potentially large town (or satellite city) centres but which also contain large populations of agricultural *hukou* holders (rural residents) living in rural villages. Often these districts are referred to as suburban (*chengjiaoqu* 城郊区) although they do not resemble the suburban sprawl of western cities but contain a mixture of agricultural and industrial activities, urban and village settlements as well as urban and rural administrative sub-units.

Within these districts rural residents, while holding identical *hukou* status to those outside the city borders, benefit from the special status of the district as part of the city. City level and district level policies designed to support agriculture, promote industrial and commercial development, improve housing, education and health systems and construct infrastructure all contributing to rising living standards and employment opportunities for local-*hukou* holders. These are largely inaccessible to outsiders, a category which includes any non-*hukou* migrants who might reside in so called 'suburban' districts and who come from outside the local *hukou* zones whether they are agricultural *hukou* holders from other city districts, the districts bordering the city or other provinces. These migrants, face the same lack of rights as 'nongmingong' migrating to cities to work in the factories or construction sites in urban areas. It is this unique feature of the Chinese system which gives rise to the conditions in which internal migrants come to play a key role in peri-urban vegetable systems, a role which this thesis has brought to light and which is a major theme in the empirical chapters.

### ***Peri-urban China as a context for vegetable production systems***

One of the key characteristics of a peri-urban vegetable production system is that it spans the interface between urban, peri-urban and rural processes. It is not bounded in a peri-urban 'area' but rather connects rural, peri-urban and urban worlds through flows of people, produce and investment. Such a food system is also heavily influenced by the effects of land use change, infrastructure and commercial construction and changing socio-economic conditions. In the context of China, the intersection of all these processes can be seen most clearly in the agricultural districts of large and medium sized cities which span urban, peri-urban and rural worlds and in which urban and rural processes, institutions and activities interact within clearly defined jurisdictional boundaries.

As a result, a peri-urban vegetable production system in China would be expected to be in a constant process of change characterised by re-configuration and re-location as urban expansion and re-development continue. The food system activities are characterised by a wide diversity of actors all of which are influenced by the rapid and large scale process of change at the peri-urban interface. Farmers themselves are ageing, seeking jobs, improving or losing their livelihoods or migrating. Enterprises invest, expand, diversify, contract and close down. Consumers' preferences change and diverge, their wealth increases or declines. The economic conditions of living, doing business and farming in the city change, as do tax laws and land use etc. The characteristic feature of the system subject to any policy intervention is that it is in flux. The system is moving in a particular direction as opposed to being in a state of equilibrium. This means that it is important to understand the histories of the diverse groups of food system actors – how they became part of the particular system structure, how their business or livelihood has developed – as well as their view of the future – their expectation of opportunities and threats to their position within the system.

This produces a context quite different from the more usual analyses of localised rural food systems. First, the production component of the peri-urban vegetable production system is closely bounded in space rather than being dispersed. Second, while local analyses in developing countries tend to link consumers and producers closely and with considerable overlap – such that food security for a household is very closely linked to livelihood security – in the peri-urban vegetable production system of a large city consumers and producers are separated in urban and peri-urban worlds while at the same time being closely connected economically through the distribution system. This means that when food security is defined as a system outcome with reference to urban consumers it has very little overlap with the livelihood security of the most marginalised producers. Food security is defined as an outcome for urban consumers and often given priority over the livelihoods of producers. Third, macro and micro level analyses tend to capture agri-food systems situated in relatively slow changing

contexts in which structures are relatively stable. However, in the peri-urban context, the food system is influenced by multiple, large scale, rapid changes in economic conditions, land use, and demographics. This means that the food system exists in a constant state of change which makes measurement of static conditions less relevant while the key issues are 1) the 'shape' or distributive nature of outcomes and structures and 2) the direction and rate of change.

In order to form a conceptual framework for this case study, the definition of a food system outlined above and the conceptualisation of food security it gives rise to must be modified to fit within the peri-urban context of the case study. It must also take into account the specific characteristics of a vegetable production system and highlight the dynamic nature of the system and its context.

## 2.4 Conceptual framework

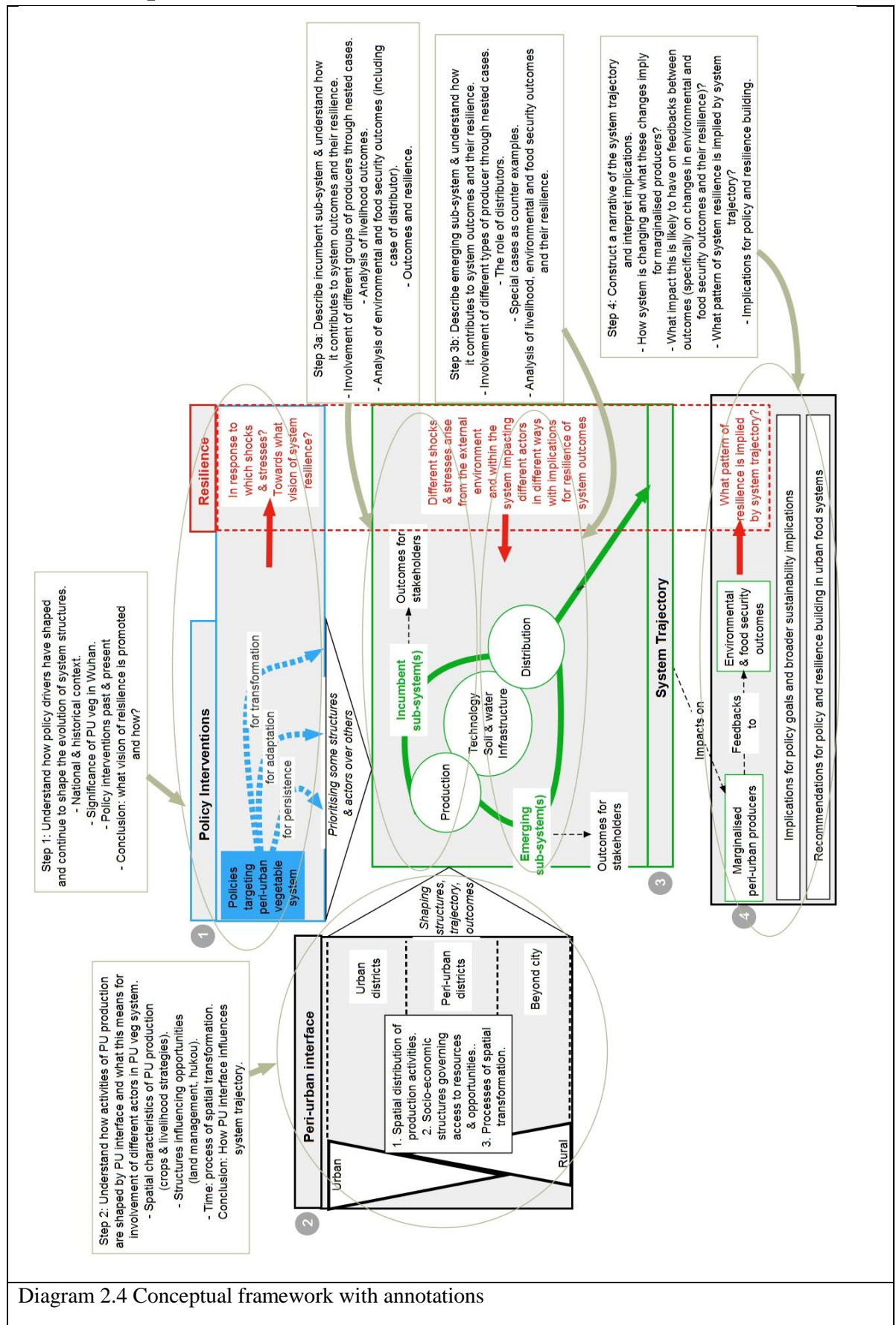


Diagram 2.4 Conceptual framework with annotations

### ***The four part conceptual framework***

The conceptual framework developed in this thesis draws together and builds upon insights from the three literatures discussed above in order to investigate the main research question stated in the previous chapter:

*What are the implications for peri-urban producers of government policies to promote food system resilience and what are the lessons for enhancing sustainability and resilience in urban food systems?*

In Wuhan, as in national policy, the peri-urban vegetable system has been a focus for urban agricultural policy for many years and has long been shaped by policies specifically designed to enhance various aspects of sustainability and resilience. Therefore, the conceptual framework begins with analysis of these policies and the vision of system resilience they represent (part [1] of diagram 2.4). This describes the way the system is framed and what types of system outcomes are valued in government policy. Policy interventions are designed to promote persistence, adaptation and transformation of the system in various ways by prioritising certain structures and actors in order to serve a particular vision of system-level resilience and in response to specific threats. Initial analysis of these policies provides a reference point against which the experience of their implementation and outcomes can be explored. Thus part 1 of the conceptual framework captures the importance of identifying the policy goals for system outcomes and the measures designed to try to achieve those goals. This part of the conceptual framework focuses not on the policy process or how these policies are designed but rather on the vision of system resilience represented by these policies and how this vision is sought to be implemented through different types of intervention.

These policy interventions unfold in the context of a system shaped by an evolving peri-urban interface. The second element of the conceptual framework is to see the food system as embedded within this dynamic peri-urban interface which shapes system structures, trajectory and outcomes in three important ways [2]. First, the peri-urban interface is understood as bringing the spatial characteristics of the system context to the forefront of the analysis. Production activities at different locations around the city operate within different conditions related to the land's relative proximity to the city, levels of access to different resources and even the way land is managed in that specific location. Second, the peri-urban interface highlights the role of overlapping urban and rural institutions in distributing access to resources and opportunities. Most significant of these are the way peri-urban land is managed and the role of the *hukou* system and the implications these have for how various actors are able to use agricultural land and realise the value of their assets. Third, the peri-urban interface is dynamic in that it is continually changing, particularly in terms of the process of spatial transformation as a result of urban development and expansion. Each of these features of the peri-urban interface

have different impacts on different groups of producers and their livelihoods and thus on the nature of their involvement in the peri-urban vegetable system.

The combination of policy measures and peri-urban context gives rise to a system trajectory which can be characterised with reference to incumbent and emerging sub-systems. The incumbent sub-system represents the established system of production and distribution while the emerging sub-system consists of a set of new actors and structures which have begun to play an increasingly important role in the peri-urban food system. These two sub-systems contribute differently to system outcomes yet also interact in ways which create feedbacks between these outcomes [3]. One important aspect of the diversity of outcomes is in the ways in which system outcomes are experienced differently by different stakeholders. The resilience of these outcomes can be analysed on the basis of system actors' experience of, and responses to, different shocks and stresses which may arise from the external environment and from within the system and which impact different actors in different ways. In light of the dynamics of the peri-urban interface and the influence of policy interventions the system trajectory is also characterised by ongoing processes of change involving different actors and system structures and which may be interpreted as being oriented towards persistence, adaptation or transformation respectively.

The resulting three part analysis of empirical evidence, drawn through the first three parts of the conceptual framework are then interpreted as a whole in order to construct a narrative of the system trajectory [4]. This narrative provides an account of the impacts of the system trajectory on marginalised peri-urban producers and the feedbacks to environmental and food security outcomes that this implies. These feedbacks are presented in terms of the direction of change in outcomes and their resilience that may be expected to result. This provides a picture of the emerging 'pattern' of system-level resilience for which the implications for broader normative issues of sustainability – including in particular social justice and environmental integrity – can be suggested. Reflection upon these issues then leads to discussion of recommendations for policy and implications for the conceptual issues around resilience building in urban food systems.

The four parts of the conceptual framework suggest four corresponding sub-level research questions:

*RQ 1. What vision of resilience are policies designed to achieve and how do they promote persistence, adaptation and transformation to these ends?*

*RQ 2. How do peri-urban dynamics shape the livelihoods of peri-urban producers and activities of vegetable production?*

*RQ 3. What are the characteristics of, and interactions between, the incumbent and emerging sub-systems in the peri-urban interface and how do they contribute to system outcomes and their resilience?*

*RQ 4. Within the context of the emerging system trajectory, what can be said about how resilience building policies impact the most marginalised peri-urban producers and what does this imply for feedbacks to other system outcomes and broader issues of sustainability and resilience in urban food systems?*

***How being a 'peri-urban' food system informs system bounding in part 2 of the framework***

The peri-urban vegetable system is understood as rooted in a dynamic context bounded in space which shapes the distribution of opportunities and constraints which result from a range of external drivers. It thus influences the evolution of system structures, the nature of outcomes for different actors and conditions the responses of those different actors to shocks and stresses to the system. In China's medium and large cities the peri-urban interface between urban and rural activities and institutions happens to be relatively clearly defined by the boundaries of 'agricultural' municipal districts which can be seen as 'peri-urban districts' in which urban and rural activities and institutional arrangements governing land-use and migration overlap and interact, shaping the influence of the broader processes of urban development and expansion. These districts are municipal in that they are part of the city's administrative hierarchy. However, they are characterised by overlapping rural and urban institutions and activities. These districts feature relatively large agricultural populations with agricultural production accounting for a significant share of the district economy while at the same time being the sites of large-scale infrastructure, industrial and high-density residential developments.

There is a range of agricultural activities which takes place within these peri-urban districts but vegetable production is the form of agriculture most likely to be on land closer to urban districts and linked most closely to urban markets. In the peri-urban vegetable system the activities of production are diverse yet spatially bounded within peri-urban districts under municipal administrative control while processing, distribution and consumption activities span the rural-urban continuum with urban markets forming the dominant food system structures.

Within urban and peri-urban districts agricultural land is cultivated for vegetables by a diversity of actors and in a variety of ways dependent upon the influence of three characteristics of the peri-urban interface. Firstly, spatial factors: the relative proximity to urban areas and the geographical and infrastructure features of particular areas influences the spatial distribution of different types of agriculture while also having implications for the value of real estate in terms of redevelopment for urban uses. Secondly, structural: the institutional structures of land management and the *hukou* system influence the distribution of opportunities and constraints experienced by different actors (in particular producers). Thirdly, temporal: the long term and large scale processes of spatial transformation associated with urbanisation and urban expansion influence the ongoing process of spatial transformation which interacts with the spatial and

structural aspects of the peri-urban interface to generate livelihood opportunities and threats for different actors respectively.

Thus, the second part of the conceptual framework [2] highlights the importance of identifying the large-scale processes of change which interact at the peri-urban interface and understanding the ways in which they shape the opportunities, constraints and threats experienced by food system actors. This then allows for an analysis of how these processes influence system structures and the trajectory of the system as these structures change in response to the dynamic context.

### ***How Ericksen's framework informs the analysis of sub-systems and outcomes in part 3 of the framework***

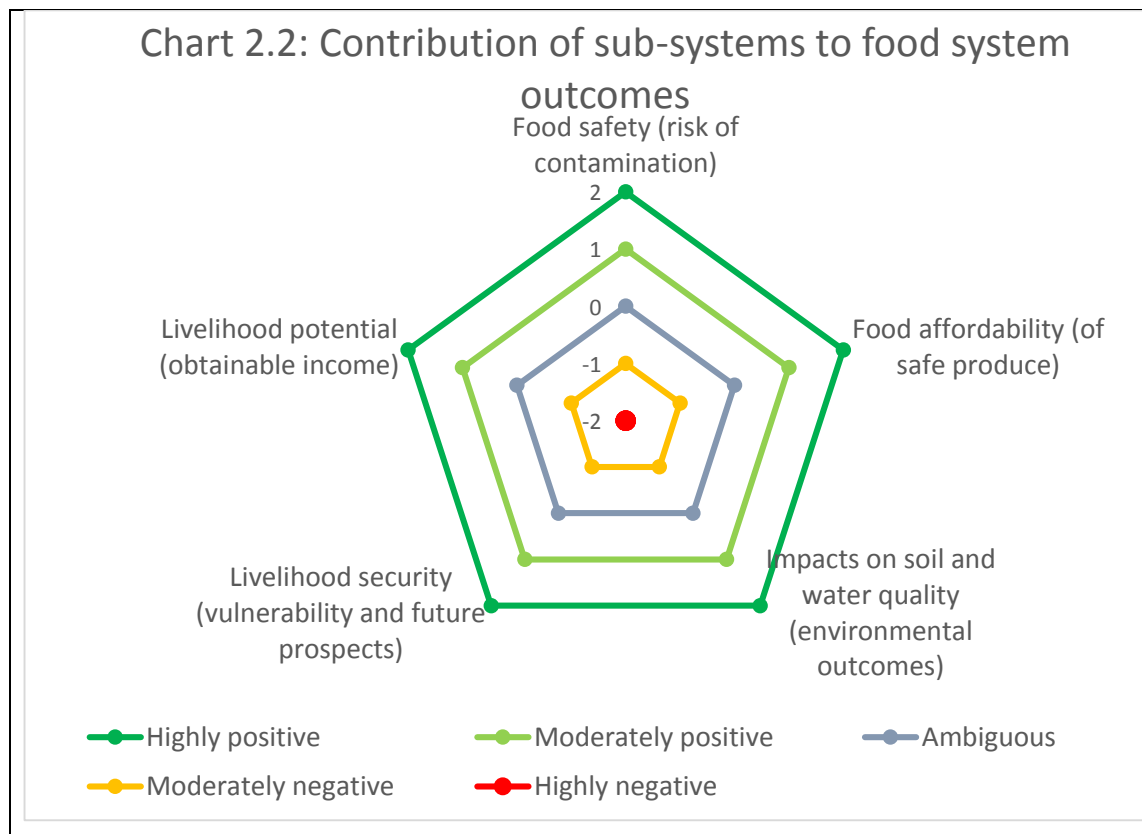
The conceptualisation of the peri-urban vegetable production sub-systems combines some of Ericksen's categories with those included in other definitions of socio-ecological and socio-technical systems. An agro-food system differs from a typical socio-ecological system in that it is a human dominated system in which ecological and technological elements are embedded within the socio-economic structures. Therefore, the model of a system employed in this framework places technology (including technical capabilities), ecosystems and infrastructure (agricultural and distributional) within the system as forming the shared structures of the peri-urban vegetable system. The activities of production and distribution are emphasised as the two key components of the system which each display a diversity of actors with a range of interactions with technology, ecosystems and infrastructure. Processing is not included because, in contrast to grain production, it is not a key aspect of peri-urban vegetable production which tends to focus on minimally processed fresh products. The activity of distribution is understood as including retail and is used to extrapolate the contribution of each sub-system to food security outcomes. The activity of production is analysed in order to explore in particular the experience of marginalised peri-urban producers and to assess how each sub-system contributes to livelihood and environmental outcomes. The environmental outcomes linked to each sub-system are analysed with particular emphasis on interactions between system actors and the ecosystems services upon which the whole system of peri-urban agriculture depends. These outcomes have implications for the long term viability of the system as a whole and also on the issues of food safety and thus highlights the feedbacks between the livelihood outcomes and environmental outcomes and the implications of these for the system resilience.

While Ericksen's framework focuses on food security as the most important 'development outcome' at the level of the system as a whole, I have sought to give greater emphasis to the social welfare and environmental outcomes and in particular to explore the contrasting outcomes valued by policy makers and the different groups of system actors respectively. By articulating the perspectives of particular groups of actors on specific system outcomes and



analysing how those diverse outcomes and their resilience are influenced by the system trajectory the framework opens a window on the implications of narrowly framed policy interventions for the system as a whole.

The selection of system outcomes is represented in the form of a radar diagram (chart 2.2) showing the outcomes produced by the two sub-systems. These outcomes also need to be understood in terms of which groups of actors experience them – i.e. to which stakeholders the outcomes are relevant. Next the contribution of each sub-system to each outcome is analysed to determine whether it is positive, negative or neutral (see chart 2.2 below) and is then compared between sub-systems in order to provide an indication of how each sub-system influences the distribution of costs and benefits throughout the system as a whole. In this way, system trajectory as demonstrated by the interaction between sub-systems can be linked to the changing impacts on system outcomes.



Having identified and analysed in this way the different sub-systems which represent the declining and emerging modes of production, the structures of the sub-systems which provide the source of resilience of the food security outcomes can be analysed. The resilience of outcomes can be understood as enhanced or undermined by particular system structures which are changing in response to the peri-urban context and interventions. The relationship between

resilience of specific outcomes and the system structures is revealed by how the shocks and stresses originating from the environmental and socio-economic conditions are responded to by different system actors and policy interventions and the effect these responses have on system structures. Pressures on system outcomes and their resilience also arise from the changes within the system structures such as the changing requirements of urban markets or the skill level of particular actors. These pressures can be understood as increasing or decreasing as the system proceeds along its trajectory. The effect of these pressures on outcomes can be seen through the livelihood decisions of different actors.

Because the peri-urban vegetable system is composed of a very diverse range of actors it is not practical within the scope of this thesis to try to identify every possible perspective on all aspects of food security and the whole range of social welfare and environmental outcomes. Therefore, it is necessary to select those outcomes which are most relevant to the particular case and aims of the research and for which it is possible to collect adequate data within the limitations of the time and manpower available.

There is a trade-off involved in deciding how to limit the range of outcomes included in the conceptual framework. Oversimplification can obscure the complex interplay of sub-systems while attempting to take into account every possible system outcome could lead to a long list of potentially marginally relevant data.

Through the initial pilot fieldwork, the most relevant selection of system outcomes were identified and defined according to the following criteria:

- a) That they are reflected in policy goals, albeit with a particular framing;
- b) That they can be linked alternatively to contrasting groups of actors so as to make comparison possible;
- c) That the groups of actors they relate to play key roles in the most significant sub-systems.

The aim is to make it possible to compare how the different sub-systems contribute differently to the policy goals for the transformation of the vegetable system, to reveal the implications for the most marginalised actors and to highlight the impact of the system trajectory on the equity of system outcomes.

The 'system-level' outcomes as framed by policy can thus be compared with the diverse range of system outcomes identified through analysis of the sub-systems. The way in which these outcomes are changing and their resilience is enhanced or undermined by the system trajectory can be revealed along with the role of policy interventions in shaping that trajectory. In particular, the outcomes experienced by the most marginalised actors and the implications for the other system outcomes can be examined so as to show what problems arise from a narrow

approach to the peri-urban vegetable system and to suggest how policy might be improved to take advantage of potential opportunities for generating greater synergy between system goals.

Analysis of the system structures and actors is designed to emphasise the diversity of actors and the dynamics within the system structures. It takes into account not simply the changes taking place in the system context but also explicitly addresses the changes taking place within the system structures. Rather than envisaging the food system as responding to external changes from a relatively stable state, the conceptual framework emphasises the system as having a trajectory which is shaped by the interplay of the dynamic peri-urban context and policy interventions. Thus the data collected needs to provide more than a snapshot of the current state of affairs but also to include elements of ‘looking backwards and forwards’ to reveal where the system has come from and where it might be going next.

In order to achieve this, the framework characterises this diversity and dynamism in terms of the presence of co-existing sub-systems which are linked through some shared structures but also exhibit important differences and contribute differently to different system outcomes. The system trajectory is the result of the combination of the dynamic peri-urban context and the changing system structures and is influenced by policy interventions which support particular actors, technologies and system structures through measures aimed variously at enhancing persistence and stimulating adaptation and transformation of the system. By analysing these sub-systems and their interactions a narrative of the system’s trajectory can be constructed and its impact on the quality and resilience of outcomes for different actors can be inferred.

### ***How resilience is understood within the conceptual framework***

The discussion of social-ecological resilience (section 2.1) examined the range of definitions of resilience relevant to food systems and developed a conceptual approach to resilience appropriate to the peri-urban context. In the conceptual framework (diagram 2.4) the term is used to indicate the maintenance of a specified set of outcomes in response to particular shocks and stresses. The distinction between resilient outcomes and the system structures upon which this resilience depends allows for analysis of the links between policies, the structural processes they promote and the specific vision of system-level resilience which those policies are aimed at achieving. For example, the persistence of some structures may be promoted in order to enhance resilience of some aspect of food security against the external shock of extreme weather.

Adaptation and transformation of other structures may be encouraged in response to economic stresses or to remedy weaknesses within the system. These structural processes can be analysed in terms of how they support or undermine the resilience of specific ‘system-level’ outcomes while at the same time revealing how those processes influence the outcomes for actors whose livelihoods are connected to them. This highlights the contrast between resilience of system-level outcomes (i.e. those outcomes defined as part of the policy goals) and the vulnerability of

the individuals or groups of stakeholders who make up the structures of the system.

In this way policies to promote resilience can be seen as having the effect of enhancing one or more of these processes of persistence, adaptation and transformation over others at various scales and in response to different shocks, stresses and in anticipation of future threats.

Therefore, keeping the distinction between responses to shock and stress in the foreground is helpful because it shows how different structural processes are linked to different aspects of resilience. It is also important to realise that a social-ecological system does not behave in any of these ways autonomously but because “present-day social-ecological systems are themselves the products of capitalist processes and social relations” (Nadasdy, 2007) these processes are inherently political.

Thus, adaptation and transformation can also be directed by policy to shift the system to what is perceived to be a more persistent structure to enhance the resilience of particular system outcomes while the resilience of others may be undermined. The trajectory of this system-level adaptation/transformation then has implications not only for the resilience of specified system functions but also for the vulnerability of marginalised groups which feeds back to environmental and food security outcomes.

This approach allows for the policy goal of building a ‘resilient system’ to be understood in terms of which system outcomes are valued and which are not. It prompts the question: the resilience of which specific outcomes for which groups of actors are identified as system-level goals? It also makes it possible to explore the relationships between those ‘system-level outcomes’ and actor-level interests without the problems of conflating system functions and structures. For example, the resilience of a system function (outcome) produced by a persistent system structure does not necessarily equate to the resilience (in terms of social security or lack of vulnerability) of the people existing within that structure and contributing to that function. A system structure may be persistent and support a resilient system function while the individuals forming that structure are highly vulnerable if they are easily replaceable. For example, one of the structures of a food system may be that farmers rent land to produce cheap vegetables close to the city. When bad weather hits or prices fall, some of these farmers lose everything and return home to face deeper poverty. However, providing there are enough other farmers willing to replace farmers who give up, then the structure remains persistent and the function of maintaining vegetable supplies continues and appears to be fairly resilient.

Further, the kind of system re-organisation implied by adaptation and transformation to enhance resilience often involves a great deal of disruption within the system structure. This will mean that the benefits and costs associated with the system functions will be distributed in new ways; a redistribution which is likely to be heavily influenced by the existing configuration of political and economic power. It may be expected that those groups already holding relatively

more economic and/or political power would be in the best position to benefit the most from the opportunities opened up while those with the least resources and influence would suffer disproportionately from the greater uncertainty and disruption associated with adaptation and transformation (see Nelson et al., 2007). Politics and power play a key role in the process of selecting which system functions are to be made more resilient, defining the system structures that are prioritised and specifying how they are to be preserved or changed in order to serve a particular vision for the system.

## Conclusion

Each part of the conceptual framework forms one step in the empirical analyses which are presented in sequence in chapters 4 to 8 through which each sub research question is answered in turn (see diagram 2.4 below). Step one (chapter 4) outlines an understanding of how policy drivers have shaped and continue to shape the evolution of system structures. It summarises the national and historical policy context; provides evidence of the significance of peri-urban vegetable production in Wuhan; discusses the development of and contemporary state of municipal policy interventions; and concludes by outlining the vision of resilience promoted by these policies and how they are oriented variously towards persistence, adaptation and transformation in relation to particular system actors and structures.

Step two (chapter 5) analyses the ways in which the characteristics of peri-urban production are shaped by peri-urban dynamics. Particular attention is given to the involvement of different system actors – specifically the roles played by migrant and local peasant farmers. It begins by outlining the spatial characteristics of peri-urban production in terms of how cropping patterns and associated livelihood strategies are distributed across the peri-urban interface. This is followed by an explanation of how the institutional structures at the peri-urban interface – land management and *hukou* system – influence the opportunities available to different actors and what this implies for the involvement of different producers. Next, the temporal dimension of the peri-urban interface is explored by examining the process of spatial transformation in terms of how this impacts different groups of producers and influences the characteristics of production in peri-urban areas. The implications of these peri-urban dynamics for the emerging system trajectory are then drawn out.

The analysis associated with step three of the conceptual framework is split between chapters 6 and 7 which discuss in turn the incumbent and emerging sub-systems. This step describes the sub-systems and analyses how they contribute differently to food system outcomes and their resilience. A series of nested case studies are presented along with analysis of some common themes which emerged from interviews with different food system actors.

Step 4 (chapter 8) builds on the conclusions drawn from the previous three steps in order to

construct a narrative of the system and its trajectory with particular emphasis on the impacts of the system trajectory on the livelihoods of marginalised peri-urban producers and the feedbacks this generates to other food system outcomes. The four parts of the conceptual framework enable an analysis of the system which, rather than assessing vulnerability or resilience as such, instead reveals the implications of promoting system resilience based on a narrow framing of system outcomes – in particular the implications for marginalised actors and the feedbacks that this produces for the system as a whole.

Before the empirical analysis is presented, chapter 3 outlines how this conceptual framework was made operational through an evolving research design and flexible fieldwork strategy and explains the methodological and theoretical assumptions which underpin the research.

## Chapter 3. Research Design & Fieldwork

The research design evolved and changed as the fieldwork progressed undergoing many permutations. As I discovered what sources and kinds of data were accessible and as gained deeper knowledge of the case itself, I adapted and redesigned my approach to the case and readjusted the conceptual framework in order to respond to my growing understanding of the system and its context. This flexible stance in the research design, grounded in the fieldwork itself, was necessary because of the purpose, approach and process of the research as an explanatory and exploratory investigation. This required a staged method of data collection and analysis through which knowledge of the case could be gradually built up. This chapter describes the purpose of the research, the approach to theory adopted and the research design which emerged (section 3.1). The use of methods and sampling is discussed in section 3.2 while section 3.3 describes how the conceptual framework was operationalised and 3.4 explains how the fieldwork was carried out.

### 3.1 Purpose, approach and process

#### *Purpose*

The purpose of this research is both explanatory and exploratory. On the one hand, to explain how the vegetable production system works, how it is changing and why, and on the other, to explore a number of conceptual issues on the basis of this explanation. The vegetable production system in Wuhan is used as a key case for this dual purpose. I am not seeking to measure or describe the impact of one or more variables on some phenomenon. Rather the intention is to study the system of vegetable production and distribution centred around a large Chinese city in a way which allows these key conceptual challenges to be explored in that empirical context. For this purpose, I have chosen a case study research design with a qualitative method of enquiry supported by some quantitative evidence.

The specific definition of the adopted case study design is from Thomas (2011): “Case studies are analyses of persons... policies, institutions or other systems which are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame – an object – within which the study is conducted and which the case illuminates and explicates.” (Thomas, 2011, p. 606). The goal is to build a picture of the whole in enough detail so as to be able to describe its particular characteristics as far as they illuminate the conceptual object of which the empirical case is an example. That object is the peri-urban vegetable system as a type of urban food system undergoing transformation.

## ***Approach***

In line with the conceptual framework developed in the previous chapter and the purpose outlined above, a methodological paradigm has been chosen which can best be described as ‘critical realist’. A ‘foundationalist ontology’ has been assumed in which the world is seen as being objectively real (Furlong and Marsh, 2010), acknowledging that this reality cannot be perfectly known from a ‘god’s eye view’. Rather, we all interact with the world, interpret and understand it in ways inevitably coloured by our own unique set of experiences and perceptions and limited by the capacity of the human mind and our analytical tools. However, I do not accept that this means that we cannot know or talk about reality in any meaningful way. Through critical engagement with the phenomena we seek to understand and through the back and forth of dialogue meaningful explanations and narratives of those phenomena can be constructed.

This philosophical stance leads me to place a high value on knowledge produced through abductive reasoning (see Shank, 2006) and to take a pragmatic approach to theory. Thomas (2011, p. 4120) notes “Abduction is making a judgment concerning the best explanation for the facts you are collecting,” and argues that the process of abduction:

“is a fluid understanding explicitly or tacitly recognising the complexity and frailty of the generalisations we can make about human interrelationships.

“They describe our processes of garnering and organising information to analyse and deal with our social worlds. Abduction connects all of these, providing heuristics – that is, ways to analyse complexity that may not provide watertight guarantees of success in providing for explanation or predication, but are unpretentious in their assumptions of fallibility and provisionality.

“All these forms of generalising to regularity – these kinds of abduction – seem to be the appropriate inferential form for the case study.” (Thomas, 2011, p. 4141).

My emphasis on abductive over inductive and deductive reasoning in the approach taken to the case study has implications for the nature of the theory which I am seeking to construct through the research as well as the criteria for assessing its validity. Inductive reasoning is designed to produce the type of theory that can be used to explain and predict phenomena within a certain range of conditions. However, the social world and in particular those parts of the world studied as social-ecological systems is inherently unpredictable. Through this research into the social-ecological system of peri-urban vegetable production I do not claim to develop theoretical generalizations or theory which can provide predictions but rather the kind of practical knowledge (often called *phronesis*) which will allow for a deeper understanding of the complexities involved in resilience building at the level of urban food systems and how social equity and environmental integrity can be enhanced.

*Phronesis* is an “Aristotelian notion... about practical knowledge, craft knowledge, with a twist of judgement squeezed in to the mix.” (Thomas, 2010, p. 578). It is a kind of ‘exemplary knowledge’ in which the case is presented not as a representative example or model but “a



particular representation given in context and understood in that context.” (p. 578). Thus the case study “offers an example from which one’s experience, one’s phronesis, enables one to gather insight or understand a problem.” (p. 578).

In this light, the validation of a case study is seen in the “connections and insights it offers between another’s experience and one’s own. The essence comes in understandability emerging from phronesis.” (Thomas, 2010, p. 579). The claim this thesis makes to an original contribution to knowledge is not that it adds a new piece of evidence in support or contradiction of a theoretical generalisation or that it offers a modification to a body of predictive theory. Rather, it is that it achieves a complex understanding of the particular case by presenting a narrative which combines the knowledge and perspectives of diverse stakeholders woven together with data and observations selected in part on the basis of my own experiential knowledge of the case itself. In that sense, the knowledge produced is an interpretation of a set of particularised understandings of diverse stakeholders guided by a framework explicitly designed to explore a particular set of conceptual issues around resilience and social justice. This thesis contributes to a growing body of empirical evidence on the peri-urban interface and urban food systems which as yet has only just begun to address the Chinese context. It develops an approach to researching that context and makes an original conceptual contribution to knowledge with reference to the theoretical approaches to building resilient peri-urban food systems in that it sheds light on the relations between system resilience and actor-level interests in the context of rapid change. The findings are not claimed to be generalizable but do offer greater insight into the issues which need to be addressed by policy-makers when attempting to promote the resilience of urban food systems in China while simultaneously seeking to address the social justice issues which are key to China’s goal of building a sustainable harmonious society.

This discussion is also important for the substance and claims of this thesis because it informs the way the field was entered, the choice of data and the way that data was gathered and analysed as well as the way it has been interpreted to construct a narrative of the case. The approach to fieldwork, data collection and analysis was to move progressively from an open ended simple overview of the case towards greater depth and breadth of investigation of its component parts. Beginning with informal and unstructured interviews which were analysed simply to build a general picture of the case the broad theoretical themes outlined in the conceptual framework were gradually operationalised and investigated as fieldwork progressed.

The aim is to construct an **explanatory** narrative and then to reflect upon that narrative in order to **explore** the implications of the system’s trajectory for marginalised peri-urban producers and the feedbacks this generates to environmental and food security outcomes. This is intended to shed light on the sustainability implications of policies aimed at steering the system towards a particular vision of system-level resilience.

## ***Process***

The subject of the case study is peri-urban vegetable production and its context in Wuhan – from producers to distributors and up to the policy makers and policies themselves – focusing on the period from 2007 to 2012. Through case study research this subject is investigated as an instance of an urban food system (the object). This provides the framework through which the processes operating within the system and its context are analysed in terms of their impact on the most marginalised peri-urban producers, the feedbacks to environmental and food security outcomes and the broader implications for the sustainability and resilience of the system as a whole.

A nested case study design has been adopted (Thomas, 2011, p. 3041) for the reasons that the case study object is understood as a complex system and the research question is about the connection between the actors within the system and the system as a whole. The principal unit is the peri-urban vegetable production system and the nested units are the actors within and acting on the system, such as farmers, traders and enterprises. The focus of data collection is then “How does the subunit connect with other subunits and the whole” (Thomas, 2011, p. 3041). Nested cases were selected on the basis that they provided insight into the incumbent and emerging sub-systems. A number of businesses and production bases were selected following the sampling procedure described in a later section below.

The system is also seen as embedded within the peri-urban context and shaped by policy interventions. For this reason, the case study design must include nested cases which provide a selection of different perspectives on the system from within (on behalf of the system actors) as well as data which presents the perspectives from the outside (on behalf of the policy makers and academic researchers). One particular aspect to these different perspectives is to illuminate the changes taking place within the system by having some nested cases representing the emerging sub-system(s) supported by policy and some representing the incumbent sub-system(s). These perspectives must also be understood as embedded within the broader context of the peri-urban interface which can be described with reference to the evidence of statistical data, satellite images and other documentary evidence.

As outlined in the conceptual framework there are four steps to the analysis. The next section explains how each analytical step is supported by data collection organised around broad themes in order to answer each sub research question. This is followed by discussion of how the fieldwork was organised in order to collect the relevant data and how this relates to the four analytical steps.

## 3.2 Method

### *Analytical steps and data collection*

The first step of the analysis relies on a small number of semi-structured expert interviews, policy documents and government statistics. The aim was to present a top down description of the system, a kind of ‘government’s eye view’, and to outline the policy goals and specific measures designed to promote those goals. This data also provides a snapshot of the system in aggregate and indicates the technical and agro-ecological features of the system as well as the infrastructure that links the activities of production and distribution to consumers. A small number of government officials were selected for interviews on the basis of their expert knowledge of the state of peri-urban vegetable production in Wuhan and the policies in place to develop it. Rather than investigate the process of policy making itself, the aim was to gain information about the policies and the measures themselves. For this reason it was not considered necessary to enlist a large number of interviewees at this stage. This data is presented and analysed in chapter 4 and provides an account of the envisaged trajectory of the system and the vision of resilience which this is intended to achieve. The typology of policies (promoting structural persistence, adaptation and transformation respectively) is used to summarise the policies and relate them to aspects of system resilience.

The second step makes use of a combination of government statistical data, satellite imagery and interviews with producers engaged in the system to explore the spatial, institutional and temporal characteristics of the peri-urban interface. These include the spatial distribution of production activities, the conditions of peri-urban agricultural land use and management, the effects of the *hukou* system and the process and impacts of urban expansion. The guiding theme of this data is to illuminate the impact of peri-urban dynamics on the livelihood opportunities and constraints experienced by different groups of producers.

The third step is where the nested case studies with peasant producers and larger scale commercial actors are developed through in depth interviews in order to investigate the ways in which each sub-system contribute to food system outcomes. Data is collected on the livelihood strategies, income levels and perception of quality and security of livelihoods of peasant producers; the characteristics of production, crop choice and target markets; the development and business strategies of commercial actors; the impact or and response to different challenges and disruptions from environmental and market shocks. This data provides an insight into the relative resilience of different outcomes and the structures and processes upon which their resilience depends.

The fourth step develops a holistic interpretation of the data and analysis presented in the previous steps, linking the findings from each together in order to construct an analysis of the system trajectory. This provides the basis for interpretation of the impacts of resilience building

policies on marginalised peri-urban producers and the implications this has for feedbacks between system outcomes. Concluding this analysis leads to an answer to the main research question through discussion of the lessons for enhancing sustainability and resilience of urban food systems in terms of both conceptual and practical policy contributions of the research.

### ***Four phases of fieldwork***

Fieldwork was conducted in four distinct phases. An initial explorative phase of fieldwork involved informal interviews with academics with research interests related to the case as well as brief site visits. This phase was conducted very early on in the research project before the conceptual framework had been fully developed and provided an initial simplistic overview of the significance, scale and state of peri-urban vegetable production, the challenges faced and the policy aims for the system (i.e. feeding in to step 1 of the analysis).

This initial phase of informal fieldwork set the agenda for the first investigative phase. This began with semi-structured interviews with key officials which covered the themes necessary to complete the first analytical step. This data, along with government statistics, reports and policy documents was analysed without complex coding as it presented a relatively straight forward overview of policy goals and measures and the changes these were intended to achieve. The first investigative phase continued with semi-structured interviews with distributors and production enterprises as well as pilot interviews with peri-urban producers. Site observations and satellite imagery also used to provide context to the interview data. These data were compared with data from the following two fieldwork phases and analysed together using the constant comparative method (see Thomas, 2011, p. 3357) in accordance with the themes highlighted by steps 2-4 of the conceptual framework.

Phase three (the second investigative phase) consisted entirely of extensive structured interviews with peri-urban producers which built upon the insights gained from the pilot interviews. After some initial data analysis this was followed by a final corroborative phase in which a series of brief site visits and informal mini-interviews with producers and academics served to strengthen the initial conclusions drawn from the body of data already collected.

The summary of themes addressed by each analytical step and their relation to the fieldwork strategy is shown in the table below.

<b>Table 3.1 Analytical steps and fieldwork phases</b>				
<b>Analytical steps</b>	<b>Step 1 – Policy interventions</b>	<b>Step 2 – Peri-urban dynamics</b>	<b>Step 3 – Sub-systems and outcomes</b>	<b>Step 4 – System trajectory and implications</b>
<b>Sub-level research questions &amp; themes</b>	<p><i>RQ 1. What vision of resilience are policies designed to achieve and how do they promote persistence, adaptation and transformation to these ends?</i></p> <p>National policy context</p> <p>Significance of peri-urban vegetable production in Wuhan</p> <p>Historical development of peri-urban &amp; role of municipal policy</p> <p>Resilience of which outcomes against which shocks and stresses are promoted?</p> <p>Persistence, adaptation and transformation of which system structures are promoted to achieve these goals?</p>	<p><i>RQ 2. How do peri-urban dynamics shape the livelihoods of peri-urban producers and activities of vegetable production?</i></p> <p>Spatial, structural and temporal characteristics of peri-urban interface</p> <p>Impact of peri-urban dynamics on opportunities and constraints experienced by different groups of peri-urban producers</p>	<p><i>RQ 3. What are the characteristics of, and interactions between, the incumbent and emerging sub-systems in the peri-urban interface and how do they contribute to system outcomes and their resilience?</i></p> <p>How do sub-systems contribute differently to food security, environmental and livelihood outcomes?</p> <p>What shocks and stresses are experienced by system actors and how do these impact outcomes?</p> <p>What does this imply about the resilience of these outcomes?</p> <p>What structures does the resilience of these outcomes depend on?</p>	<p><i>RQ 4. Within the context of the emerging system trajectory, what can be said about how resilience building policies impact the most marginalised peri-urban producers and what does this imply for feedbacks to other system outcomes and broader issues of sustainability and resilience in urban food systems?</i></p> <p>What does system trajectory imply for relative changes in these outcomes and their resilience?</p> <p>How does this compare with policy goals?</p> <p>What are the implications for promoting enhanced sustainability and resilience of urban food systems?</p>
<b>Main RQ:</b>	<p><i>What are the implications for peri-urban producers of policies to promote food system resilience and what are the lessons for enhancing sustainability and resilience in urban food systems?</i></p>			

Fieldwork phases in sequence showing how data types and sources fit analytical steps.				
<b>Explorative phase</b>	> Informal interviews with academics > Site visits			
<b>Investigative phase 1</b>	> Semi-structured interviews with officials. > Government statistics, reports & policy documents		> Statistical data > Satellite imagery > Informal pilot interviews with producers > Informal interviews with business people and other system actors > On-site observations	
<b>Investigative phase 2</b>			> Structured producer interviews	
<b>Corroborative phase</b>			> Brief on-site observations > In-formal mini interviews with producers > Informal interviews with academics	

### ***Interview sampling***

The interviews conducted throughout the fieldwork included a combination of unstructured, structured in-depth and semi-structured interviews conducted on the basis of purposive sampling. Sample size was not pre-determined but was guided by the notion of ‘data saturation’ which was assessed ‘in the field’ on the basis of continuing cursory analysis of interview data throughout the fieldwork process. This was supplemented by collection of secondary quantitative and qualitative data from Chinese language government policy documents, reports and government statistical data. Below I explain the rationale behind the sampling strategy and how it was put into practice in the course of the fieldwork.

Guest et al (2006, p. 60) note that, in much qualitative research when non-probabilistic sampling and in particular purposive sampling are used, the size of sample depends on the concept of ‘saturation’. In such circumstances when the research is focused on fieldwork and not seeking statistical generalizability, purposive sampling allows specific theoretical themes to be explored through a sample selected on the basis of predetermined criteria relevant to those themes (Guest et al., 2006, p. 61). Data saturation is reached when, for example, further interviews do not generate any further significant variability in the data at which point it is judged the sample size is large enough to provide good quality data on a particular phenomenon.

In reviewing the use of the concept of ‘saturation’, the authors conclude that, although widely used as a standard for determining sample size, it is often not clearly operationalised. The most

common recommendations are “that the size of purposive samples be established inductively and sampling continue until ‘theoretical saturation’ (often vaguely defined) occurs.” (Guest et al., 2006, p. 61).

Guest et al.’s own concept of ‘data saturation’ is intentionally distinguished from the more generally cited notion of ‘theoretical saturation’. This is because the latter concept, while originally defined by Glaser and Strauss (1967) as specifically related to the development of theory within the practice of grounded theory research, has gradually taken on a less useful and more vague definition (Guest et al., 2006, pp. 64–65). In contrast, Guest et al. (2006, p. 61) define ‘data saturation’ as “the point in data collection and analysis when new information produces little or no change to the codebook” (p. 65). The researcher needs to know “how many interviews [are] needed to get a reliable sense of thematic exhaustion and variability within [the] data set.” (p. 65).

The authors found that, in their own research, data saturation was reached at a sample size of 12, beyond which point further interviews and analysis did not yield significantly more codes than had already been generated. Although they acknowledge that it is hard to determine how generalizable their findings are they do draw on consensus theory (Romney et al., 1986) to support the conclusion that a small sample size can, under the right circumstances, produce very accurate and reliable data (Guest et al., 2006, p. 74).

They argue that what Romney et al. (1986) demonstrated in the context of ‘expert knowledge’ is also applicable to the realm of experiences and perceptions. Namely “that small samples can be quite sufficient in providing complete and accurate information within a particular cultural context, as long as the participants possess a certain degree of expertise about the domain of inquiry (‘cultural competence’)” (Guest et al., 2006, p. 75). The theory assumes the existence of an “external truth” – a real realm of experience – present in the subject of research which Guest et al. argue can also include the truth of shared common experiences or perceptions (p. 75). This is consistent with the critical realist methodological paradigm adopted in this thesis. It then follows that, providing 1) the participants can be considered to have ‘expert’ knowledge of the themes covered by interview questions, 2) these questions together relate to a “coherent domain of knowledge” and 3) that the participants are interviewed independently and with a consistent interview instrument then the sample size can be very small while still providing accurate data on a relatively homogenous group (Guest et al., 2006, p. 75).

In order to develop the purposive sampling strategy and the interview tools necessary to achieve a reasonable level of data saturation the investigative part of the fieldwork strategy involved two distinct phases followed by a carefully targeted selection of unstructured ‘corroboration’ interviews. The first phase consisted of initial interviews covering the whole range of system actors including government officials, business people, local and migrant

farmers. These interviews were semi-structured and the purpose was to gain an overview of the system, identify the main groups of ‘experts’ who would form the sample groups and start to develop the key themes which would form the basis for designing a structured interview tool. This interview tool was then used with producers during phase two in which a larger number of interviews were conducted across a wide selection of production sites. Following phase two a final phase of short corroborative interviews and site visits was carried out with producers in a number of other locations across the city as well as with three researchers in the field of urban agriculture in Wuhan. These interviews and visits were designed to reveal whether the data already obtained was reasonably representative of the case or whether there were any variations which had not shown up in previous interviews.

The explorative phase and the first investigative phase of fieldwork both employed snowball sampling to identify the first set of key interviewees. Because the aim was mainly to discover ‘the party line’ and the straightforward details of policy measures it was not considered necessary to obtain a representative sample of informants. The combination of a small number of interviews with those possessing expert knowledge and official policy documents was enough to produce good quality data at this stage. The snowball method was also used to identify those business people engaged in production and distribution activities across the system which represented the government’s intended goal for the future of the peri-urban vegetable system. It was not difficult to persuade government officials to provide introductions to those whom they considered to display the success of government policies. Pilot interviews with peri-urban producers themselves were harder to arrange but by trial and error a strategy was developed for identifying the appropriate locations and interviewees which is described later in this chapter.

### **3.3 Operationalising the conceptual framework**

A key task in operationalising the conceptual framework is to define how the three categories of food system outcome are to be defined, evaluated and interpreted within the analysis of the case as a whole. Ericksen’s framework suggests different aspects of food security which can be analysed as well as the significance of social and environmental outcomes. The ways these outcomes are expressed differs according to the particular characteristics of the food system being investigated. Thus the particular aspects of environmental, social and food security outcomes most relevant to the case were identified through the course of the fieldwork.

The peri-urban vegetable system as a social-ecological system embedded within the peri-urban interface of a large and rapidly developing Chinese city is quite different from a rural food system based on near-subsistence staple crop production or livestock grazing etc. Peri-urban vegetable production does not play a key role in ensuring availability of staple foods for example. Rather, as fieldwork progressed, it became clear that the main food security outcomes



of concern to the government and in the awareness of food system actors was the issue of food safety. Of secondary importance but relevant nevertheless was the issue of affordability as the labelling regime designed to guarantee quality and safety was necessarily linked to different pricing.

Through the course of the initial pilot interviews with producers it was obvious that the most relevant social welfare outcomes were related to the livelihoods of peri-urban farmers, in particular those of migrant vegetable producers who depended more heavily on vegetable cultivation than on any other source of income. Two issues related to livelihood outcomes were recognised as most significant for peri-urban farmers: 1) the potential level of income that could reasonably be expected under normal conditions (livelihood potential) and 2) the relative security of said livelihood in terms of what threats or opportunities were likely to influence the future prospects of maintaining that level of income (livelihood security). It was then through the nature of their involvement with the system as producers that the feedbacks between social welfare, environmental and food security outcomes became clearly visible. Although, the migrant farmers were the most disadvantaged and marginalised producers, they were not poor in the sense that their incomes put them below China's poverty line and neither did they depend upon social security payments for their living. Neither was the aim of my research to provide an assessment or explanation of their relative poverty. Nevertheless, a more holistic view of poverty such as is suggested by Chambers (Chambers, 2006) helps to highlight the range of experiences that form a web of poverty which in turn constrains and shapes people's actions. For example, development as good change from ill-being to wellbeing might consist of five changes from 1) powerlessness to freedom of choice and action, 2) bad social relations to good social relations, 3) material lack/poverty to enough for a good life, 4) physical weakness/illness to physical wellbeing and 5) insecurity to security; and each feeds into the others to form the whole experience of living and being.

The role of migrant farmers appeared to be most closely linked to the potential quality of livelihood obtainable as peri-urban vegetable producers. This was what largely determined their entry into the system and their continuing participation as producers despite challenges and disruptions. However, the level of security of those livelihoods also influenced their livelihood strategies and thus had feedbacks to environmental and food security outcomes. For these reasons the social welfare outcomes addressed in the case study were the twofold outcomes of livelihood potential and livelihood security of producers.

Finally, the environmental outcomes most relevant to the case study are the impacts on soil and water quality. These are most closely linked to peri-urban vegetable production in terms of how they support crop yields but also in terms of the impacts of agricultural techniques on degradation of these resources. Further, contamination of soils from both agricultural and

industrial sources of pollution can also lead to food safety risks and reduced yields so that the spatial distribution of agriculture in peri-urban areas is significant in determining how environmental outcomes feed back to food security and livelihood outcomes. For the purpose of this research the impact of production activities on degradation of soil and water resources was the focus of the system's environmental outcomes. Some consideration was also given to the impact of non-agricultural sources of pollution and the impacts on vegetable production through interviews. However, due to the various limitations (gaining official permission is extremely difficult and time and resource constraints were prohibitive) quantitative analysis of soil and water pollution was not carried out. For these reasons, the emphasis in this research was on the types of agricultural practices which are known to impact soil and water quality and food safety as these were within farmers' knowledge whereas information on possible contamination from industrial sources was unavailable.

The following table explains how each outcome is assessed and scored. It also includes a column for 'stakeholders' in which the particular group which is affected by that outcome is identified. This table then forms the framework for analysing the sub-systems of vegetable production in terms of their respective contribution to the different outcomes and the various stakeholders who benefit (or suffer) from those outcomes.

<b>Table 3.2 Evaluation of outcomes for different stakeholders</b>			
<b>Outcome</b>	<b>Evaluation</b>	<b>Scoring</b>	<b>Stakeholders</b>
<b>Safety</b>	The relative attention paid to the quality of produce and controls on pesticide use, cleaning and packaging	Scoring from +2 to -2 the sub-system has a highly or moderately positive, ambiguous, moderately or highly negative contribution to the outcome	Which system actors or stakeholders are affected by this outcome?
<b>Affordability</b>	Relative affordability: Is produce sold through wet markets or supermarkets, value added through extra processing and packaging? As 'green', 'organic' or 'conventional' vegetables?		
<b>Soil &amp; water quality</b>	Is production extractive or conservative of soil and water resources? Does it reduce pollution of surface waters and degradation of soil fertility?		
<b>Livelihood potential</b>	Is the livelihood for producers in the sub-system economically viable? Can it support households long term? Can it have an appreciable positive effect on their quality of life?		
<b>Livelihood security</b>	Is the livelihood vulnerable to bad weather, economic uncertainties or other threats? If the livelihood is lost is there compensation and are there ready alternatives?		

Livelihood outcomes were assessed by analysing peri-urban producers' perception of the quality and security of their livelihoods and their reporting of changes in income and production costs over the past 5 years. The livelihood potential enabled by the sub-system consists of the income provided by vegetable production and the ability to convert that income into a higher quality of life for the farming household. This is the central feature of the economic benefit obtained by the producers and distributors who depend upon the vegetable production system for their livelihood. The difference in potential for generating a successful and satisfactory livelihood from different activities (rice, fish or vegetable farming for example) depends upon the economics these activities. Insight into the relative potential for vegetable production to provide a satisfactory livelihood for farmers can be gained by asking why they grow what they do, what income they obtain from vegetable production, what proportion of their household income it provides, whether their livelihood is improving etc.

Livelihood security is also important and is determined by the relative sensitivity of the livelihood to environmental and economic shocks, access to resources and assistance to cope with such shocks and also the longer term likelihood of the loss of livelihood. Asking farmers about these shocks and how they cope, and their view of past and future helps to reveal the relative security of their livelihoods as part of the vegetable production system.

Environmental outcomes were assessed on the basis of the characteristics of production (in terms of farmers' use of soil and water resources, cropping practices and use of agro-chemicals) and farmers' own reports on the changing quality of soil and water resources. This was compared with expert opinions of academic researchers familiar with the situation in Wuhan. Food security outcomes were assessed according to the quality controls present at the stages of both production and distribution and the implications of these for relative levels of food safety offered by various products of the different sub-systems. Affordability was also inferred through type of product and target markets each sub-system was intended to reach. Environmental outcomes are linked to food security outcomes because the degradation of soils and pollution of water resources leads to a higher dependency on chemical fertilisers, pesticides and fungicides as biodiversity and soil quality decline and pests and diseases increase. This has feedbacks on the quality and safety of produce. At this stage other environmental factors also contribute to food security risks such as the proximity of polluting industries and urban infrastructure projects which may contribute to air, soil and water pollution and so these issues were also explored through interviews with producers.

### 3.4 Implementing the fieldwork strategy

#### *Explorative phase and research team development*

The explorative phase of fieldwork involved two visits to the city – the first during the first year of the PhD while the literature review and initial research design were being written and the second during the following period of language study. During these trips some site visits were made and informal interviews with two experts on Wuhan's urban agriculture were conducted. This helped to set the boundaries for the case and begin the work of designing a fieldwork strategy.

Preparation for the investigative phases of fieldwork included 10 months in Beijing in full time language study to gain proficiency in Mandarin. At the same time I was able to familiarise myself with Chinese culture and the politico-economic system. Moving from Beijing to Wuhan in the summer of 2011 I started getting to know the city better and met Professor Ding who would host me there at the Zhong Nan University of Economics and Law (中南财经政法大学).

Once in Wuhan, it became clear that the first task was to build relationships and organise a small research team. The data I wanted to discover would not be obtained by adopting a typical 'western' style of qualitative research. Simply visiting officials and farmers with questionnaires or doing recorded formal interviews would be likely to produce a very low quality of data due to people's inherent wariness and lack of trust when presented with 'official' or 'academic' investigations. Rather, the data would be revealed through relatively informal interviews and conversations and through building relationships of trust over time with those people who would be likely to hold the knowledge I wanted to gain or able to provide introductions to those who did. Further, the highly contextual and often indirect nature of communication meant that if I was to rely on my own interpretation of conversations and interviews alone, I would be likely to misunderstand the layers of meaning and miss relevant points. Therefore, I needed a way to gain relevant contacts and a small research team of Mandarin native speakers who were familiar enough with the domain of knowledge covered by my research to act as 'cultural interpreters'.

With the help of Professor Ding I recruited a research team who were able to help me negotiate the complexities of unfamiliar social interactions and gain a deep and accurate understanding of what my interviewees were saying. This research team consisted of a number of students studying for a Master's degree in agricultural extension at the University. The research team was as follows:

Table 3.3 List of research assistants.	
Name	Master's subject
<i>Core team of interviewers</i>	
Xiang Sen Lin 向森林	Agricultural extension
Pan Zhi Xiang 潘志翔	Agricultural extension
Du Qin 杜钦	Agricultural and rural development
<i>Additional interviewers who assisted occasionally</i>	
Liang Wei 梁伟	Other
Liu Tian 刘甜	Other
An Cai Mei 安彩玫	Other
Ye Lee 叶丽	Other

All interviews were conducted in Mandarin. The main reason was to avoid the inherent problems of interpretation into English which unavoidably leads to the degrading of data through the incredibly difficult process of simultaneous translation. Written notes of interviews were used rather than audio recordings so as not to bias interviewees' responses. Throughout the fieldwork interviews were carried out with the research team members and written up by them into Mandarin as electronic documents. Conversations with them about what we were learning through the fieldwork helped to inform and clarify my own observations written up in a fieldwork diary and photographs recorded physical conditions and served as memory triggers when analysing the interview data and fieldwork diary. Initial analysis and discussion of the interview data was conducted by me and the research team in Mandarin as fieldwork progressed. Final translation into English was only done once all interviews had been completed and field notes written up and it was done by me simultaneously with data coding. This meant that the quality of data was preserved as much as possible.

### ***Investigative phase 1***

This first formal phase of fieldwork began with a snowball sampling strategy to obtain interviews with government officials and business people involved in production and distribution/retail activities. Initial contacts were obtained through Prof Ding and a locally based foreign diplomat. Three government officials were interviewed at the Wuhan Agriculture Bureau Markets Department (武汉市农业局市场处), the Hubei Provincial Department of Agriculture Vegetable Office (湖北省农业厅蔬菜办) and at the Wuhan Vegetable Technology Service Centre (武汉蔬菜技术服务总站). A series of interviews with business people followed as my list of contacts grew. Through developing these contacts and through serendipitous exploration I conducted interviews with 11 business people representing a range of larger scale commercial actors. These are listed below.

<b>Table 3.4 List of enterprises selected for interviews</b>	
<b>Food system activity</b>	<b>Enterprise</b>
<b>Production</b>	<ul style="list-style-type: none"> <li>• National level leading enterprise;</li> <li>• District level leading enterprise;</li> <li>• Largest farmers' co-operative in Wuhan specialising in vegetable production (强鑫蔬菜专业合作社);</li> <li>• Small farmers' co-operative linked to a Wuhan distributor (紫金蔬菜专业合作社);</li> <li>• Vegetable association farm (汉南区邓南镇窑头村蔬菜协会);</li> <li>• Government run organic farm (金水国营农场梨园大队);</li> <li>• Private organic farm.</li> </ul>
<b>Distribution</b>	<ul style="list-style-type: none"> <li>• Supermarket vegetable buyer for Wushang (武商量贩) – one of the largest supermarket chains in Wuhan;</li> <li>• Wholesale market trader;</li> <li>• Medium scale vegetable distributor (武汉奥发后勤服务公司);</li> <li>• Large scale vegetable distributor with linked production base.</li> </ul>

Part of the reason for starting by interviewing government officials and business people was that I had expected them to be able to help me locate one or two suitable peri-urban vegetable producing villages in which I could lodge for a number of weeks in order to conduct interviews with peasant farmers. My assumption was that, without first building relationships of trust, the farmers would be unwilling to talk to me at all let alone be interviewed. Consequently, due to time limitations I expected to be able to do at most two sets of interviews with farmers, one group in each of two villages. Access to migrant farmers then would come through the large scale producers or introductions from local farmers. In the event, most of this plan was neither possible nor practical and an entirely different strategy emerged as it was impossible to cross the first hurdle and get introductions from government officials to local farmers and production bases. Rather, a much more straightforward and far more efficient and exciting path opened up as I responded to the set-backs. Thus the first investigative phase opened up the possibility of a second more extensive phase of fieldwork. The strategy and interview tools for the second investigative phase were developed and piloted during this first investigative phase.

While searching for the location of one of the production enterprises I was due to visit I noticed that satellite imagery of the area showed a range of quite distinctive patterns of fields and buildings. During the visit I explored the area and compared my observations on the ground with what I had seen on satellite imagery. I realised it was possible to use satellite imagery to

distinguish easily between vegetable fields used for intensive vegetable cultivation and grain or cotton fields through the shapes and colours of those fields. Vegetable fields were characterised by long narrow strips with mixtures of green, brown and white (see image 3.1 below). Because vegetable cultivation typically involves mixed and staggered planting the different stages of the cropping cycle can be seen alongside each other as green ripe strips sit adjacent to bare fields and young crops covered by plastic or polytunnels. By contrast, grain and cotton fields showed up on satellite imagery as larger rectangles of single blocks of colour as entire crops were at one stage of growth. Household vegetable gardens which tend to be mainly for home consumption rather than intensive production can also be distinguished from other vegetable fields because they are typically adjacent to village houses and divided into much smaller strips.



Based on these observations I was able to examine satellite imagery from across Wuhan to identify the main areas of intensive vegetable cultivation. I then drove with my research team to one such area to find out how practical it would be to arrive unannounced and conduct interviews with farmers there. It turned out to be very straightforward to interview peasant farmers in this way. The lack of any sense of 'official-ness' – ensured by bypassing any local government structures and by simply turning up – helped to put farmers at ease and they were happy to sit and talk for an hour or so. During this visit we made several unplanned visits all of which were successful in generating interviews.



Through these initial interviews with peasant farmers it became clear that the presence of single storey housing spread along the edges of vegetable fields was a reliable indicator that this was an area in which the majority of vegetable producers were migrant farmers. Local farmers lived in villages which appeared on satellite imagery as clusters of larger multi-storey houses alongside roads. Migrant farmers on the other hand, as tenant farmers, could only build housing in the form of single storey (pingfang, 平房) buildings on the edges of the land they rented (see image 3.1 above). The contrast can be seen in the series of photographs and images below.



Image 3.2: Photograph of migrant housing visible in opposite image.



Image 3.3: Migrant housing lining vegetable fields with polytunnels visible on the left. (2010-10-17)



Image 3.4: Photograph of locals' housing visible in opposite image.



Image 3.5: Locals' houses clustered alongside the main road. (2010-10-17)

This second observation led to further analysis of historical satellite imagery using Google earth to identify the process of urban expansion and its impact on the activity of vegetable production which forms a large part of chapter 5 and turned out to be an important source of data to complement the interview data.

The pattern of finding a location on satellite imagery and turning up to interview farmers at the field-side over a few days in each site became the model for the more extensive second investigative phase of fieldwork. This strategy meant that I did not have to rely on official



introductions and I was able to avoid the risk of having a biased sample of interviewees or of interviewees' responses being influenced by any fear of interference if they expressed negative opinions. The result was that I could secure a much higher level of reliability in the evidence than if I had gone through the traditional channels used by many foreign researchers who often work in larger research teams in co-operation with local officials and local researchers.

In this manner 19 interviews were conducted with peasant farmers in a number of locations including migrant and local peasant vegetable producers, a field-side trader and a village vegetable broker. Interviews in Jiayu town, just beyond the border of Wuhan provided a counter example to the peri-urban vegetable producers. Although these are not discussed in the data analysis, they helped to confirm the assumption that production activities within Wuhan's peri-urban districts were conducted under conditions specific to their location with Wuhan's administrative borders while other vegetable production outside Wuhan was linked most closely to the local small town centre which held administrative control over those areas.

<b>Table 3.5 List of farmers interviewed in first investigative phase of fieldwork</b>			
<b>District</b>	<b>Migrant</b>	<b>Local</b>	<b>Outside Wuhan</b>
<b>Jiangxia</b>	JX-01, 08	JX-02 to 04, H-09 (vegetable broker), T-01 (field-side trader)	
<b>Dongxihu</b>	DX-01 to 03, 08, 09	DX-10, 11	
<b>Hannan</b>		HN-01	
<b>Jiayu (town outside Wuhan)</b>			JY-01 to 04

The interviews were loosely structured and gave me the opportunity to identify some of the key themes which were relevant to the case study and to test what kinds of data farmers were willing and able to share. This led to the development of a structured interview tool for the next phase of fieldwork.

### ***Investigative phase 2***

In order to cover the range of local contexts I selected the following five districts for the bulk of the structured interviews: Dongxihu, Jiangxia, Xinzhou and Huangpi as well as a special chemical industrial district sandwiched between Hongshan, Qingshan and the river which showed evidence of a large area of vegetable production on satellite imagery. In total a further 42 interviews were conducted in the second phase of investigative fieldwork.

<b>Table 3.6 List of farmers interviewed in second investigative phase of fieldwork</b>			
<b>District</b>	<b>Migrant</b>	<b>Local</b>	<b>Outside Wuhan</b>
<b>Dongxihu</b>	DX-05 to 07, 12 to 16, 18, 19, 22	DX-04, 17, 20, 21	
<b>Gongye (Honghsan/Qingshan)</b>	GY-01 to 10	Agricultural inputs shop manager.	
<b>Huangpi</b>	HP-01 to 04		
<b>Jiangxia</b>		JX-05 to 07, 09	
<b>Xinzhou</b>		XZ-01 to 05	
<b>Jiayu (town outside Wuhan)</b>			JY-05 to 07

Interviews were conducted by members of the research team and supervised by me. They used the structured interview tool which they completed with the responses given by interviewees and then typed up the interviews the same day.

The interview tool was divided into 5 broad areas:

**A. Introductory/background information** including the following topics:

- 1) Area (description of local agriculture and population);
- 2) Personal (name, gender, age, *hukou* status, phone number);
- 3) Family circumstances (family members, ages, work, residence, who farms, if non-local what is origin and story of coming to present location);
- 4) Type of agricultural enterprise and number of years engaged in it (household, co-operative, led by private company, large scale family run, commercialised);

**B. Production and sales:**

- 5) Land (area, usage and land quality, advantages, disadvantages);
- 6) Crop choice and reasons;
- 7) Future aspirations for cultivation and reasons;
- 8) Cultivation practices – crop, broad class (staple, fast growing etc), quality (organic, green, non-polluting, conventional, pesticide use, fertiliser use), polytunnels use, cropping cycle, revenue, costs, sales channels, prices;

**C. Livelihood:**

- 9) Household income (sources of income, estimate household income for past 5 years, how well income supports quality of life, profits from vegetable production, profits from other agricultural activities, income from other household members, house ownership, debt or savings

with reasons why);

#### **D. Difficulties and disasters:**

10) Recurring problems: Economic challenges, common weather problems, environmental changes – which have most important impact on income and livelihood, what impact do they have, how are they responded to, what support is provided, how could support or response be improved;

11) What are the most important issues out of above mentioned;

12) Extreme events: how recent extreme events have impacted livelihoods (snow/ice disaster, flooding, drought etc) – how responded to, what support offered, how could support or response be improved;

13) Future fears;

14) Future needs and hopes for improvement of quality of life for vegetable producers;

#### **E. Support and opportunities:**

15) Learning – how skills were obtained, what further assistance would benefit;

16) What support and opportunities would improve quality of life, what role should farmers and government play?

The interview tools were designed and used in Chinese. The responses of interviewees were recorded handwritten by the research assistants who then typed up these responses within electronic versions of the interview tool. I then translated these into English and coded them into the following themes along with the producer interviews from the first investigative phase:

Area, Personal, Income, Savings/debt, Story, Veg-experience, Land, Crop choice, Future, Inputs, Polytunnels, Sales, Cultivation practices for individual crops, Market Issues, Environmental Issues, Government Assistance, Needs, Other.

Next the coded interviews were imported into NVIVO to enable me to view the data in different ways. Further coding was done in order to compare the characteristics of each household interviewed so that some simple quantitative results could be generated. The qualitative data was analysed alongside the quantitative results, fieldwork diary and photographs to write up detailed case studies of each location. These case studies were then written up into shorter cases while the common themes linking back to the conceptual framework were analysed and written up in order to provide a detailed analysis of the sub-systems. Data from the interviews were also used to support the analysis of policy drivers and the peri-urban interface.

#### ***Corroborative phase***

Once the majority of vegetable bases had been visited and it became clear that relatively little

variation in data was being produced by further detailed interviews I decided to conduct a series of mini-interviews in those sites not yet visited in Caidian, Hongshan and some of the central districts to provide comparisons with the findings from other areas. This data was recorded in the fieldwork diary.

In addition, I interviewed three academics with expertise in relevant policy areas and discussed my findings with them in order to test whether my own interpretations of the data made sense from their perspective. These interviews were written up in electronic documents and contributed to the overall analysis of the rest of the data.

### ***Ethical issues***

Although the general topic of this research is neither commercially nor politically sensitive, there were particular issues which were responded to carefully based on the advice of the host Professor and research team members. These were the danger of bias and self-censorship and the need to preserve the anonymity of certain participants.

All interviews were conducted with the explicit consent of participants and photographs were only taken after verbal permission was given. Participating farmers were first informed verbally of the purpose of the study and how the information they provided would be used. Then if they wanted further information they were offered an information sheet (see appendix 1). Relying on verbal explanation of the research backed up by an optional information sheet was more appropriate than giving out information sheets by default. Although the content of the interviews was in no way sensitive, farmers were worried that we might be developers or government representatives come to discuss developing the land. They were often suspicious until we explained we were students doing research. It was important to avoid the appearance of having any links to the government or business. Handing out long complicated information sheets to every interviewee would not have helped to lower these suspicions.

Most participants (especially farmers) were unwilling to sign forms but happy to give verbal consent to be interviewed and for the information they provided to be used for the purpose of writing research papers. Thus it was not practical to have consent forms signed directly by the farmers themselves. Instead before each interview began I and one of my research assistants confirmed that they had given verbal consent. Government officials who participated were given information sheets.

Farmers' names and phone numbers were recorded with their consent in case there arose a need to contact them again for follow up interviews. Locations were also recorded down to the village level and are indicated in diagrams and satellite imagery in the thesis. Identification of individual farmers would not be possible from this data because each location contained many households. Interviews were assigned identification codes using the initials of the village names and the date of the interview. The farmers' names were stored with these codes in an Excel file

but were not included in any of the writing up. When referenced, each interview is labelled according to district initials and the numerical order in which the interviews were conducted (e.g. DX-03). In this way there is no danger of farmers being identified from the information revealed in this thesis.

Government officials are not identified by name but as ‘XX department director’ – ‘director’ being a generic title for officials of a particular rank. Business people were not concerned about anonymity and the topics of the interviews carried out with them could not be considered particularly sensitive apart from one case in which the identity of the company is withheld. Anonymity for farmers interviewed was considered important, especially for migrant farmers, because their opinions were often critical of local government. In order for farmers to speak freely they had to be assured that they would not be identifiable and that those interviewing them did not have links to local government.

No financial inducements were given for any of the interviews but simple gifts of water and cigarettes were offered to encourage friendly interaction as is appropriate to the cultural context.

## **Conclusion**

This chapter has set out the research design and methods used for the case study and explained how these were piloted and adjusted as the fieldwork unfolded. The key themes emerging from the fieldwork have been outlined and the stage has been set for the analysis which follows in the next four chapters. This analysis follows the sequence set by the conceptual framework and progressively builds up a narrative of the peri-urban vegetable system, its trajectory and outcomes and the implications of these changes for the sustainability goals of social justice and environmental integrity.

## Chapter 4. Step 1 – Policy interventions and the system in outline

***RQ 1. What vision of resilience are policies designed to achieve and how do they promote persistence, adaptation and transformation to these ends?***

*National policy context*

*Significance of peri-urban vegetable production in Wuhan*

*Historical development of peri-urban & role of municipal policy*

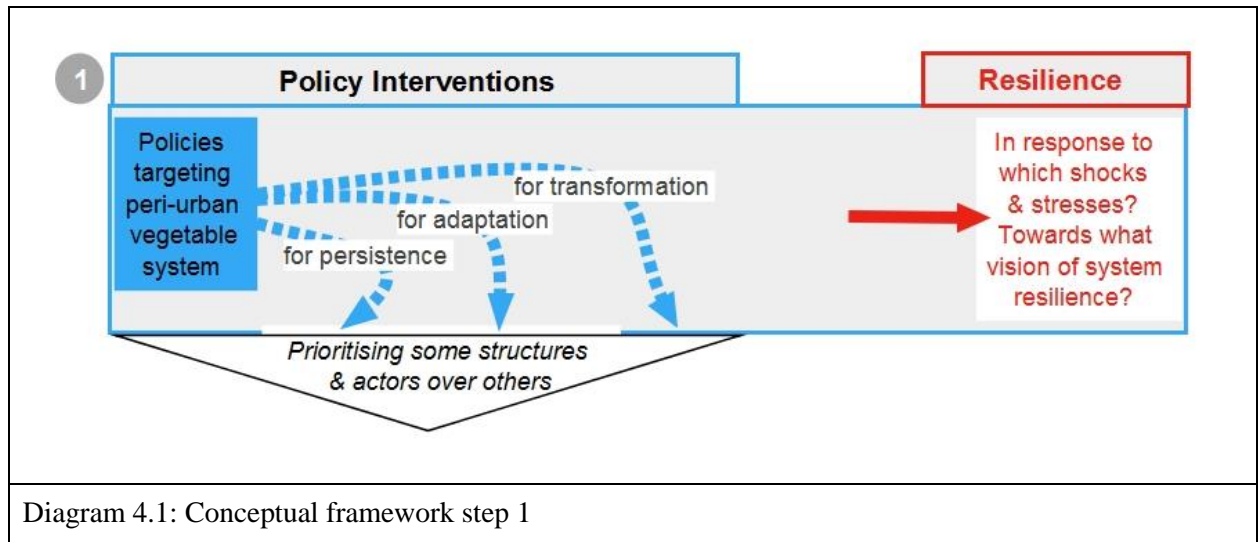
*Resilience of which outcomes against which shocks and stresses are promoted?*

*Persistence, adaptation and transformation of which system structures are promoted to achieve these goals?*

### ***Introduction***

The city government's stated priority for urban agriculture is to increase vegetable production to supply the city and to improve the city's competitiveness with other cities by building nationally known brands of vegetables for both national and international export (Wang, 2010). This is in the context of national policy having begun to explicitly recognise and support a form of peri-urban development associated with rapid urbanisation and large scale capital spending (Webster, 2002, p. 10). At the same time a strong commercial vegetable sector in China is emerging, closely linked to urban centres of domestic consumption but also increasingly developing links to global export markets. These trends have started to transform systems of rural and urban agriculture across China (Gu, 2009).

This chapter begins the analysis of Wuhan's peri-urban vegetable system by exploring the policy drivers which have shaped and influenced the evolution of system structures. It takes as its starting point the national and historical context of policy relevant to vegetable production and peri-urban agriculture in China. This sets the scene for understanding the significance of peri-urban vegetable production in Wuhan, its development over time and the role of municipal policies in shaping the system. Specific policies and policy goals are analysed to construct a picture of how policy makers understand the system which identifies how policies are aimed at promoting the persistence, adaptation and transformation of various system structures and which actors and technologies are envisaged as the means of achieving this. The aim of this chapter is to present a top down view of the system in that it explores the system through the lens of government policy and aggregate data from government sources – in short it presents a snapshot of the peri-urban vegetable system in aggregate.



## 4.1 National vegetable industry policy

The development of the vegetable industry in China has been influenced most heavily by the long running “Vegetable Basket Programme” which was introduced in 1988. Since that time the Chinese central government has tried to continually expand and modernise vegetable production and distribution.

Gu (2009) identifies three stages of policy led development of China's vegetable sector. In the first stage of the programme from 1988 to the mid-1990s the aim was to increase supply to keep up with growing urban populations, especially in large cities, by improving distribution networks centred on large urban areas (Gu, 2009). This programme began a shift among many farmers from grain production to vegetable production as well as other commercial crops such as fruit, oil, sugar and tobacco. This involved converting land previously used for cereal production into vegetable and other commercial crop production bases requiring different facilities, techniques and technologies and bringing new pressures on soil and water resources.

This change in land use continued through the second stage of the programme supported by developments in research, superior varieties, new technologies such as polytunnels, and establishing a nationwide distribution network. This stage also went beyond stage 1, which focused on large cities, by covering smaller cities and towns. One of the goals emphasised in stage 2 of the “Vegetable Basket” programme was to address the issue of rural incomes lagging behind urban incomes by promoting production of commercial crops instead of cereals in areas close to urban areas supported by the extension of distribution networks (Gu, 2009).

Stage 3 began in 2002 with a speech by Premier Wen Jiabao to the annual National Working Meeting on the “Vegetable Basket Programme” (Gu, 2009; Wen, 2002) followed by circulation of a State Council ‘Requisition on Advancing the Vegetable Basket Project’ (Gu, 2009, p. 507; citation of SC, 2002). This stage brought a greater emphasis on food safety and quality as well

as continuing development of distribution networks and production bases. More recently, in 2012, the China Ministry of Agriculture published its 'China National Vegetable Industry Development Plan 2011-2020' [全国蔬菜产业发展规划2011-2020] (CMA, 2012) which outlines goals for development of the vegetable industry across China, in specific regions, and in medium and large cities.

The plan requires China's 36 large-mid sized cities, including Wuhan, to enhance year round supply of vegetables and guarantee supply in emergencies by intensifying peri-urban vegetable production, especially for perishable vegetables such as leafy greens, and opening up new vegetable production bases in areas further out from the city. The significance of this can only be seen after one has understood the administrative and spatial structure of cities in China.

China's "city administering county" system of urban/peri-urban governance has been part of China's spatial restructuring strategy since the 1950s. This arrangement put a city's neighbouring counties under the control of the city so that the city began governing a large area of the surrounding rural land including a network of smaller towns and villages. The counties surrounding an urban centre were thus converted into city districts to be governed under the city government (Ma, 2005, p. 486).

Originally it was intended to increase the stability of supply of vegetables etc. to the urban population of China's largest cities. The policy was progressively expanded to encourage urban led development and more integration between urban and rural areas (Ma, 2005, p. 487). By 1999, of the cities at and above prefecture level, 97% were governing subordinate counties forming city-centred regions (Liu et al., 2002, p. 243; cited in Ma, 2005, p. 487).

A prefecture level city is one administrative level below the provincial level. Most of the capital cities of provinces are prefecture level cities with a few exceptions (for example of Beijing, Shanghai, Chongqing and Tianjin which are municipalities directly under the central government). Including Wuhan, Hubei province has 13 prefecture level cities and in China as whole there are 283 so it is clear that this form of city-centred regions plays an important role in China's urban and agricultural development. It is this unique way in which urban governance has developed in China that forms the vehicle through which China's vegetable industry policy goals are outworked.

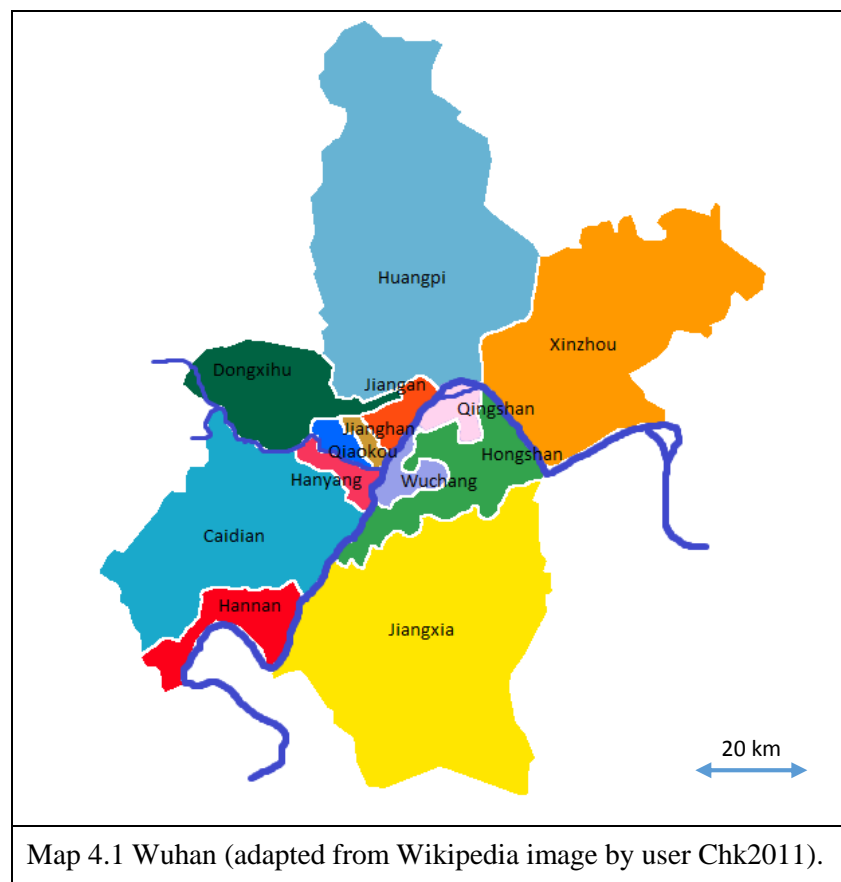
The most significant expression of how policy is worked out through cities, is in the Vegetable Basket's prescription that it is the city mayor's responsibility to ensure a secure supply of vegetables for the city while the responsibility for grain supply belongs to the provincial governor (HAB Director, 2012; WAB Director, 2012). Thus, Wuhan and many other Chinese cities like it have both the resources and the mandate to specifically invest in and support peri-urban vegetable production. Wuhan's peri-urban vegetable production policy has evolved in ways connected to the national policy context but also specifically in response to



Wuhan's economic and environmental conditions. The scale and nature of peri-urban vegetable production in the city is outlined in the next section followed by a description of Wuhan's specific policy measures for development of the system.

## 4.2 Significance of peri-urban vegetable production in Wuhan

Wuhan is the capital of Hubei province. It is the most populous city in central China at approximately 10 million at the end of 2011 (WSB, 2012, p. 17). The city's administrative boundaries cover an area of 8,494 km<sup>2</sup>. That is more than five times larger than Greater London's 1,579 km<sup>2</sup>. It is a city with three urban centres set at the intersection between the Yangtze river (Changjiang 长江) and the Han river (Hanjiang 汉江). Hubei province contains a population slightly larger than the UK in an area approximately three quarters of the size. The city itself is a sub-provincial level city which administers 7 central districts and 6 outer districts each with their own district governments under the central municipal government. There are about 6 million registered urban residents and 3 million registered rural residents, not counting those temporarily residing in the city (the 'floating' population). The six outer districts and the largest of the central districts are special agricultural districts.



The Wuhan Agricultural Bureau refers to all agriculture within the city's administrative limits as 'urban agriculture' although in reality the agricultural districts contain large areas of mainly rural land (Wang, 2010) while agricultural activity could also be seen along the ring roads and roads into central districts. The agricultural districts are linked to the central city by several (7 as of 2004, (see Han and Wu, 2004)) major towns (with urban populations) which range between 15 and 25 km from the city core, providing centres of industrial activity and consumption. In addition, a number of smaller central towns act as production, circulation and service centres of agricultural production and processing (Han and Wu, 2004).

For the sake of simplicity, in this thesis I refer to the city's agricultural districts as 'peri-urban districts' because it is within the boundaries of these districts that the spatio-economic impacts of the peri-urban interface are most directly felt. Vegetable production occurring within these districts as well as in the urban districts will thus be referred to as peri-urban production because it occurs under conditions of overlapping urban and rural institutions, activities and processes. Beyond the borders of the city the government's policies around peri-urban agriculture are less directly relevant and the other impacts of the urban economy are less significant for farmers' livelihoods as their economic opportunities, public services and market access are tied to their own local township or prefecture administrations.

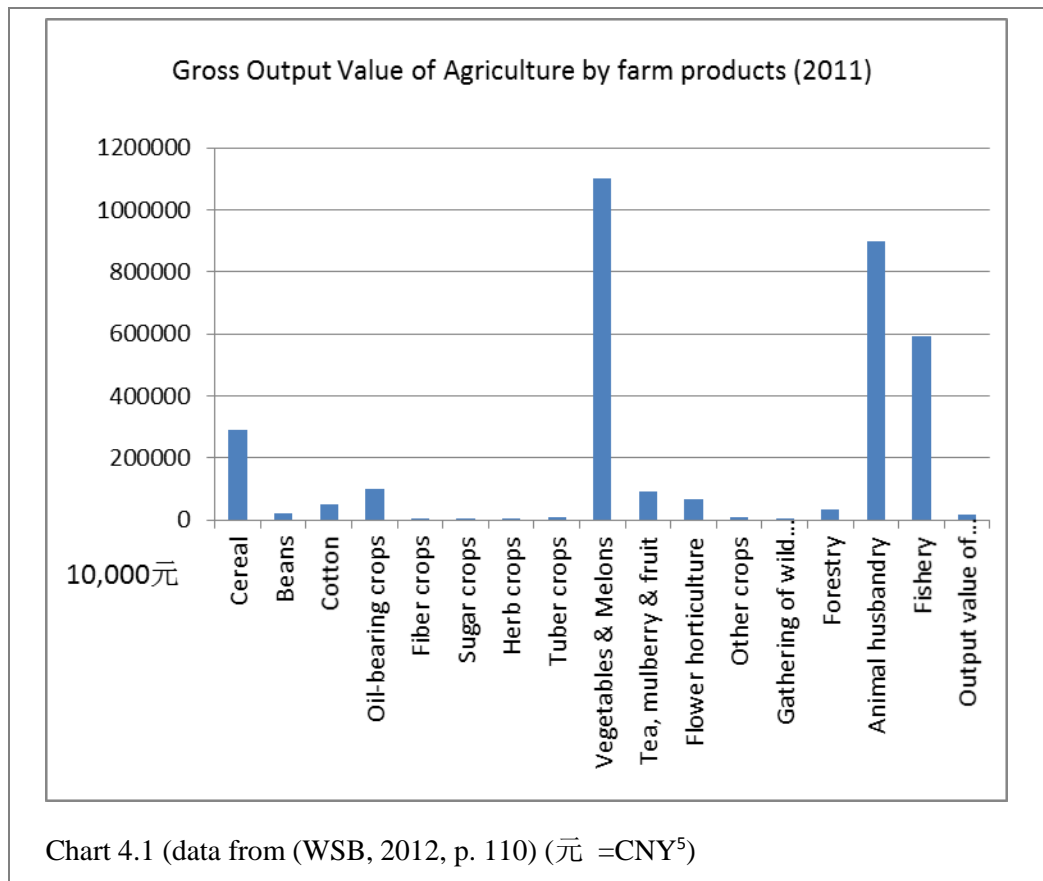
Wuhan's central districts are almost completely urbanised and combine residential, industrial and commercial zones and a string of 'down town' city centres characterised by large mixed use developments and shopping centres. Some of these central districts have patches of agricultural land left over from the time when Wuhan's urban conurbation included only its central 'three cities' of Hankou, Hanyang and Wuchang. The outer districts, however, each have their own urbanised centre from which extend large areas of what is effectively countryside in which agriculture is one of the main occupations.

At the end of 2011, 2.74 million of Wuhan's residents were registered as rural (i.e. have rural *hukous*), of which 540,000 (20%) were recorded as engaged in agriculture (WSB, 2012, pp. 20–22, 44, 101). The land under cultivation was 2,065 km<sup>2</sup> and has remained fairly stable since 2003. 59% of cultivated land was wet fields or paddy fields while the rest was dry fields (WSB, 2012, p. 102).

In order to manage agricultural activities across the city the municipal government has an agriculture bureau which is involved in making and implementing policies to develop agricultural production and distribution of agricultural products. This central bureau leads district level agricultural bureaus in each of the agricultural districts. The city government and each of the district governments all publish five year plans which include goals and prescriptions for agricultural development. Below the district level there are government farms, township governments and village committees which each play a part in managing and

supporting agriculture at a local level.

The significance of peri-urban vegetable production in Wuhan's agricultural economy can be seen from the charts below. Chart 4.1 shows that, measured by gross output value, vegetable production stands out as the most important sector of agricultural production in Wuhan with animal husbandry (mainly pigs & poultry) and fishery second and third respectively (melons are included in the data for vegetable production and they represent just over 10% of the total sown area of vegetables and melons).



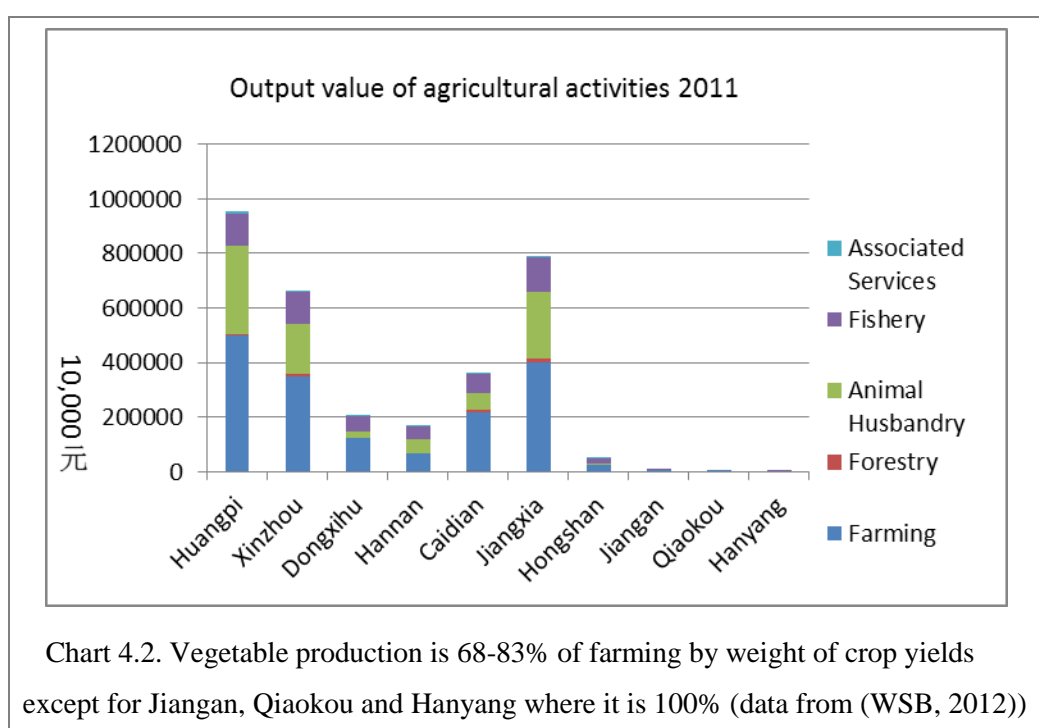
Vegetable production is not limited to only a few districts but forms the largest percentage of arable farming by weight of yields across all Wuhan's agricultural districts. Chart 4.2 shows the output value of farming, forestry, animal husbandry, fishery and associated services by district. The first six districts from left to right are agricultural districts and in each of these, vegetable production accounts for between 68% and 83% by weight of yields in farming (see table 4.1). The other four districts (Hongshan, Jiangan, Qiaokou and Hanyang) are effectively urban districts with some small areas of cultivated land still remaining. In these areas vegetable production is the only agricultural activity apart from in Hongshan where animal husbandry (mainly pig farming) also plays a role. In table 4.1, 'other units' refers to the four special development zones: East Lake High-Tech Development Zone (东湖新技术开发区); Wuhan

<sup>5</sup> At time of data collection 10CNY was approximately £1

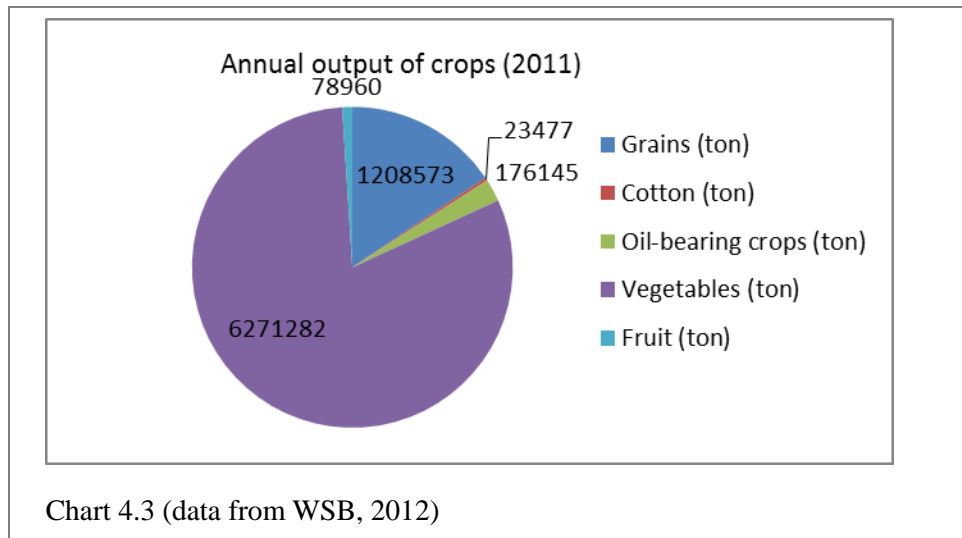
Economic Technological Development Zone (武汉经济技术开发区); Wuhan Chemical Industry Park (武汉化工新区); East Lake Ecotourism Scenic Zone (东湖生态旅游风景区).

Table 4.1: Vegetables as percentage of arable farming by weight of yields (2011) (data from (WSB, 2012)).

Huangpi	Xinzhou	Dongxihu	Hannan	Caidian	Jiangxia	Hongshan	Jiangan	Qiaokou	Hanyang	Other units
76%	76%	83%	68%	71%	74%	73%	100%	100%	100%	87%



Total production of vegetables in Wuhan in 2011 was 6.27 million metric tons which is 80% of the annual output by weight of crop production in Wuhan (see chart 4.3). Wuhan's total consumption of vegetables and derived products in 2011 was 5.05 million tons of which 3.05 million tons were consumed by Wuhan's citizens as fresh vegetables while the remainder was processed, handled by local exporters or used as feed. This is equivalent to 305 kg of vegetable consumption per head per year which is 1.17 times the national average of 260.7 kg. 33% of produce (2.1 million tons) was sold outside Wuhan while 1.1 million tons were imported from other parts of China to meet demand for non-local varieties and make up for seasonal declines in local supply (WAB, 2012, p. 2).



From government statistics it is clear that vegetable production is a key part of Wuhan's peri-urban agriculture and provides a livelihood for a great many local producers. The data also reveals that urban markets and peri-urban producers play the largest role in the system of vegetable production and distribution while links to external markets supplement supplies to the city and provide opportunities for the export of less perishable and processed products. Thus, while peri-urban vegetable production is important in national policy, it appears to have an especially significant role in Wuhan as a city which already boasts a relatively high level of self-sufficiency in supply. However, different categories of vegetables are of differing importance in local supply.

### ***Three categories of vegetables***

All of the system actors interviewed - including government officials, producers and distributors - identified two broad categories of vegetables which are cultivated in peri-urban districts. These are categorised according to the length of time from planting to harvesting and the amenability to storage and transportation. Fast growing leafy vegetables (FGV, kuaishengcai 快生菜) are those leafy greens and salad crops which have short growing cycles but are highly perishable and must therefore be sold and consumed relatively quickly after harvesting. Staple vegetables (SV, dalucai, 大路菜), on the other hand, are those vegetables with longer growing cycles which are easy to store and transport long distances. SV include crops such as cabbage (baocai, 包菜), Chinese leaf (dabaicai, 大白菜), pumpkin (nangua, 南瓜), various kinds of beans, cucumber (huanggua, 黄瓜), aubergine (qiezi, 茄子), tomato (xihongshi/fanqie, 西红柿/番茄) and garlic (dasuan, 大蒜). FGV includes Chinese leaf hearts (xiaobaicai, 小白菜), spinach (bocai, 菠菜), lettuce (shengcai, 生菜) and amaranth (hancan, 苋菜).

SV are usually less labour intensive to grow than FGV, and are usually grown in open fields without the use of polytunnels, but often require a higher level of skill than FGV. They are less

vulnerable to pests, disease and bad weather but do not provide the same potential as FGV for multiple harvests throughout the year. Due to the longer growing cycle and ability to store after harvest, short periods of intense labour are involved and some farmers will hire people to help with sowing or harvesting. Because they can be more easily stored and transported large distances SV will often be sold in bulk outside Wuhan as well as to local wholesale markets.

FGV by contrast tend to have high nitrogen demands, require more water and are very susceptible to pests so require high inputs of chemical pesticides. They are also more sensitive to weather and require more intensive management than SV. They are often grown under polytunnels in order to extend the growing season, speed up the time from planting to harvesting and protect the plants from bad weather. However, the higher humidity created by polytunnels can increase the pressure from pests, disease and fungus requiring higher quantities of pesticide and fungicide to be applied. Planting, spraying, weeding and harvesting will often be done continuously as crops are planted in a staggered fashion in order to compensate for the risk of widely fluctuating prices and provide a more continuous cash flow throughout the year.

A third category is a subset of staple vegetables which are suitable for protected cultivation under polytunnels and greenhouses as off-season vegetables (OSV). These include tomatoes, chillies, cucumbers, tall lettuces (woju, 莴苣) and beans – crops with longer growth cycles than FGV but which can be grown out of season under polytunnels in order to obtain better prices at times when local supply is seasonally low.

Due to their perishability and the high dependence upon good irrigation and the use of polytunnels FGV are grown on inner peri-urban areas on land which is flat, well irrigated, close to access roads and within an hour's journey of the city's wholesale markets. They are sold almost exclusively to Wuhan's markets. SV on the other hand are usually grown in the outer peri-urban areas near good quality sealed roads which provide easy access for the trucks of traders from Wuhan or elsewhere to collect produce from the field-side.

Thus, municipal level policies to promote peri-urban production and develop local markets are closely related to the goals of securing the stability and quality of local supply which means the emphasis is increasingly on FGV and OSV. These policies have developed in the context of specific environmental, economic and technical conditions and have often been defined as responses to the pressures and threats which arise from their interactions. The following section describes how municipal policy has developed and highlights the key environmental, economic and technical factors which have influenced policy goals and measures.

### 4.3 Municipal policy interventions

*“现在市长管菜篮子（吃菜），省长管饭碗（吃饭），也就是说市长负责蔬菜产业，省长负责粮食产业。”*

*“Currently the city mayor manages the ‘Vegetable Basket’, the provincial governor manages the ‘Rice Bowl’. In other words, the mayor is responsible for the vegetable industry while the governor is responsible for the grain industry.” (WAB Director, 2012)*

Local municipal policies are required to implement the general policy goals outlined at a national level in ways which take into account the local conditions relevant to peri-urban vegetable production. These include the agro-ecological conditions of climate, soil and water resources which shape the opportunities and constraints for producers in terms of the techniques and technologies which can be used. Technical resources and capabilities within the system influence the ability of actors to respond to these constraints. The level of agricultural and distribution infrastructure (irrigation, transport links, drainage) has an important impact on producers and distributors by constraining their response to climate shocks and stresses and determining their access to urban markets. The level of development of urban markets has implications for both consumers, producers and sellers/distributors as it is linked to the quantity, quality and price structure of vegetable supplies. These conditions have arisen over time as the system and its context have evolved. The history of this development is discussed below.

#### ***Responding to seasonal variability and extreme weather***

In an interview one government official described the history of Wuhan’s vegetable production and the policies designed to modernise it. Until the market reforms of the 1990s the vegetable industry in Wuhan was very seasonally variable. It experienced a clear slack season in spring (April to May) - due to low temperatures and lower levels of sunshine - and in autumn (August to September) - due to extreme high temperatures, sudden heavy rains and intense sunshine (WATSC, Director).

After the 1990s government policies liberalised the sector allowing farmers and traders to respond to, and take advantage of, an ever growing and connected market. Simultaneously the government promoted new technologies including ‘protected cultivation’ (sheshi shucai, 设施蔬菜) using polytunnels (dapeng, 大棚) to more closely control growing conditions.

Transportation and delivery systems improved and investment in technological development helped make vegetable production a relatively profitable option for crop producers. As a result, the seasonal variations became less pronounced such that they were manifest in differences in prices and varieties rather than lack of supply (WATSC, Director). Although vegetable cultivation could be continued further into the winter months as polytunnels helped to extend the growing season, this also brought new vulnerabilities.

Agricultural producers in Wuhan have always had to deal with the challenges of heavy rains,

flooding and scorching summer sun. However, a significant shift in the urgency of policy intervention in peri-urban vegetable production in Wuhan came in 2008 in response to unusually heavy snow fall and freezing weather which extensively damaged vegetable crops, destroyed polytunnels, disrupted harvesting and blocked distribution routes (HAB Director, 2012).

The interviewee explained that, in response, the government improved production base facilities by constructing over 3,000 mu (200 ha) more metal framed polytunnels which are better able to withstand heavy snows, improved irrigation and drainage channels and improved agricultural information services to give better weather warnings to farmers and set up traceability systems for vegetable produce (WATSC Director, 2012).

In order to cope with the immediate impacts of events such as these the government uses a standard range of measures including providing assistance with harvesting and guaranteeing minimum prices to farmers and mobilising supermarkets to go directly to production bases (WS Purchaser, 2012; WAB Director, 2012). These kind of extreme weather events are not isolated and the government has standard ways of coping focused specifically on maintaining supplies to urban markets and stabilising the prices to consumers (HAB, 2012).

An official at the Hubei agricultural bureau explained the recent history of extreme weather events in Wuhan, how they affect vegetable production and how the government typically deals with their impacts. Twenty years ago, he said, extreme weather was less frequent and it was unusual to have a continuous string of disastrous weather. More recently, however, these have become more common so that people now talk of ‘normal’ disasters (changtai zaihai, 常态灾害) (HAB Director, 2012).

At the start of each year during the winter months (December to February) producers normally face episodes of freezing rain and snow and long periods of overcast and rainy weather. In 2012 they experienced the most serious example of such weather since 1983. From February to May there are often extended droughts which are commonly quite severe. July and August see flooding caused by heavy rains combined with extreme high temperatures both of which impact yields and mean that farmers will often avoid planting during these months (HAB Director, 2012).

As well as these ‘normal’ weather disasters, there are also freak weather events, the most important of which was the 2008 snowfall which was the most serious in 60 years and has not previously been common in that area. Vegetables were frozen on a large scale, snow and ice prevented harvesting and roads were frozen which disrupted transportation (HAB Director, 2012).



### ***Mitigating price fluctuations***

In order to cope with the short term disruptive impacts of such weather disasters the city government focused measures on protecting consumers from the price fluctuations and supply deficiencies that occur. The main way of doing this is through the supermarkets. The big three in Wuhan - Zhongshang, Wushang and Zhongbai - are all controlled by Wuhan government owned holding companies so that the municipal government can set maximum and minimum prices and provide subsidies to supermarkets when necessary (WAB Director, 2012). I personally saw such intervention happen while living in Wuhan when our local supermarket put up signboards stating a government imposed price stability measure was in force.

Price fluctuations are not only a result of extreme weather, they also stem from weaknesses within the system of production and distribution of vegetables as an official at the Wuhan Agricultural Bureau explained (WAB Director, 2012). Further, price volatility and extreme weather also have feedbacks on the vulnerability of peasant farmers' livelihoods as they struggle with limited labour on small plots of land and relatively low skills and technology levels.

A lack of market information available to farmers and the scattered and small scale nature of vegetable production combine to create very unpredictable local supply (WAB Director, 2012). Farmers grow whatever they think might get a good price based on their previous experience in the hope that when it comes to harvest time they will be able to sell it in the markets or to traders for a fair price. This phenomenon of 'blindly producing' 盲目生产 (CMA, 2012, p. 17) leads to large and rapid variations in supply which contributes to price volatility. For farmers it is like a lottery because they may make a loss or make an unexpected profit depending on the state of the urban markets and the patterns of peri-urban production. This is particularly true of farmers growing FGV because they do not have ready access to other markets beyond Wuhan – it is difficult for farmers to find any alternatives and they simply have to take the prices they are offered. Neither are farmers able to obtain stable purchase orders because their scale of production is so small (WAB Director, 2012). A further weakness acknowledged by the WAB official was that the facilities at vegetable production bases are often very poor making them more vulnerable to environmental conditions (WAB Director, 2012).

### ***Assisting peasant farmers***

According to one academic (Zhang, 2010) and confirmed by a government official (WAB Director, 2012) a further perceived weakness of the system is that the majority of farmland in the agricultural districts of Wuhan is collectively owned by village committees and farmed at household level on a very small operational scale – on average 1 mu (1/16 ha) per household. These farms are mostly worked by women, children and the elderly while the men commute to work in factories in the urban areas. Incomes from this type of agriculture have increased since

the repeal of the agricultural tax (effectively removing all land costs to farmers on collectively owned land) and a rapid intensification of small scale farming has resulted as formerly idle land has been re-cultivated.

While this has helped ‘peasant’ farmers, who usually sell their produce to local markets, the larger scale commercial farms are more profitable and peasant farmers find it difficult to compete and can become excluded from markets. These larger scale agri-businesses can take advantage of heavy government subsidies and investment, economies of scale and access to mass markets as well as national and international export markets through supermarkets to sell high quality commodified products which maximise their profits.

To reduce farmers’ and traders’ transportation costs ‘green transport’ routes (lvse tongdao 绿色通道) have been a long term policy feature. This policy allows farmers to apply for an official registration sticker to place on their vehicles to allow them to pass through toll roads with no charge as they carry their produce to market. In addition, even without the official sticker, if a vehicle is carrying vegetables then it will also be exempt from tolls. Virtually all the highways into and encircling the city are toll roads so without this free access farmers would have to use the much lower quality village roads which are often severely damaged and would add significant time and cost to their journeys.

One alternative strategy to assist peasant farmers improve their livelihoods that has been used in recent years has been to support the development of villages into combined agricultural and tourism villages. This comes under the broad policy initiative “building a new countryside” (xinnongcunjianshe, 新农村建设) (see Long et al., 2010) and involves government subsidy and support for beautification activities such as redecorating the outside of villagers’ houses, training for villagers in tourism related businesses (restaurants, hotel, homestay etc.), introduction of new ‘green’ vegetable farming techniques and local government promotion of the village as a tourism site (marketing, website construction etc). Tourists from Wuhan’s urban areas can then visit the village and stay overnight, taste ‘authentic’ cuisine, buy locally produced ‘green vegetables’ or even rent a field which the villagers will farm for them – handing over the produce at the end of the growing season. However, this model of local development naturally involves intense local competition as other villages seek to imitate and outdo each other and it is ultimately dependent upon the changeable preferences of urban citizens.

The government’s most recent strategy for dealing with these weaknesses in the vegetable production system was to find ways to help farmers rapidly scale up production through cooperating together and improving the level of technology available to them. The most innovative of these is the concept of “Farmers’ Specialised Co-operatives” (nongmin zhuan ye hezuoshe 农民专业合作社). This is an idea taken over from Japanese agriculture in which

farmers are given assistance to form co-operatives which are run by farmers themselves and allows them to obtain large purchase orders from supermarkets and other mid-sized buyers, organise their sowing and harvesting accordingly, share resources, and apply for subsidies etc. as an official organisation rather than individuals. The official stated that 1,000 farmers' co-operatives now exist in Wuhan in a variety of sectors of agriculture, not just vegetable production (WAB Director, 2012).

The development of co-operatives and other larger scale production enterprises also helps farmers and other producers to access the support policies available to farmers in terms of purchasing subsidised technology and investing in facilities. Subsidies are provided for polytunnel construction (up to 60% of the cost) and machinery (HAB Director, 2012). It is also intended to give peasant farmers the opportunity to participate in higher value markets for higher quality, packaged and labelled produce which are beginning to emerge as the government seeks to promote the standardisation of vegetable products.

### ***Transforming production and distribution to take advantage of changing markets***

A growing demand among the burgeoning urban middle classes for higher quality fresh produce amid fears around food safety is reflected in the municipal government's strategy of creating a segmented market for vegetables. Through product labelling, the government has created a hierarchy of commodities within the vegetable market (as well as other foodstuffs) ascending in quality and price. At the lowest end of quality is conventional (unlabelled) produce sold mainly through the 'wet markets', road side stalls and informal markets. Then there are three labelled categories sold mainly through supermarkets which include 'non-polluting' (wugonghai, 无公害), 'green' (lvse, 绿色) and finally 'organic' (youji, 有机) produce, each distinguished by increasingly strict controls on production methods, chemical inputs and processing.

This strategy, along with an emphasis on increasing the peri-urban production of protected FGV (kuaishengcai 快生菜 or yezecai 叶类菜) is at the heart of the government's attempt to modernise the peri-urban vegetable system. Interviews with academics (Wang, 2010; Zhang, 2010), government officials (WAB Director, 2012; WATSC Director, 2012) and some of the key business people running larger scale production enterprises (FSC-1 Director, 2012; NLLAE Manager, 2012) along with policy documents (WAB, 2012) all indicated that the government's vision for the peri-urban vegetable system emphasised two key features: a drive towards larger scale, protected cropping of higher value FGV and the segmentation of the vegetable market to encourage a modernised system of production and distribution for affluent consumption employing a greater level of standardisation and traceability of products. The main actors involved in this transformation are the district level leading enterprises, specialised co-

operatives and private companies distributing through supermarkets and contracts with restaurant chains, universities and the canteens of large companies in the urban centres. The aim is to link peri-urban producers more directly with urban consumers through formalised distribution channels which cut out the middle-men traders, thus reserving more of the profits for producers, and simultaneously provide consumers with the assurance of a quality safe product in and out of season.

The emphasis is on using policy measures to increase the area of protected (sheshi shucai, 设施蔬菜) FGV cultivation under polytunnels and greenhouses and to scale up and mechanise production through supporting private and public enterprises and farmers' co-operatives mainly through polytunnel and machinery subsidies. As production and distribution become more formalised products will be made traceable and quality and safety guaranteed (HAB Director, 2012).

Additional components of this policy strategy include setting up factory farming style production of seedlings for farmers to plant out, supporting farmers with training in agricultural techniques (through the Wuhan Agricultural Technology Service Centre) and establishing direct links between farmers and supermarkets (nongchaoduijie, 农超对接) to cut out the middle-men traders (HAB Director, 2012).

### ***Promoting persistence, adaptation and transformation***

As a whole these policies can be organised according to the typology of promoting persistence, adaptation and transformation of system structures.

<b>Table 4.2 Policy measures, processes and resilience</b>		
<b>Policy measures</b>	<b>Typology of processes</b>	<b>Resilience</b>
1) Supermarket price controls 2) Emergency assistance for producers and distributors	<b>Persistence</b> Responding to the shocks or ‘freak’ and ‘normal’ extreme weather by improving coping capacity of producers and distributors through short term intervention and reducing exposure of consumers to price volatility.	Enhance resilience of food security outcome (affordability)
3) Polytunnel subsidies 4) Training in techniques 5) Improved infrastructure 6) Direct to supermarket sales 7) Green transport routes	<b>Adaptation</b> Responding to ‘normal’ extreme weather and internal system weaknesses by enhancing production and distribution capabilities and reducing sensitivity of producers to extreme weather.	Enhance resilience of food security outcome (affordability) and livelihood outcome (raise and secure farmers’ incomes).
8) Construction of more protected FGV production bases 9) Support commercial enterprises and specialised farmers’ co-operatives 10) Labelling to improve food safety controls and encourage more environmentally friendly production	<b>Transformation.</b> Responding to food safety concerns, changing demand and internal system weaknesses by commercialising and scaling up production of protected FGV (through private, state owned and co-operative enterprises) and formalising distribution channels to enhance traceability, reduce inefficiencies, raise and secure farmers’ incomes, reduce environmental impacts, and meet consumer quality demands.	Enhance resilience of food security outcome (food safety), livelihood outcome (raise and secure farmers’ incomes), environmental outcomes (reduce impact of production)

The system itself is framed in rather simplistic terms as including peasant farmers operating within the responsibility system of rural land tenure and production enterprises operating on leased land as the main two types of producers linked to urban consumers through a long supply chain including traders, wholesale markets, local wet-markets and supermarkets. The main constraints internal to the system are seen as being a lack of skills on behalf of peasant farmers, backward infrastructures and lack of market and weather information available to peasant farmers and the fragmented nature of the supply chain.

The solutions are targeted to support peasant farmers on the one hand and to encourage the scaling up of production, particularly through encouraging co-operatives and enterprises to take a lead on the other. The measures to promote persistence in system structures are focused on responding to the threat posed by extreme weather. The government intervenes to control prices through the supermarkets, provides assistance to producers in getting products to market when bad weather disrupts harvests and transport routes and offers guaranteed prices to farmers when such disruptions occur.

There are a range of policies designed to promote adaptation to the perceived internal stresses of poor infrastructure and lack of market information available to peasant farmers. Equipment subsidies, infrastructure improvements on production bases and provision of timely market information through websites are the main vehicles for this. Some policies are also designed to encourage transformation by helping peasant farmers to organise themselves into larger scale production enterprises through setting up specialised co-operatives. Equipment subsidies and training services are offered to help upgrade farmers' resources and capabilities and encourage the expansion of protected cultivation of FGV. Beyond all these measures to try to stabilise prices and protect the livelihoods of peasant farmers the government's greatest efforts are towards transforming the system through a programme of modernisation.

Taken together these policies imply the framing of system outcomes in terms of ensuring a stable and relatively affordable supply of quality fresh vegetables (particularly FGV) to urban consumers while enabling peasant farmers to improve their livelihoods and reducing the vulnerability of the system to disruptions from extreme weather events and seasonal variations. Policies aim to enhance the resilience of these two outcomes against external shocks from bad weather by promoting a particular set of actors, structures and technologies: large scale enterprises, specialised co-operatives and supermarkets linked through direct sales contracts and supported by the expansion of protected cultivation under metal-framed polytunnels and greenhouses using conventional intensive cultivation techniques.

## Conclusions

Vegetable production in Wuhan is the largest sector by value of agriculture occurring within the city's administrative boundaries. In response to heavy snows and unusually cold temperatures in the winter of 2008 the city government has renewed efforts to develop peri-urban vegetable production and distribution to try to further secure supply of vegetables to the city (HAB Director, 2012; WATSC Director, 2012). Policies are aimed specifically at guiding the peri-urban vegetable system towards a structure which can support the functional resilience of a specific set of outcomes such that vegetable prices are more stable, quality and safety is enhanced and farmers' livelihoods are improved. These policies have changed over time, responding to urban development, advances in agricultural technology, changing environmental conditions and the national policy context. Most recently local policy has been driven by a "National Vegetable Industry" development plan. By promoting particular technologies, forms of organisation and groups of system actors through financial support, emergency interventions and price controls the municipal and district governments seek to manipulate the system towards achieving a particular set of policy goals.

Persistence is promoted as a response to 'freak' and 'normal' extreme weather by providing emergency assistance to producers and distributors and through price controls. Adaptation is a response to 'normal' extreme weather and weaknesses within the system, remedied by measures to improve the capabilities of producers and distributors. Transformation of the system is promoted through supporting larger scale commercial producers and encouraging peasant farmers to form co-operatives. This is complemented by an effort to standardise markets through a regime of labelling products as conventional, non-polluting, green or organic designed to enhance food safety through restrictions on agri-chemical use. An increasing role is envisaged for supermarkets and specialist distribution companies which manage vegetable bases themselves.

The vision of resilience these measures appear to be designed to achieve is one in which the safety of vegetable products for consumers is enhanced, stability of supplies are maintained (manifest in stable prices) and the livelihoods of peasant farmers are improved.

The framing of the system presented here and the vision of resilience associated with it leaves out some important factors which influence the system structures and the ways in which policies unfold and impact on the system actors in diverse ways. The most significant of these is the impact of rapid urban and peri-urban spatial transformation on land use and livelihood patterns throughout the system and subsequent implications for vegetable production practices and multiple dimensions of food security. These will be explored in the following chapter.

## Chapter 5. Step 2 – Peri-urban dynamics

***RQ 2. How do peri-urban dynamics shape the livelihoods of peri-urban producers and activities of vegetable production?***

*Spatial, structural and temporal characteristics of peri-urban interface*

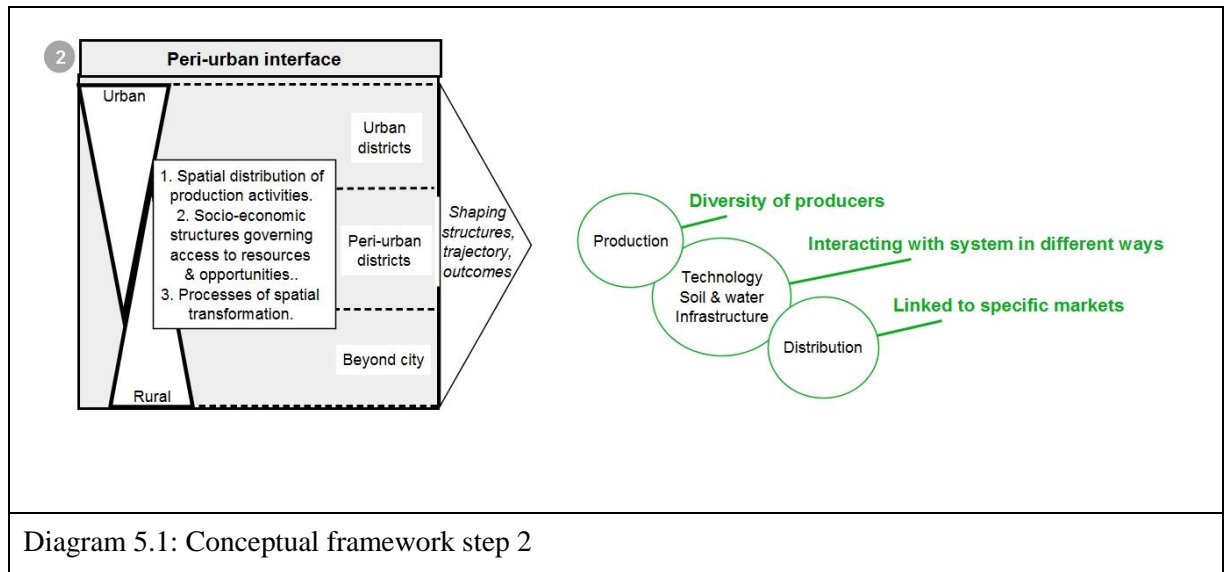
*Impact of peri-urban dynamics on opportunities and constraints experienced by different groups of peri-urban producers*

### ***Introduction***

Peri-urban vegetable production is already an established and important part of Wuhan's agricultural sector and clearly plays a key role in the livelihoods of many of Wuhan's farmers while also contributing to food security for urban consumers. Wuhan's peri-urban vegetable production system is one of the most important sectors linking urban and peri-urban/rural areas. The fact that production takes place in agricultural districts governed by the city (peri-urban districts) means that these districts can be understood as the places where the impact of processes operating across the peri-urban interface is most clearly seen. In these districts urban and rural institutions (district governments, village committees, township governments, urban and rural *hukou* systems), rural and urban activities (agriculture, factories, construction etc) and processes (urban expansion, capital investment, agricultural investment, land seizure and compensation arrangements) all interact.

This chapter describes how vegetable production activities are embedded within the peri-urban interface. The purpose is to explain how the dynamics of the peri-urban interface influence the livelihood opportunities available to different producers and thus shape their involvement in the peri-urban vegetable system. The first section focuses on space, describing the spatial distribution of different types of vegetable production within the peri-urban context. The second section deals with the structures which shape how production takes place in these spaces. It examines the two main types of land management – village committee owned land and state farm land – and how urbanisation and the *hukou* system influence the different opportunities available to different actors. This analysis reveals the key role played by migrant farmers in intensive vegetable production on inner peri-urban land. The third section introduces the element of temporal change linking space and structures to the city wide process of urban expansion and shows the implications for peri-urban production and producers. The concluding section draws these insights together into a summary of how peri-urban dynamics shape the livelihoods of peri-urban producers and the activities of vegetable production.





## 5.1 Space: scale and location of peri-urban production

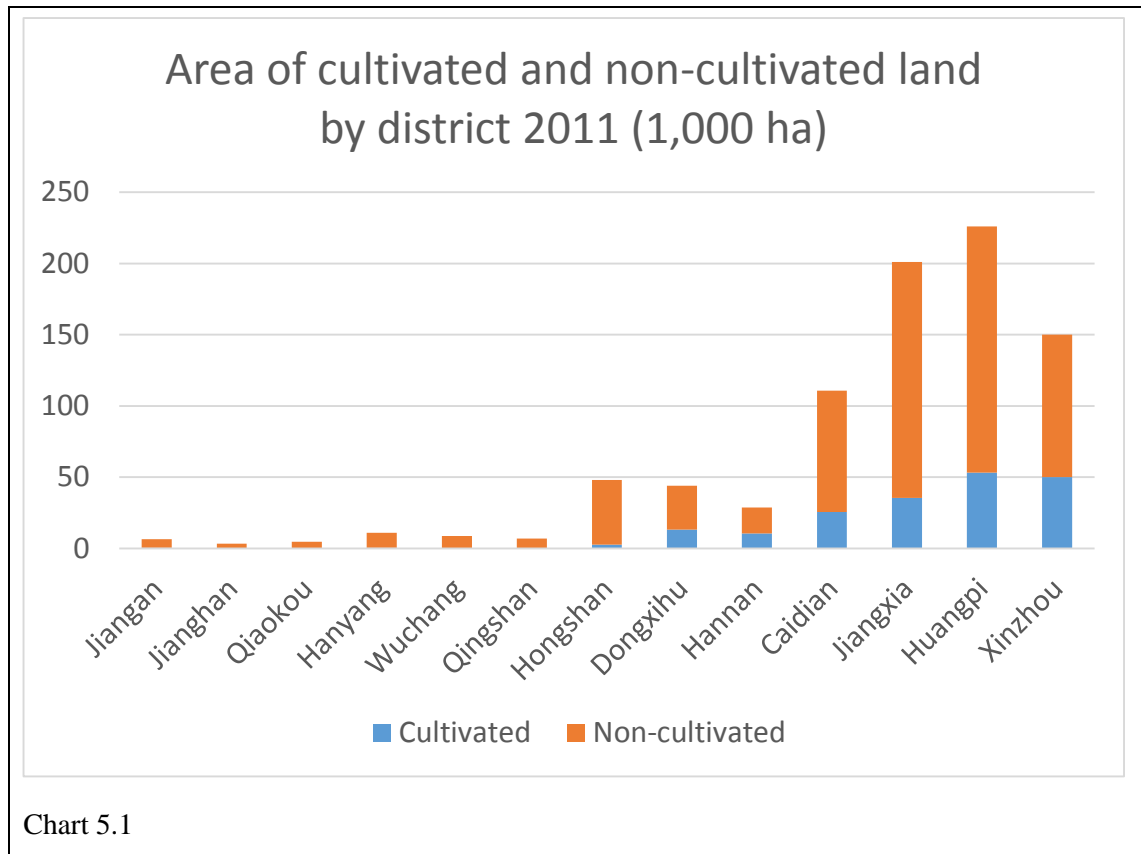
The overall scale of production activities can be seen through the government's own statistics. At the end of 2011 the total sown area of vegetables in Wuhan was 1,618 km<sup>2</sup> (WSB, 2012, p. 112) or 2.4 million mu. This included the area of each crop sown on the same piece of land through the course of a year as part of a rotation as well as areas re-sown after losses to extreme weather etc. It represents 30% of the total sown area of farm crops (5,330.2 km<sup>2</sup>) in 2011 (WSB, 2012, p. 112). According to an interviewee at the department of the Wuhan Agricultural Bureau the area of vegetable production bases is approximately 667 km<sup>2</sup>, which is about 32% of the total area of cultivated land (WAB, 2012, p. 1) (WATSC Director, 2012). It is important to note here that this refers to land specifically set up for vegetable production on which vegetables are cultivated intensively as the main crop type. In addition to this, grain producing land is also used for less intensive vegetable cultivation in rotation with maize and other grain crops where grain is the main crop and vegetable production is secondary. Approximately 200 km<sup>2</sup> of these vegetable production bases is wetlands used for aquatic vegetables (mainly lotus<sup>6</sup>) while the remaining 467 km<sup>2</sup> is dry fields for soil based vegetable cultivation. According to this estimate approximately 56% of the area of dry fields in Wuhan (total 831.7 km<sup>2</sup>) is used for intensive vegetable production. In other words 5.5% of Wuhan's total area is given over to dry field vegetable production including varieties such as lettuce, cabbage, aubergine, cucumber,

<sup>6</sup> Aquatic vegetable production and specifically lotus makes up a significant part of vegetable production in peri-urban Wuhan because of the large areas of lakes and ponds across the city's agricultural districts. However, this type of vegetable production is a separate industry. It remains the case that dry-land vegetable production occupies the majority of land dedicated to vegetable production and peri-urban vegetable production policy deals with dry-land vegetable production and more specifically with FGV production.

pumpkin and green beans.

This vegetable producing land is spread across each of Wuhan's peri-urban districts as well as several of the city's central districts. The following table 5.1 shows the total areas of cultivated land (dry land cultivation of any crop including grains and vegetables) in each of Wuhan's districts. This same data is presented in chart 5.1 below to show the proportion of each district's total area which is cultivated land. The seven districts with the largest areas are the peripheral districts, of which the six showing a significant proportion of agricultural land are what I am calling peri-urban districts.

Table 5.1 Area of cultivated land by district	
<b>2011</b>	<b>Cultivated land (1,000 ha)</b>
<b>Central districts</b>	
Jiangan	0.34
Jiangnan	0
Qiaokou	0.02
Hanyang	0.44
Wuchang	0
Qingshan	0
Hongshan	2.66
<b>Peri-urban districts</b>	
Dongxihu	13.1
Hannan	10.46
Caidian	25.59
Jiangxia	35.53
Huangpi	53.11
Xinzhou	50.1
<b>Other</b>	15.17
<b>Total</b>	<b>206.52</b>



Vegetable production was observed in all the peri-urban districts as well as in four of the central districts: Hongshan, Jiangan, Qiaokou and Hanyang. All areas of agricultural land in these central districts were either vegetable cultivation or ponds for farming fish or lotus root. There were no grains or cotton grown in rotation in these areas although Hongshan contained some small scale pig farming and mushroom growing. In the main, however, such staple grain and non-vegetable cash crops were seen only in the six peri-urban districts in areas some distance from the urban centre and the districts' satellite towns.

The six central urban districts excluding Hongshan are relatively small but have retained some small areas of vegetable production on agricultural land which I have labelled 'marginal peri-urban' land because it is entirely surrounded by urban areas forming islands of agricultural activity which exist in a kind of limbo – awaiting clearance at any moment. Hongshan, Dongxihu, Hannan and Caidian districts are the four districts with large areas of agricultural land closest to Wuhan's urban wholesale markets – land which is inner peri-urban and which is first in line for redevelopment in the course of urban expansion, being directly adjacent to urban areas and close to key infrastructure. Jiangxia, Huangpi and Xinzhou are the largest districts and also contain the largest areas of agricultural land, most of which is beyond easy access to large wholesale markets and which is far enough from the urban fringe to be relatively unlikely to become the target for urban development in the near future. These districts are where the

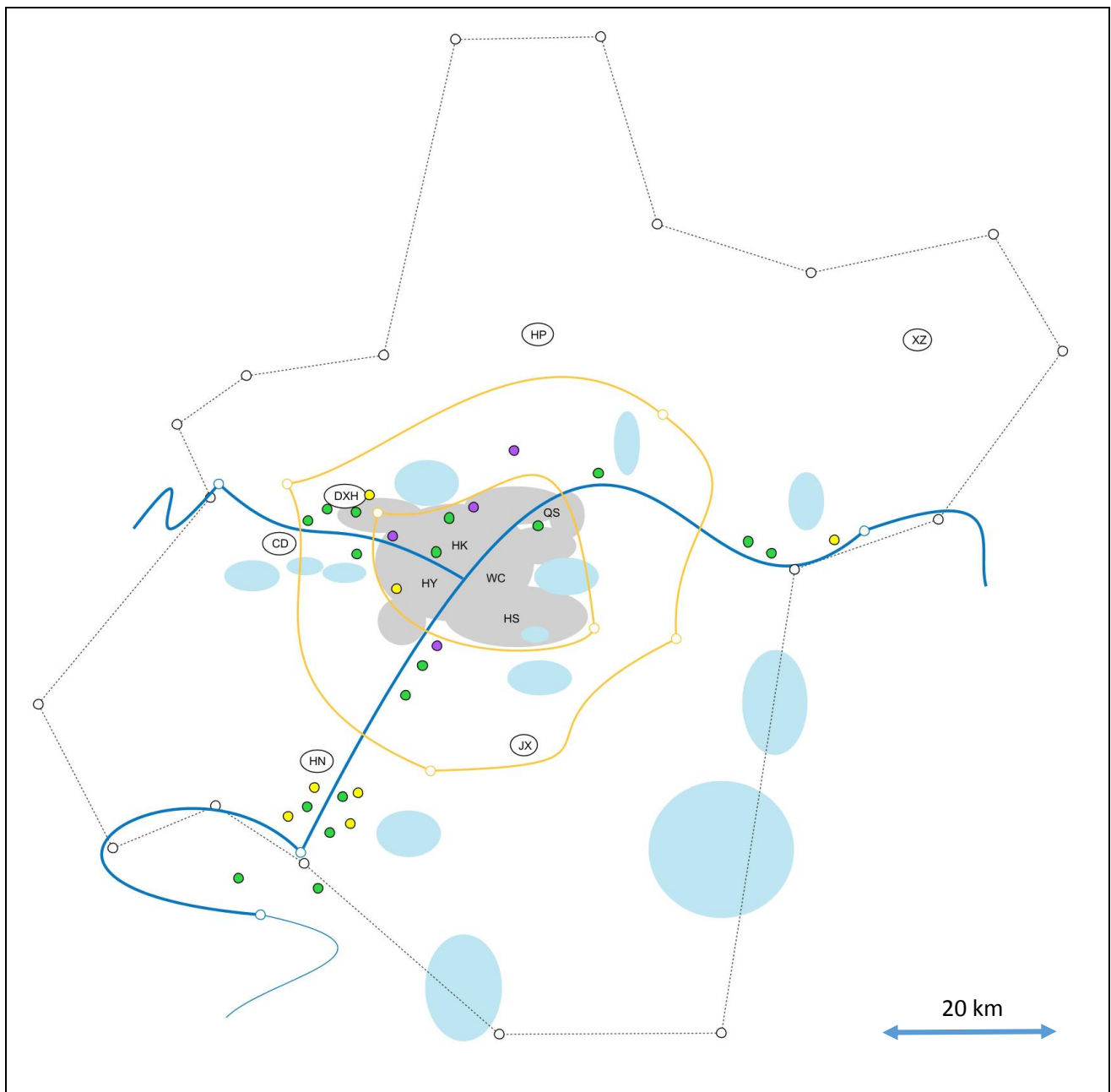
majority of Wuhan's outer peri-urban land is found.

Observations on the ground and satellite imagery of each district indicated that the majority of intensive vegetable production occurred on inner peri-urban land which was flat with easy access to water and trunk roads and relatively close to central urban areas. The largest areas of intensive production were spread across this inner peri-urban land in the districts of Dongxihu, Hannan, Caidian, and Hongshan. By contrast, Huangpi, Xinzhou and Jiangxia districts contain a significant proportion of land which is relatively distant from urban centres and there can only be seen small pockets of intensive vegetable production in those areas closest to the central districts. The remaining vegetable production occurring in these districts is mostly less intensive and most likely part of mixed crop rotations with grains or as household vegetable gardens.

A state farm manager confirmed this spatial distribution of vegetable production activities and explained that vegetable production in the 'inner peri-urban' areas (his words: *jinjiaoqu*, 近郊区) closest to the urban centre is mainly fast growing vegetables (FGV) while production further out in the 'outer peri-urban' areas (his words: *yuanjiaoqu*, 远郊区) is mainly green beans (*doujiao*, 豆角) and other similar vegetables which can be transported further distances and stay fresh for longer (staple vegetables or SV) (WJS-Manager, 2012). It could therefore be expected that intensive cultivation of FGV and OSV would be concentrated on inner peri-urban agricultural land to provide rapid access to markets and in particular on land which is flat, well drained, close to transport routes and with access to irrigation water to meet the requirements for FGV crops and protected cultivation of FGV and OSV. On the other hand SV would be grown on outer peri-urban land and often in rotation with other crops because rapid access to urban markets is less vital. Further, for SV crops high levels of irrigation are less important and polytunnels are not used so such crops are more suitable for incorporation into grain and cotton cropping systems as supplementary crops.

This pattern is reflected in the interview data and site observations. Site visits and interviews were carried out in 17 distinct locations and further additional observations were made on a number of drives through various other areas to identify what kind of agriculture took place. The simplified diagram of Wuhan below shows the city centre in grey shading, the rivers in thick blue lines, the largest lakes in blue shading and the districts indicated by capital initials which are circled to show the position of the district's town centre (see map 5.1 and key for details). The green dots show the 17 sites of vegetable production where interviews were conducted. The yellow dots represent commercial enterprises where interviews took place, including larger scale producers and a distributor. The purple dots show the location of larger wholesale markets which featured in interviews with farmers. To give an idea of the scale, the borders of the city (grey dotted lines) are approximately 120 km east-west by 140 km north-south. The outer ring road (orange outer circle) encircles an area approximately 50 km east-west

by 60 km north-south and the inner ring-road (the inner orange ring otherwise known as the third ring road) 28 km east-west by 25 km north-south.



Map 5.1 Wuhan showing interview sites and site visits.

**Key:**

Grey outline indicates Wuhan's administrative borders covering an area of 8,494 km<sup>2</sup> over five times larger than Greater London.

Urban centres of central urban districts: HK = Hankou, QS = Qingshan, WC = Wuchang, HS = Hongshan, HY = Hanyang.

Urban centres of agricultural districts: HP = Huangpi, XZ = Xinzhou, JX = Jiangxia, HN = Hannan, CD = Caidian, DXH = Dongxihu.

Green dot = site of farmer interviews. Yellow dot = site of farming enterprise interview.

Purple dot = site of wholesale vegetable markets. Blue shading = lakes.

Grey shading = urban areas.

Orange line = inner and outer ring road.

The three sites visited inside the inner ring road were on marginal peri-urban land – each surrounded by urban developments – and the main crops were FGV or OSV under polytunnels, cultivated intensively. One of the sites was very large consisting of over 1,000 households. There was no evidence in these areas of any other crops apart from vegetables and no livestock – with the exception of the largest site in which water buffalo (shuiniu, 水牛) were used for ploughing. Between the inner and outer ring roads the 7 sites and one production enterprise were situated on inner peri-urban land – adjacent to urban areas but not yet surrounded by developments. Here too, the main crops were FGV and OSV grown intensively, often under polytunnels. Beyond the outer ring road 5 sites and 5 production enterprises were visited and these could all be considered to be on outer peri-urban land – some distance from urban areas or district town centres and on land which was clearly rural in character apart from the fact that it lay within city boundaries and was linked to the city by quality dual carriageways<sup>7</sup>. On all but one of these 5 sites in Wuhan's outer peri-urban areas SV crops were grown in rotation with grains or cotton and there was little evidence of polytunnels except for pockets of melon production. The one exception was a small community of migrant farmers who grew tomatoes and chillies for the local town market. Of the production enterprises, all 5 were cultivating a wide variety of FGV and OSV intensively under polytunnels. Beyond the borders of the city two sites in villages in Jiayu were visited which revealed a mixture of FGV, OSV and SV cultivation which interviewees said was for sale in the town's markets and to long distance traders and thus did not have significant connection with Wuhan itself.

The implication of the pattern of peri-urban vegetable production outlined above is that intensive production of FGV and OSV occurs under different conditions to the production of SV, conditions which are determined in large part by relative proximity to the central urban areas and their wholesale markets. These conditions are also shaped by the way peri-urban agricultural land is managed, the range of opportunities which arise from proximity to the developing urban economy and the ways in which access to these opportunities is controlled through the *hukou* system. Together these form the structures which shape the roles of the different actors involved in the different activities of production, whether intensive FGV or less intensive SV in rotations.

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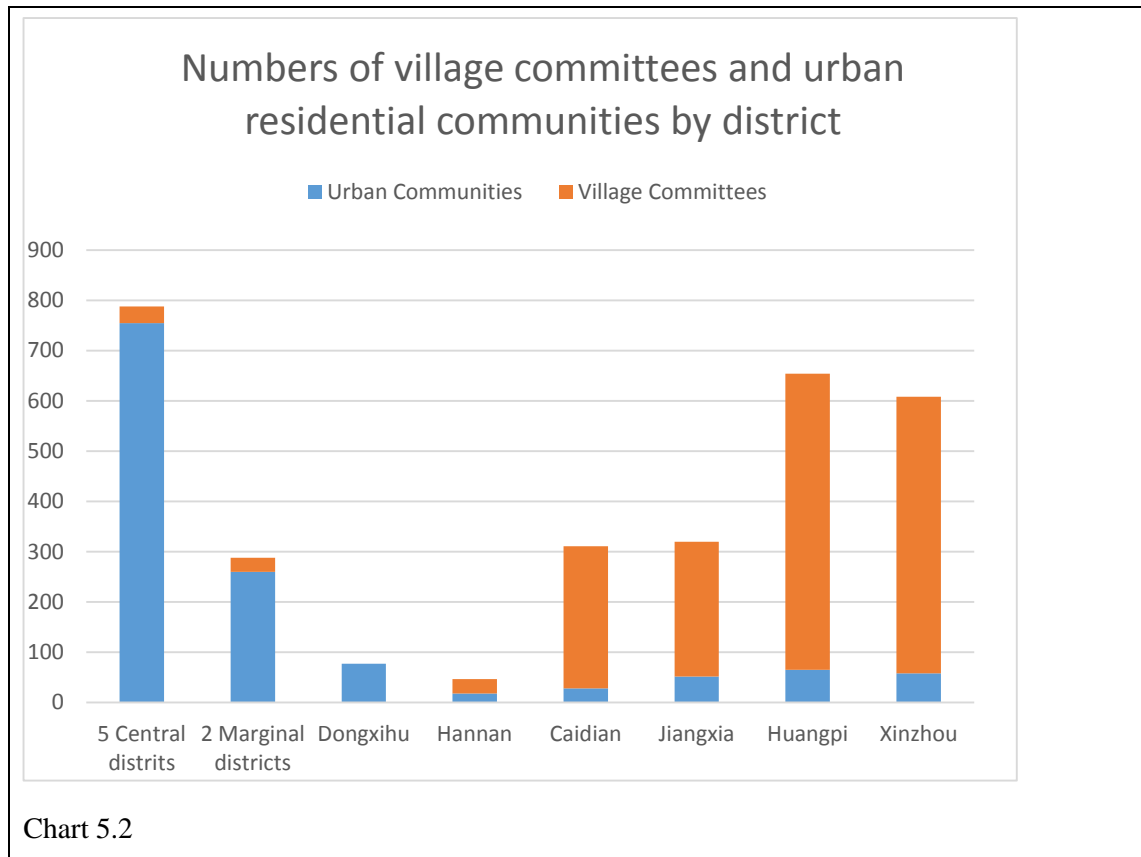
<sup>7</sup> In rural areas beyond city boundaries it is more common to see raised highways crossing fields and bypassing villages thus cutting them off from access and leaving the rural infrastructure backward or decaying.

## 5.2 Structures: shaping opportunities for locals and migrants

Having described the general spatial pattern of different types of vegetable production the next question is how is production organised and who are the key actors involved? According to estimates by government interviewees and the manager of the largest vegetable producer in Wuhan (NLLAE Manager, 2012), about 70-80% of vegetables produced in Wuhan are grown by peasant households and sold through the main wholesale and local vegetable markets. The remaining 20-30% are produced by leading enterprises or other entities who hold the land on long term leases (including local companies such as Guangdi 广地, Xinshen 新神, Lanshi 兰氏, Yuansheng 元生). The land which these peasant households and commercial enterprises cultivate is managed in two main ways: through village committees and by state farms.

### *Village owned land*

The largest proportion of vegetable land (267 km<sup>2</sup>) belongs to local peasant farmers who hold the land use rights under the rural ‘system of contracted responsibility’ (chengbao zerenzhi, 承包责任制) (WATSC Director, 2012). The chart 5.2 below shows the number of village committees (cunweihui, 村委会) compared to urban residential communities (shequjuweihui, 社区居委会) by district. The five central districts have a very high density of urban residential communities but still have a small number of villages in existence – yet to be converted to urban residential use. The two districts of Hongshan and Qingshan also have some villages left. Dongxihu and Hannan are where the state farms play the most significant role in managing agricultural land which means that, while there are large areas of agricultural land, there are few village committees. Caidian, Jiangxia, Huangpi and Xinzhou are the four agricultural districts most dominated by the village committee form of land management.



On village owned land peasant farmers have the formal right to transfer the responsibility of cultivating it to other local farmers for which they may agree a fee. Several of the local farmers interviewed in Jiangxia district farmed their own land as well as additional land contracted from other local farmers who worked elsewhere. For example, farmer JX-02 had contracted over 100 mu of land in 2010 from other local farmers in order to scale up his vegetable production (JX-02). He employed 30-40 locals in high season and 5-6 during the slack season and estimated his household income at around 150,000-200,000CNY per year, much higher than other local residents (JX-02). JX-04 similarly farmed 10 mu of his own land plus 20 mu contracted from the local production brigade for a yearly fee and JX-05 rented 30 mu on top of his own 10 mu from friends who had given up farming to get jobs in the city (JX-04, 05). Thus peasant farmers in peri-urban areas have the options to either 1) continue farming their own land and diversify household incomes as family members seek work in the city, 2) expand and intensify their agricultural operations by contracting land from other locals or 3) give up farming altogether and rent their land to other locals while they find employment in the city. A further possibility is for locals to rent their land informally to migrant farmers. More will be said about this possibility in a later section.



### ***State farm land***

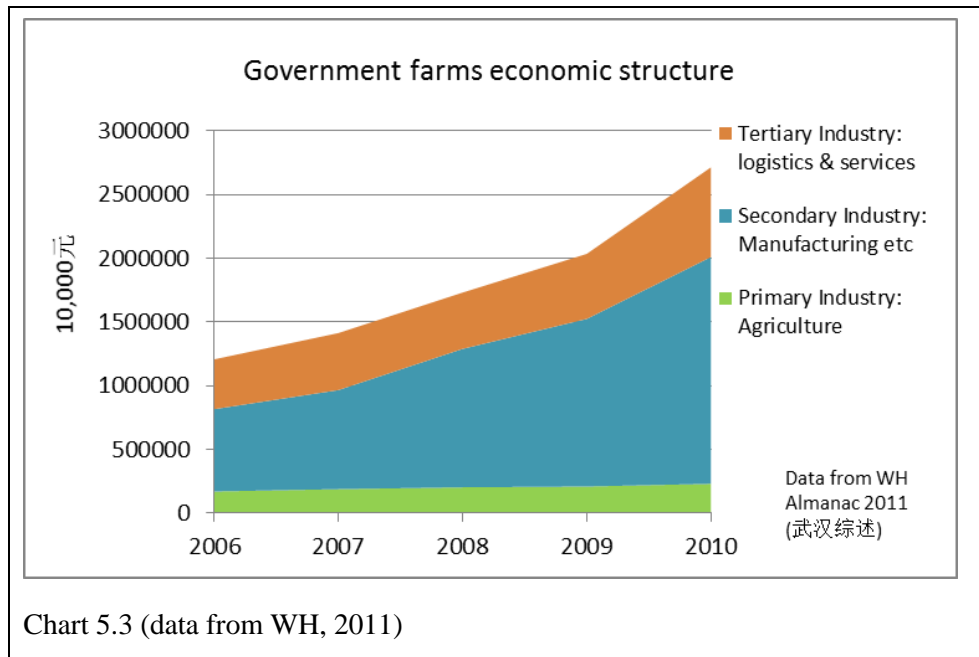
According to an interviewee at the Wuhan Agriculture Bureau the remaining 200 km<sup>2</sup> of dry field vegetable cultivation is managed by leading enterprises who farm commercially at a larger scale and other entities who hold the land on long term leases. Among these entities the most important are state farms or guoyou nongchang (国有农场). Based on government statistics it appears that the majority of vegetable production land managed in this way is in fact owned by state farms while the smaller proportion can be accounted for by leading enterprises and other such larger scale producers (WH, 2011). Before discussing how peasant farmers operate on state farm land it is first necessary to briefly describe the status and role of state farms themselves.

China has 1,785 state farms which manage a combined 6.12 million ha of arable land (5% of China's total) and are home to over 13 million people including 3.29 million agricultural labourers (according to Caixin - Wang, 2014). In Wuhan, state farms play an important role in peri-urban land management. As of 2010 there were 21 government farms in Wuhan which managed 736 km<sup>2</sup> of land in 6 of the outer districts of the city (WH, 2011, pp. 231–2). An important point about state owned farms in a city like Wuhan is that they are very different from western farms and agriculture is just one part of what they are engaged in. They are effectively land management companies and can be involved in real estate development, industry or other commercial enterprises while also being responsible for maintaining and managing farm land. In 2010 the area of cultivated land managed by these government farms was 285 km<sup>2</sup>, a further 130 km<sup>2</sup> was water (33 km<sup>2</sup> of lakes etc. and 97 km<sup>2</sup> of fish ponds), 45 km<sup>2</sup> forestry and 8.7 km<sup>2</sup> tea gardens apparently leaving 266 km<sup>2</sup> for non-agricultural uses.

In terms of their structure state farms are subdivided into management groups including branch farms, industrial groups, construction industry groups, distribution industry groups, commercial groups and production brigades<sup>8</sup>. The annual production value from agricultural activities on state farms in 2010 was just 26% of these farms' total production value while secondary industries (e.g. manufacturing, construction) accounted for 66%, having almost tripled in value since 2006 (see chart 5.3). The total population on these farms was 439,000 of which 6.9% (30,100 people) were engaged in agriculture as agricultural labourers (nongye congye ren yuan 农业从业人员) (WSB, 2012, p. 101). It is clear that farming is just a small part of what state farms are involved in.

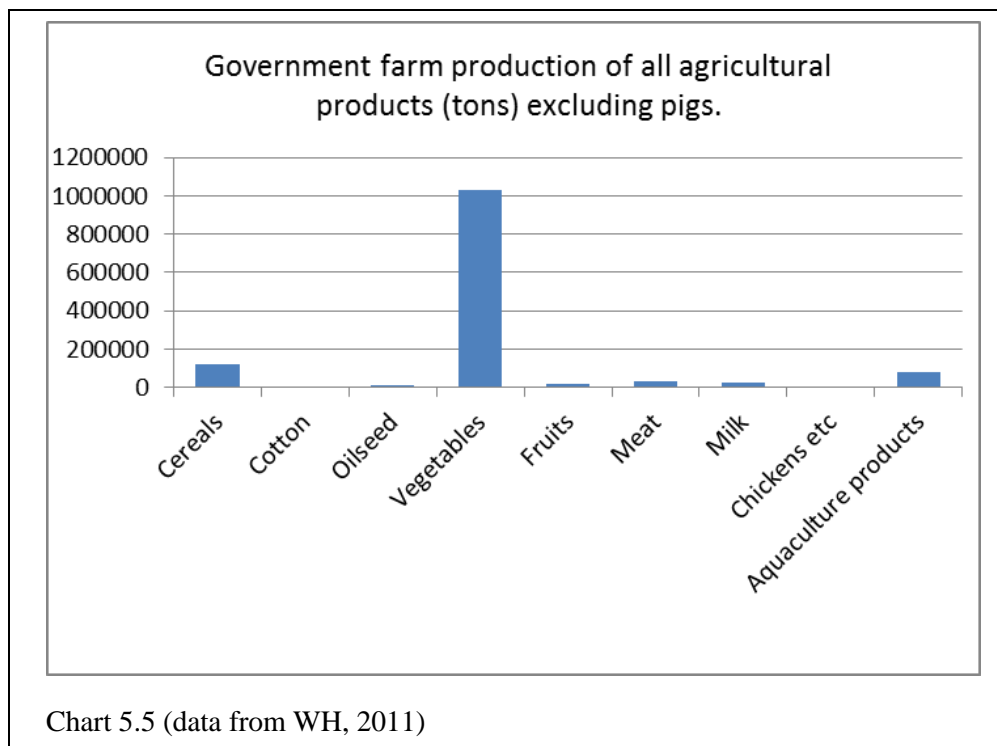
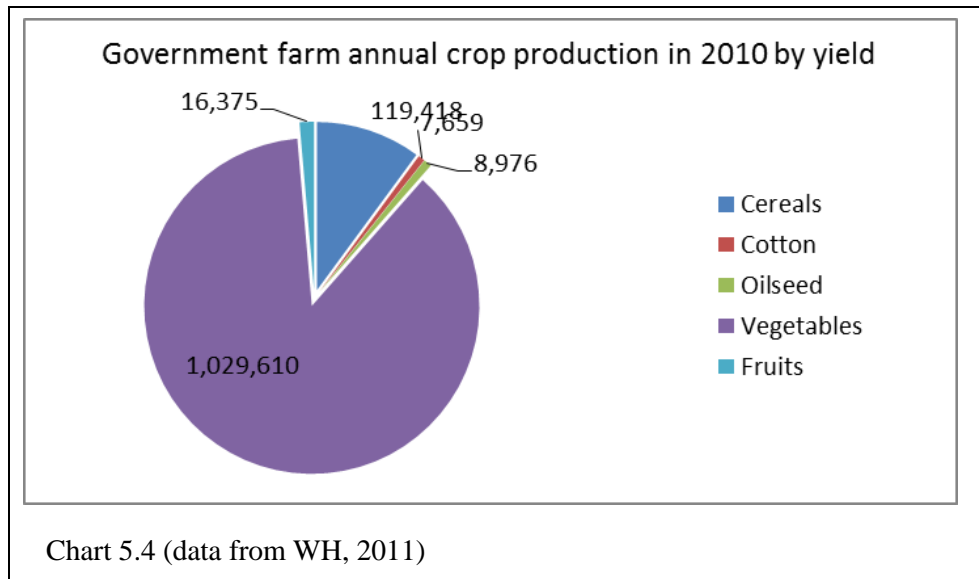
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<sup>8</sup> A production brigade (or 生产大队) is the basic work unit left over from the era of the People's Commune.



Nevertheless, measured in annual yields, vegetable production is by far the most significant part of crop cultivation on state farms amounting to 1.03 million tons (87%) annual production in 2010 (see chart 5.4 ) which accounted for over 17% of the city's total output of 5.97 million tons (WSB, 2011, p. 115). Chart 5.5 shows that even when taking animal products into account, vegetable production is still the largest sector by weight of produce (not included in the chart is annual pig production which is 391,977 pigs slaughtered in 2010). Clearly, despite their diversification into other industries, state farms still play a very important part in Wuhan's vegetable production & distribution system in their role as agricultural land management bodies.

As indicated in chart 5.2 above Hannan and Dongxihu districts, have relatively few or no village committees despite their large areas of agricultural land. This is because state farms play a larger role than village committees in land management in these districts. Dongxihu district has just over a third of Wuhan's total state farm workers and 11 out of Wuhan's 21 state farms and it was here that a relatively large number of interviews and site visits were conducted over a wide area. In particular an interview with a farm manager shed light on how vegetable production is carried out on such state farms.



The farm management rents land to local farmers (through a contract and responsibility system) for a very low annual rent per mu (in this case 60CNY in 2011 which was reduced to zero in 2012 due to the imminent land seizure for redevelopment). The state farm provides some services such as maintaining drainage ditches and road surfaces and local farmers can often have the status of official farm labourers which gives them access to health insurance schemes and small pensions on retirement. The farm manager also said that the management office helps to control the use of pesticides and organise training in agricultural techniques six times a year which is apparently open to all farmers regardless of *hukou* status. Apart from this basic level of

support, farmers (whether local or migrant) are entirely independent and decide themselves what crops to cultivate according to their own experience or market information. They are also responsible for selling their produce themselves and all profits and losses are their sole responsibility. Not only this, but in a similar fashion to farmers on village owned land, local farmers renting land from state farms also have the option of informally sub-letting to migrants who are less able to access the formal rental arrangements available to locals, a situation made possible in large part by the *hukou* system (SF Manager, 2012; Field Diary, 2013).

### ***The hukou system determines access to opportunities***

For local farmers on village owned land and state farms their user rights provide them with an asset which can become part of a diverse household livelihood. Having a local *hukou* as well as the local connections (or *guanxi* 关系) built up over many years makes it easier for local peasant farmers to benefit from the growth of jobs provided by urban development and growth in the urban economy. They also enjoy the benefits of access afforded by local *hukou* status to the subsidised health and education facilities and social security services locally available. If they live on inner peri-urban land and it becomes prime real estate for urban development they can expect to receive compensation according to the area of land and buildings they own and may even receive replacement homes in urban residential developments and benefit from the transfer of their *hukou* from rural to urban status bringing with it access to the superior quality urban public services. In addition to the right to compensation, local farmers on state farm land may benefit from status as farm labourers (农工). One farmer and his wife explained that as farm workers they also receive a pension from the state farm of 900CNY per person per month (DX-20, 2012).

Local farmers however are not the only producers involved in the peri-urban vegetable system and maybe not even be the most significant actors involved in the intensive production of FGV and OSV which is the focus of government policy. The majority of farmers interviewed on vegetable bases were actually rural migrants from beyond Wuhan's borders. In contrast to local farmers, these migrant farmers are effectively landless having left their own lands in an effort to escape poverty or as the result of displacement by infrastructure projects. Further, because they hold non-local rural *hukou* status they are also excluded from local public services and their only avenue to getting access to land for cultivation is through informal rental arrangements with local farmers. Even on state farm land they have limited access to the formal cheap rents available to locals because the farm will not rent to migrant farmers unless they have some *guanxi* – i.e. they have developed a direct relationship with farm management – because they have no way of tracing them since they are not registered locally. This means that local farmers who own land or those locals who rent from state farms through the formal low rent contracts (around 60CNY per mu) have the option of obtaining substantial rents in turn from the land they

have access to by sub-letting to migrants who have no formal access to it but who will pay up to 500-800CNY per mu on informal 'cash-in-hand' arrangements (FWD, 2013; WJS-Manager, 2012).

In Dongxihu, of the farmers interviewed, two rented around 6.5 mu each with a yearly contract directly from the company managing that part of the farm for 60 and 72CNY/mu per year respectively (DX-04, 2012; DX-07, 2012). Other farmers rented at a rate of 600-800CNY from local farmers without contracts and paying once a year in cash (DX-01, 2012; DX-02, 2012; DX-03, 2012; DX-05, 2012; DX-06, 2012). They explained that the cheaper rents were available to those with local *hukou* or who had been around a long time and had good relationships with the farm management which allowed them to rent directly from the farm management company rather than privately from local farmers. It emerged that local farmers commonly rented from the farm at these lower rates and then sub-rented the land out to migrant farmers at rates of 600-800CNY depending on land quality and position etc. (FWD, 2013).

Even for farmers from one district of Wuhan who move to another district the *hukou* is still an issue. One of the interviewees was from the Wuhan district of Hannan (汉南) but still counted as an outsider in Dongxihu district (DX-06, 2012). These examples confirm what was said by a farm manager who explained that farmers without local *hukou* are unable to rent directly from the farm so have no choice but to rent privately from local farmers at these higher rates (FWD, 2013; WJS-Manager, 2012).

What is, for local farmers, an opportunity to retreat from agricultural production and exploit the rental value of their land as part of a diversifying household income is, for migrants, an opportunity to leave behind rural poverty and pursue a better livelihood as vegetable producers. For decades, rural migrants from the relatively poorer counties of Hubei and the provinces beyond have been coming to Wuhan specifically in order to take up intensive vegetable production on land rented from local farmers, taking advantage of Wuhan's growing urban markets. This situation could be described as a cascade of opportunities generated by urbanisation and structured by the *hukou* system.

There is a spatial dimension to how this cascade of opportunities is distributed. Outer peri-urban land suitable for vegetable production tends to be used for the production of SV in rotation with grains and cotton unless it is within easy access of Wuhan's wholesale markets and has adequate irrigation for FGV and OSV production. Local farmers in these areas would be more likely to have a stake in the long term future of the land and can take advantage of national and urban markets for SV. They organise agriculture as part of a diverse source of household incomes as some family members work in the city or run small businesses. The exception to this would be the larger scale production enterprises which have the resources (larger and refrigerated trucks for transport, processing and packaging facilities) to overcome, to

some extent, the problem of distance from markets which would deter peasant households from growing FGV.

For local peasant farmers on the other hand, in addition to the difficulties of access to the wholesale markets for FGV there is disincentive to switching to intensive FGV cultivation because of the higher intensity of labour and greater risks involved in production. The livelihood mix of SV in rotation with other crops and supplemented by urban work is less labour intensive and more stable and secure than a household income entirely dependent upon intensive FGV. The final reason for the preference of this livelihood mix is the access local farmers have to national markets through long distance traders which enables them to take advantage of regional price differences and seasonal variations in supply from other areas.

On inner peri-urban land, where the incentive to begin FGV and OSV production is higher due to greater access to markets and lower financial and time-costs of transportation, local farmers are able to rent to migrants who will take on intensive FGV and OSV production for urban wholesale markets as their sole household livelihood allowing local farmers to obtain rents from their land while they work locally on urban development projects or in factories or run small businesses. Thus migrants come to play a key role in the peri-urban vegetable system as intensive producers of FGV for Wuhan's markets.

The scale of their role can be inferred from the sample of interviews conducted on production bases across Wuhan. The majority of farmers were migrants and many of the interviewees, especially on the inner peri-urban FGV and OSV areas, estimated the percentage of migrants farming in their areas at 60-80% with local vegetable producers forming the minority of 20-40%. Given the case that peasant farmers are responsible for the majority of citywide vegetable production, this implies that much of the state farm vegetable land and inner peri-urban vegetable bases on village owned land are cultivated by peasant farmers at a household scale. Further, it may be expected that a significant number, if not the majority, of these peasant farmers engaged in intensive FGV and OSV production are in fact migrants.

### **5.3 Time: The process of transformation of peri-urban space and its impact on producers**

I have shown how the spatial and structural features of the peri-urban interface shape the distribution of opportunities experienced by locals and migrants respectively and what this means for the activity of peri-urban vegetable production. This 'shaping' is not simply a static effect of proximity to the urban economy but takes place within an ongoing process of urban development and expansion which itself is evolving over time. This means that the relative proximity of land to the urban markets and the opportunities that follow change over time. The result is that what was once outer peri-urban land and largely rural in character becomes inner and eventually marginal peri-urban land before finally being incorporated into the urban fabric.

This process gives rise to a progression of opportunities for local farmers potentially leading to a long term and relatively secure improvement to their livelihoods as they gain an increasing share in the fruits of urbanisation. At the same time it creates a cycle of opportunity and crisis for migrant farmers.

The evidence for this process and its impact on vegetable production and producers can be seen through analysis of satellite imagery when interpreted in the light of the experiences of peri-urban producers described above. In four of the interviews migrant farmers were asked in detail about their route into vegetable production in Wuhan and the previous locations in which they farmed. Following their routes through satellite imagery of the different locations they have farmed shows how their movements are related to the transformation of peri-urban space and also provides evidence of how the process unfolds.

The image below (image 5.1) plots their home towns and their journeys to their first, second and in one case third place of residence as migrant vegetable farmers. The green patches are the main vegetable production bases farmed as of 2013. The white line indicates the city's 3rd ring road. The image shows these four farmers coming from counties outside Wuhan into the centre of the city where, 10 to 20 years ago there was agricultural land available to rent for vegetable production. They have since moved from these central locations to the places where I interviewed them in Dongxihu, Jiangxia and Huangpi districts. Examining the transformation which has taken place in each of these locations reveals the significant role of migrant farmers producing vegetables in inner peri-urban areas even at the earlier stages of urban expansion in places which are now largely converted to urban space.

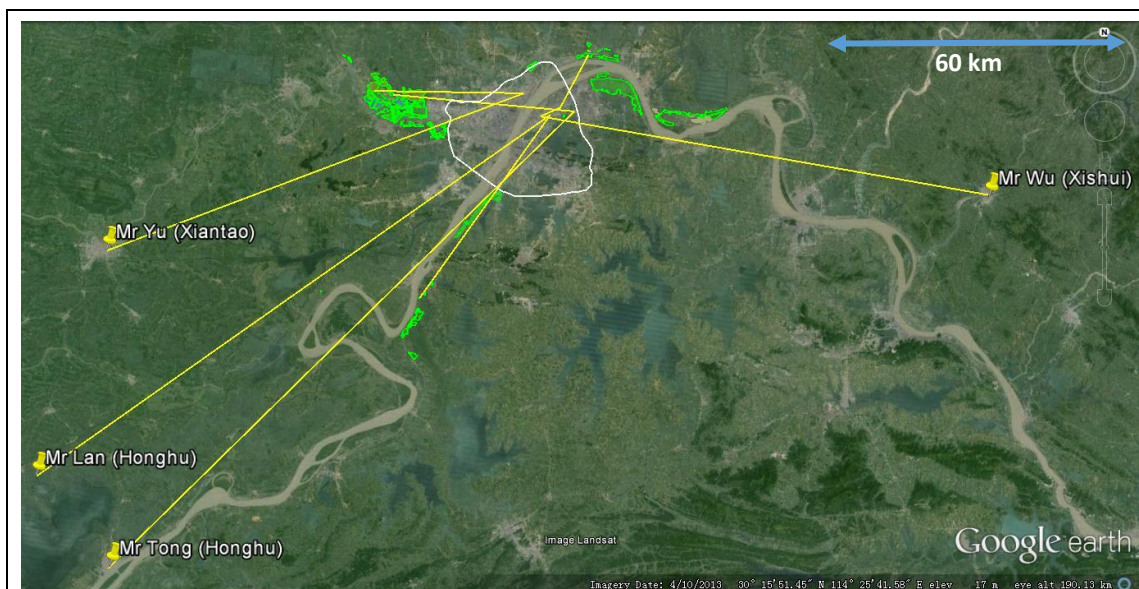


Image 5.1 Four migrants' journeys into Wuhan (the white line indicating the third ring road around the city covers an area approximately 25 km north to south and 30 km east to west).



### ***Inside the 3<sup>rd</sup> ring road – transformation from inner to marginal peri-urban***

On entering Wuhan migrant farmers look for land to rent which is as close to urban markets as possible and of a suitable condition for vegetable production. Three of the farmers above went first to the area of Hongshan district close to Wuchang urban centre between 1987 and 1996. The image below shows a section of the area where these migrant farmers first began vegetable farming. There is only limited imagery available pre-2007 so it is not possible to see the conditions and extent of vegetable production when the farmers first arrived, but it is safe to assume that the area would have been largely rural, becoming gradually more influenced by its nearness to the Wuchang city centre. In the late 1980s and 1990s when the migrants arrived to grow vegetables the land could be considered to have been inner peri-urban in that it was adjacent to the city's urban areas. Evidence of this can still be seen in the image below which shows village housing through the centre, surrounded by vegetable fields (indicated by the rows of long narrow strips of silver and green crisscrossed by narrow roads and drainage channels).



Image 5.2: Peri-urban agriculture in a central district (2007-11)

Five years later, by 2012 almost the entire area of vegetable fields has been replaced by construction sites and new buildings. At this point local farmers have begun to become absorbed into the city as urban residents and many migrant farmers have left to find alternative places to grow vegetables.



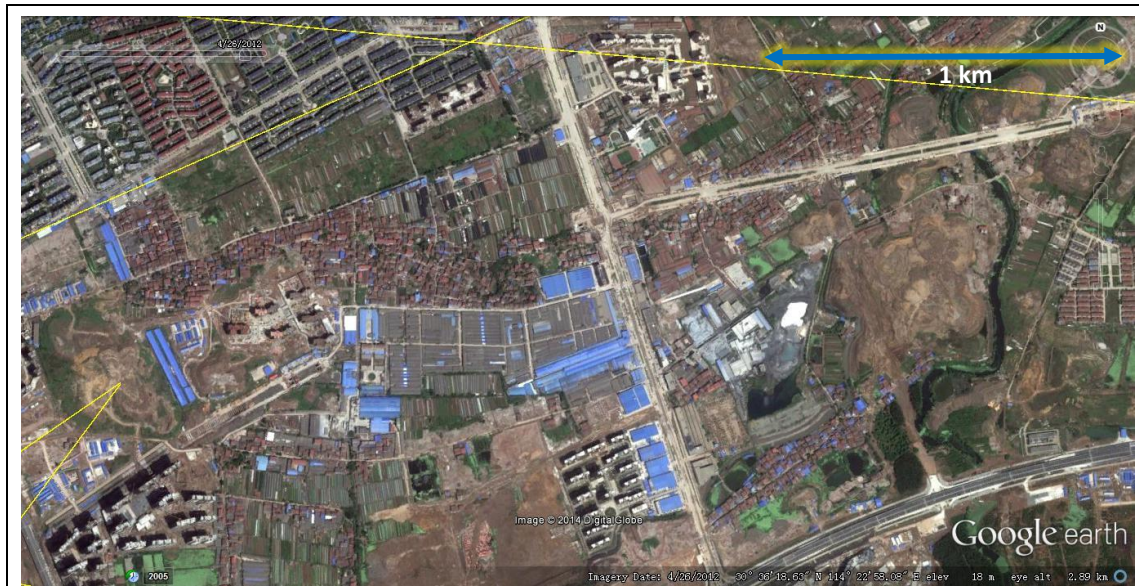


Image 5.3: Peri-urban agriculture in a central district replaced by urban land use (2012-4)

The following photographs are from a similar marginal peri-urban location at the same stage of transformation and tell the story of the impact of urban expansion on land use and livelihoods of migrants and locals. The houses of local villagers have been demolished and they have been rehoused in replacement housing in the form of apartments in the new residential developments. Some fields still remain and some migrant farmers still live in the houses they built on portions of the rented fields when they first arrived in the area. They can still make some sort of livelihood farming what is left of the fields they rent, but increasingly the land is covered by rubble from construction waste and eventually the migrants too will leave their homes.

Some of the local farmers – who still own the use rights to the fields – will have chosen to end their arrangements with their tenant migrant farmers and instead take payment from the construction companies to dump construction waste and rubble on their land. During the visit in which these photographs were taken a migrant farmer explained that when locals expected to receive compensation in 1 or 2 years they realised they could make more money from charging construction companies for dumping waste on their land than they could from a couple of years renting to migrants. Thus on driving around Wuhan it was a common sight to see piles of earth and rubble snaking across fields adjacent to village style housing and occasionally interspersed with the shacks of migrant housing and some remaining vegetable cultivation. This implies that some of the migrant farmers who cultivate such land are deprived of a livelihood even before they have any chance of seeing whether or not they are to receive any compensation for the loss of their homes. In fact, one farmer reported that the locals from whom his community rented land had tried to claim the migrants' homes as their own so as to secure higher compensation for themselves when they were finally demolished.

The migrants however are unlikely to receive replacement homes or compensation for the loss of livelihood and houses. Instead, they will follow those who have already moved on to begin again growing vegetables on land further out from the city centre. Indeed, the three farmers I interviewed had moved on from these now marginal peri-urban areas in 2000, 2006 and 2009 respectively.

Images 5.4 Photographs of old and new housing in peri-urban agricultural areas.



New apartments and villagers house still standing amidst the rubble of what is left from the village



New apartments, some of which are likely to be those offered to locals as compensation for the loss of their houses



Migrants' housing lining vegetable fields



A pile of construction rubble on what was once a vegetable field



Each stage of the process is visible: vegetable fields, dumped rubble, new construction

From these photographs and satellite images it is possible to show the existence of vegetable production by migrants in the central districts and how this has been displaced. These images together with the testimony of those farmers who once farmed these fields provide evidence that at least by the 1990s migrant farmers were significant actors in vegetable production on inner peri-urban land in Wuhan's central districts which are now largely urban with pockets of marginal peri-urban land remaining. The implication is that the same process would be repeated in areas further out from the city centre which are being transformed from outer to inner and marginal peri-urban areas themselves. A visit to one of these areas in Dongxihu district provided further evidence of this.

***Beyond the 3<sup>rd</sup> ring road – transformation from outer to inner peri-urban***

Dongxihu has seen a steady decline in the percentage of land under cultivation from 33.7% down to 29.8%, a loss of 1,680 ha. This is consistent with the economic changes in State Farms identified previously, a large proportion of which are in Dongxihu. It also matches the satellite image evidence of urban expansion (image 5.5). The following three images (5.5, 5.6, 5.7) show a 15 by 8 kilometre (12,000 ha or 27% of the district's total 43,919 ha) section of the southeast of Dongxihu closest to its urban town centre (far right of the image) and bordered by the Yangtze river along the bottom. In 1999 the area was almost entirely agricultural land – outer peri-urban. By 2008 nearly 600 ha had been converted to urban land and by 2010, approximately another 600 ha. The urban expansion seen in these images represents about one third of the loss of cultivated land in Dongxihu between 2008 and 2011 when, according to the Yearbook, the area of cultivated land was reduced by 1,680 ha. Evidence from interviews in the area and the district government's own 5 year development plan indicate that further large scale conversion of agricultural land to urban residential and commercial use is imminent as the development plan has designated a large area of Dongxihu as a commercial development zone.



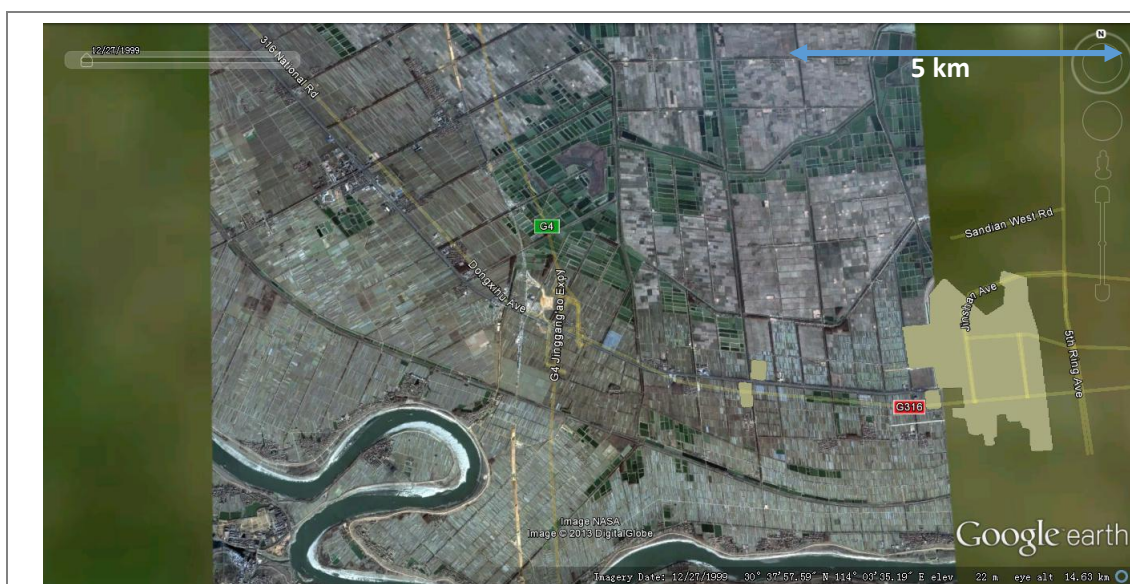


Image 5.5: Land-use change in Dongxihu 27-12-1999



Image 5.6: Land-use change in Dongxihu 20-5-2008



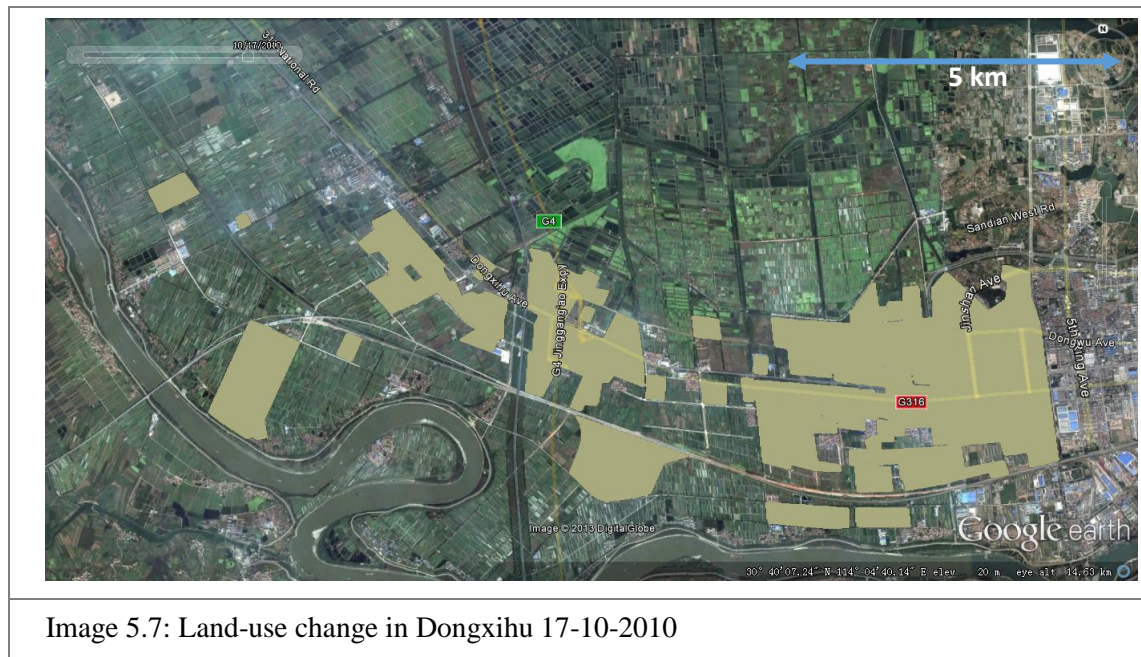


Image 5.7: Land-use change in Dongxihu 17-10-2010

Examining the satellite images of Dongxihu in greater detail and at various points in the past allows one to distinguish between farmland with and without migrants present and between grain and intensive vegetable production and to plot the changes over time. It was also possible to plot the changes in land use from agricultural to industrial/commercial. As an example which demonstrates the whole process of land conversion the area marked in purple outlined in the image below has been selected (image 5.8). The tiny yellow square shows the location of the Qiangxin co-operative which I visited and where the co-operative director was interviewed.

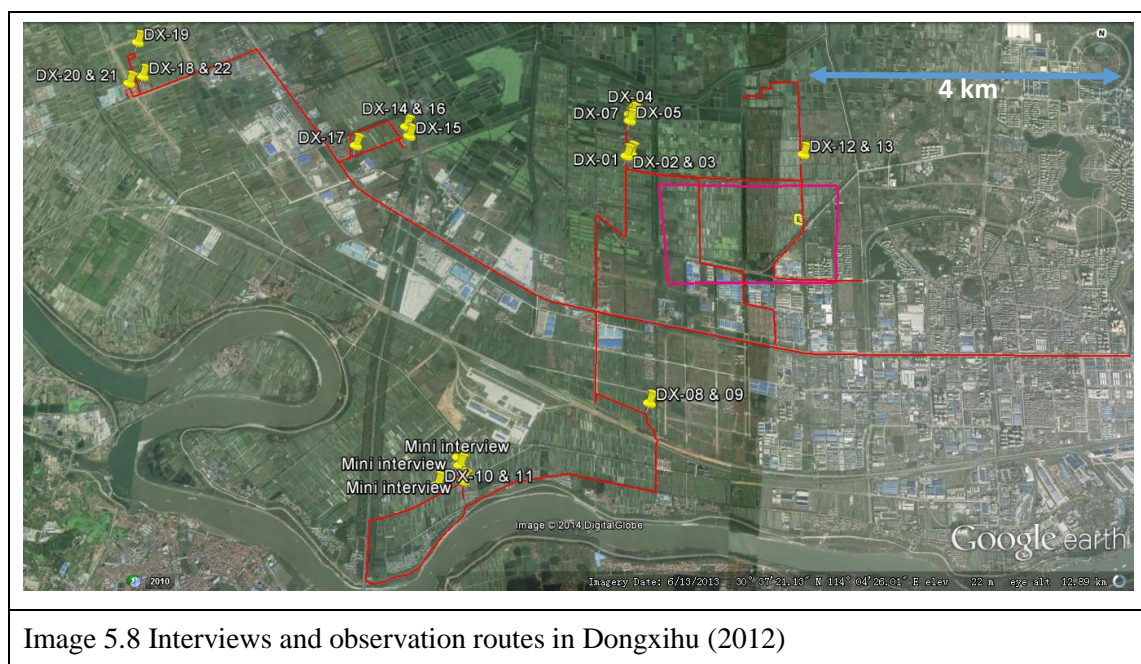


Image 5.8 Interviews and observation routes in Dongxihu (2012)

In 1999 (see image 5.9 below) square fields can be seen north of the tree-lined road which bends north at the bottom of the image and cuts through the top right corner. These are probably used for grain or cotton cultivation. There are no houses lining the fields but the village houses sit along the tree-lined road. South of the road is a rectangle of vegetable fields cut into strips and dotted with houses. Another area of similar vegetable fields sits on the right of the image. These are migrant communities most likely renting either from the government farm (who administers this land) or from the local farmers directly.



Image 5.9: Farmland in Dongxihu (1999)

This next image from 2003 (image 5.10) shows some interesting changes. The two patches of vegetable cultivation at the bottom and right hand side of the image have been cleared and the houses removed. The land north of the road has begun to be used for vegetable production with a lot of polytunnels which implies intensive cultivation of FGV. The little white rectangles of migrants' houses can be clearly seen lining the new vegetable fields.





Image 5.10: Farmland in Dongxihu (2003)

By 2008 almost the entire area north of the road is now migrant vegetable production (image 5.11). The narrow strips of brown, green and white are indicative of intensive cultivation of vegetables, in particular green leafy vegetables and the use of polytunnels. The small white rectangles of migrant housing are clearly present across the entire area. In addition, a cement factory has been constructed at the bend in the road indicated by the blue roofs typical of commercial and warehouse structures (one of the first steps towards re-development).



Image 5.11: Farmland in Dongxihu (2008)

It is now 2010 (see image 5.12). The vegetable production continues and south and east of the road urban development progresses. A complex of high-rise apartments has been built on what was migrant vegetable production in 1999.





Image 5.12: Farmland in Dongxihu (2010)

This final and most recent image from 2013 (image 5.13 below) shows a stark outcome. The land north of the road is now wasteland. Vegetable production has been abandoned and nearly all the houses have gone. More detailed satellite images of the area reveal the dramatic difference before and after clearance.

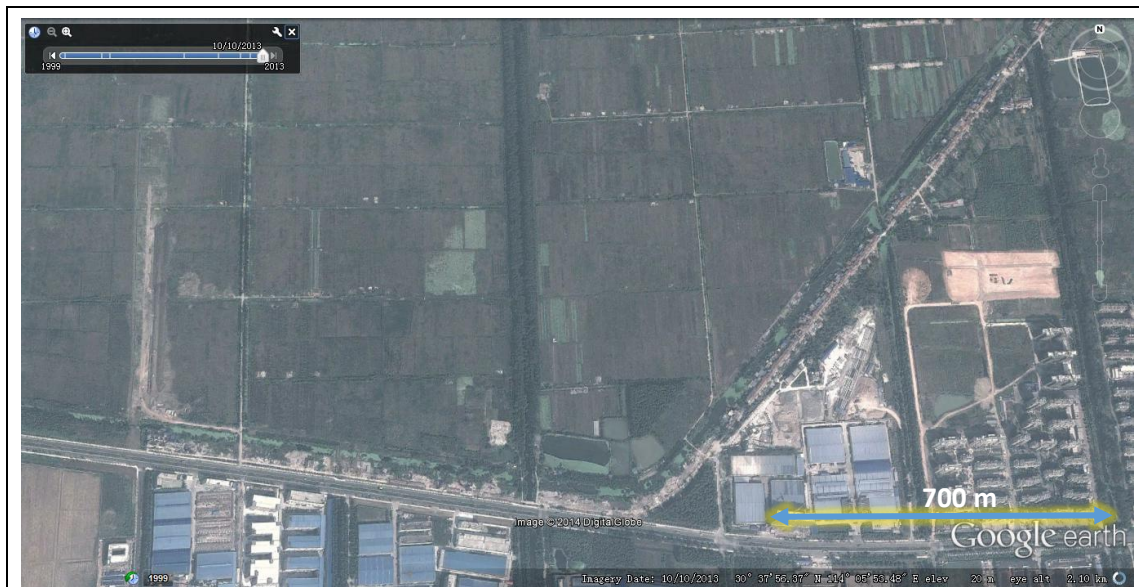


Image 5.13 Farmland in Dongxihu (2013)

This close up image below from 2010 (image 5.14) shows most clearly the narrow strips of vegetable fields. The bright green patches are ripening vegetables coming ready for harvest. The dull green patches on the ends of some of the bright green strips are where harvest has begun and waste plant matter has been left behind on top of the soil. Fields which have been re-tilled or re-planted are brown. The duller silver strips are where plastic mulch has been used to cover



the soil into which fruiting vegetable crops are planted. The white strip on the left is a sign of the more reflective plastic polytunnels used to speed up growth of leafy vegetables and grow off-season crops. Relatively small and dispersed houses can be identified at the ends of the fields, built actually onto the fields themselves and alongside the drainage/irrigation ditch which cuts through the middle of the image.

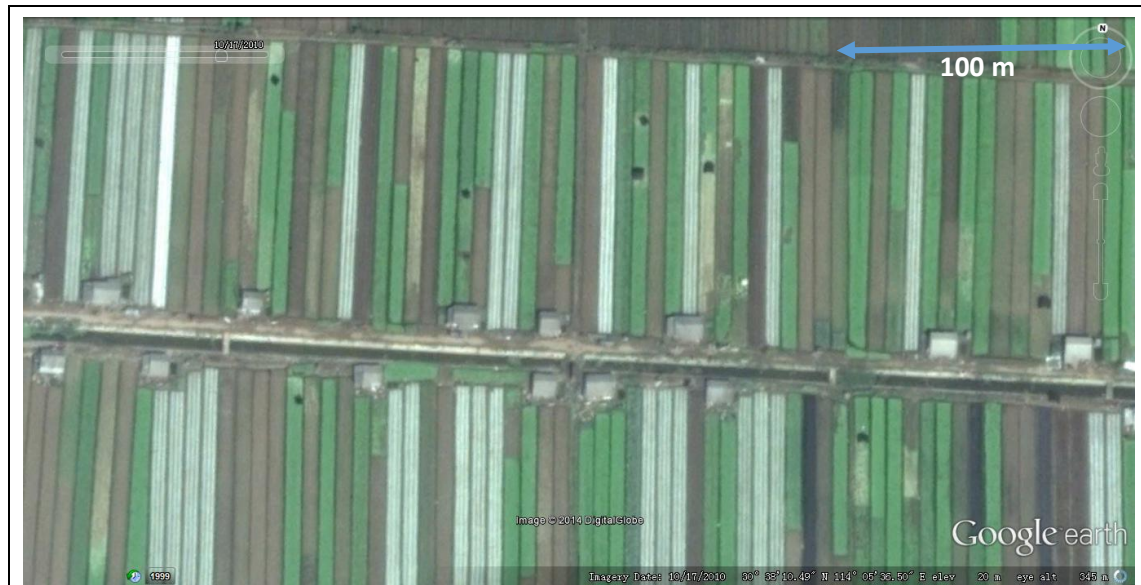


Image 5.14 Close-up of farmland in Dongxihu (2010)

The next image (5.15) of the same piece of land in 2013 shows the fields now overgrown and the houses have completely disappeared.

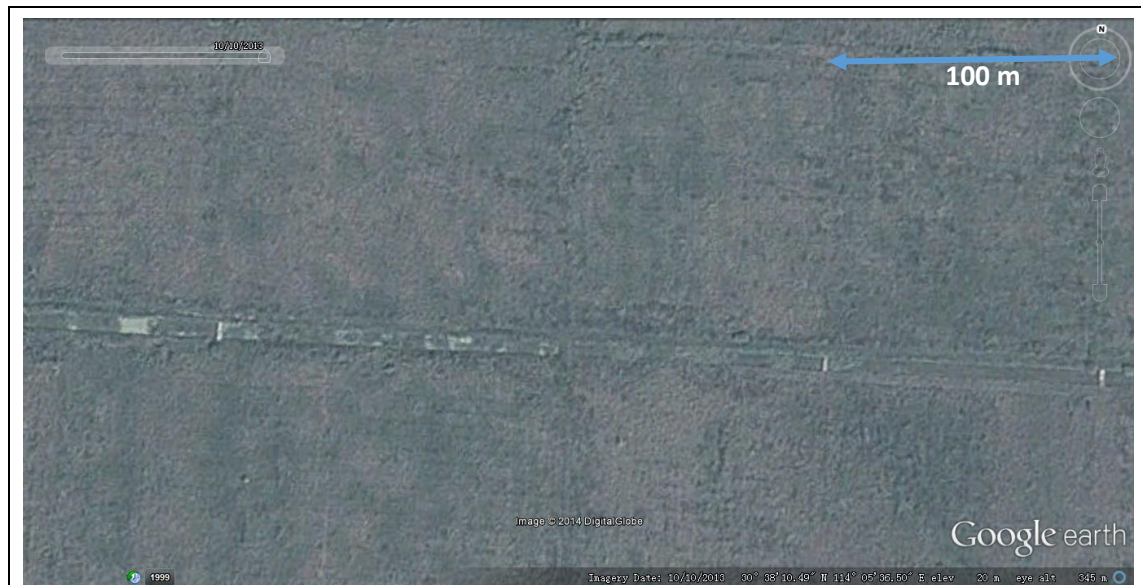


Image 5.15 Close-up of farmland in Dongxihu (2013)

When interviews were conducted in the area in May-July 2012 the fields were still cultivated. Migrant farmers were living and working all over the area and in some places new families had moved in having been removed from other areas as urban development spread. There were, however, already signs of imminent re-development of the area and the interviewees knew they would have to move on soon. I returned to the area in December 2012 to interview one of the farm management officials. By that time people had already started to leave and clearance had begun.

This series of images reveal in small scale the process of the conversion of land from local grain production to migrant vegetable production and finally to clearance and re-development. Having witnessed first-hand the final phase of this process and after discovering the ease of remotely observing the longer process in the satellite imagery, I went on to visually analyse satellite imagery across Dongxihu from 1999 to the present to see what it would reveal about the scale of this process. The result was startling.

The following sequence of images show the changes in vegetable production that have taken place over a larger scale in Dongxihu. In 1999 (image 5.16) there was already a significant area of migrant vegetable production (light green filled areas) as well as some local farmers also growing mixed vegetables and grains (light blue filled areas). The extent of urban development is indicated by the grey area on the right. The rest of the agricultural land in this image is mainly grain or aquatic products.



Image 5.16: Migrant and local agricultural production in Dongxihu (1999) **Key:** Light green shading = migrant vegetable production; Light blue shading = local farmers growing mixed vegetables and grains.

By 2012 (image 5.17) the urban and commercial land use has encroached on the agricultural land and former grain producing land has been newly taken over by migrant farmers to grow vegetables (yellow filled areas). The areas shaded in yellow were all converted to vegetable production between 2008 and 2010. There has been a displacement of vegetable production land outward as urban expansion has continued. This also represents the displacement of the settled migrant population.



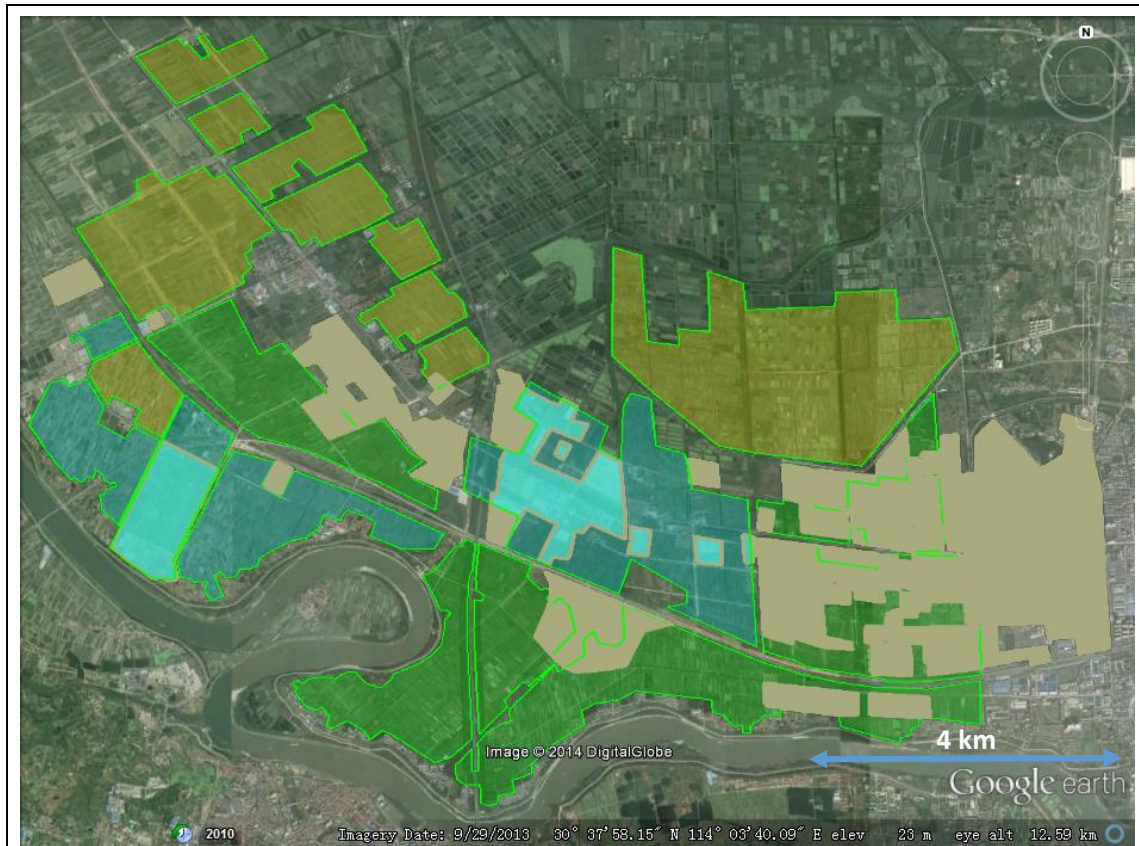


Image 5.17: Migrant and local agricultural production in Dongxihu (2012) **Key:** Light green shading = migrant vegetable production; Light blue shading = local farmers growing mixed vegetables and grains; Yellow shading = land formerly farmed by locals now used for vegetable cultivation by migrants.

By 2013, however, one can see clearly that most of these new migrant vegetable production areas have already begun to be cleared for redevelopment (see image 5.18 below).



Image 5.18: Migrant and local agricultural production in Dongxihu (2013). **Key:** as in image 5.17.

Thus many of the migrant farmers who have moved to such areas had a very short window of 4-6 years in which to grow vegetables and earn as much money as possible before being moved on again.

The process highlighted above is widespread in Dongxihu as an interview with one of the farm's managers demonstrated. He told me that WJS farm was established in 1958 with around 20,000 mu of land (1,333 ha). As Wuhan's development of a high tech zone (Wuhan shi gao keji jingji kaifa qu, 武汉市高科技经济开发区) in Dongxihu has progressed most of the farm's land has been taken over for re-development. There is now approximately 3,000 mu (200 ha) left. 1,000 mu of that is fish ponds (yuchi, 鱼池) and the other 2,000 mu is dry land (han di, 旱地). Within 3 years the interviewee expected the remainder of the farm's land would have been re-appropriated for development (WJS-Manager, 2012). Dongxihu district has a total of 11 such state farms of similar size. Most of them have also been largely re-appropriated for development as urban expansion has continued. The three that remain mostly intact are Dongshan (东山), Xinandu (辛安渡), Baiquan (柏泉) farms.

What these series of satellite images show is that the stories of the migrant farmers interviewed are not isolated accounts. Migrant farmers have been involved in vegetable production in central districts of Wuhan alongside local farmers for two or three decades. While there was little evidence of this remaining at the start of my fieldwork, it has been possible, through historical satellite imagery, to witness the first stage of a process which has unfolded across Wuhan. As the central districts became more urban and expanded into surrounding agricultural land an opportunity opened up for migrant farmers to rent vegetable fields from local farmers as they in turn were able to take advantage of the opportunities provided by urban development.

Within a decade, as these central districts have become almost completely urban and the peri-urban districts have simultaneously developed larger urban centres, migrant vegetable farmers have moved further out from the city to those areas of agricultural land near to the urban centres of these outer districts. However, as the interviews have revealed, farmers who have moved from central to peri-urban districts are soon to be moved on again as urban expansion continues.

## Conclusions

The characteristics of a vegetable production system embedded at the peri-urban interface have a deep impact on the activities of production and the lives of producers. The effect of proximity to urban markets and infrastructure mean that the land most likely to be farmed most intensively for vegetables is marginal and inner peri-urban land. It also means that different

types of crops are grown in different areas with FGV and OSV more typically grown within easy reach of Wuhan's urban wholesale markets while SV, more amenable to storage and long distance transportation, are more suitable for cultivation on outer peri-urban land as part of crop rotations and for sale in Wuhan and beyond.

The institutional structures governing land use and access to social goods combine to generate a hierarchy of opportunities in which local farmers can transfer or monetise their land use rights and gain access to urban jobs to diversify their livelihoods. The labour intensive nature of FGV and OSV cultivation is a disincentive to local farmers to base their livelihood strategies on such cropping systems, particularly when there are alternatives. One of the alternatives is to rent land out to migrant farmers and seek urban employment. These alternatives become more viable on inner peri-urban land because migrant farmers are willing to pay relatively high rents for such land which can sustain a livelihood solely or mainly dependent upon intensive vegetable cultivation. Thus, the intensive cultivation of FGV and OSV on inner and marginal peri-urban land for sale in Wuhan's wholesale markets becomes largely the domain of migrant farmers.

The livelihood opportunity provided to migrant farmers as a result is, however, one which is periodically disrupted by the large scale, ongoing process of the transformation of peri-urban space. The land which supports the majority of intensive cultivation by migrant farmers is also prime real estate for redevelopment. As urban expansion continues, this land is often the next in line for seizure by local government to be redeveloped for urban residential and commercial/industrial uses. At this stage, local farmers have the right to expect some level of compensation and increasing access to urban public services and opportunities while migrant farmers lose their livelihood, having few choices but to move on to other land to set up as vegetable producers all over again.

Government policies aimed at promoting persistence, adaptation and transformation of the vegetable production system (with a view to enhancing urban vegetable supply and building resilience) are implemented in the context of an already ongoing process of rapid and large scale transformation. These ongoing processes will have a major influence on how urban vegetable production policies unfold on the ground, and the success in achieving stated goals, but are apparently not recognised or addressed in policy development. Notably, this is a process which perpetuates a situation in which those producers most crucial to the supply of a large proportion of vegetables may also have least access to the policies which are designed to enhance persistence and adaptation of system structures.

## Chapter 6. Step 3a – Incumbent sub-system

***RQ 3. What are the characteristics of, and interactions between, the incumbent and emerging sub-systems in the peri-urban interface and how do they contribute to system outcomes and their resilience?***

*How do sub-systems contribute differently to food security, environmental and livelihood outcomes?*

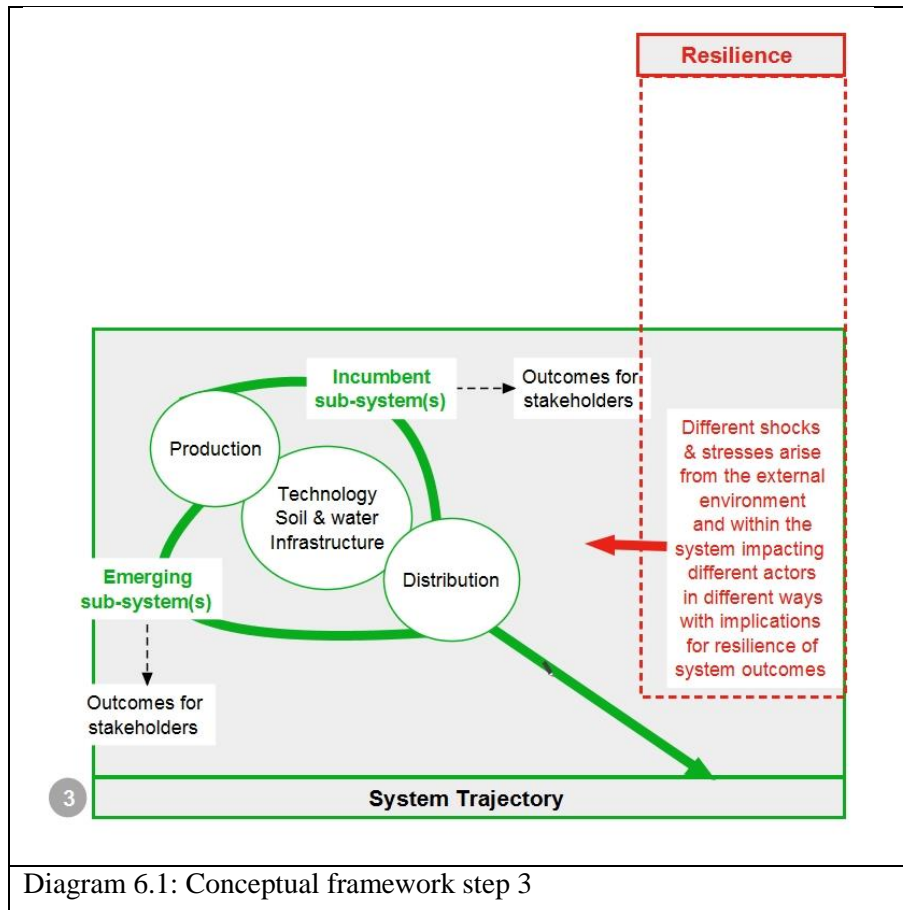
*What shocks and stresses are experienced by system actors and how do these impact outcomes?*

*What does this imply about the resilience of these outcomes?*

*What structures does the resilience of these outcomes depend on?*

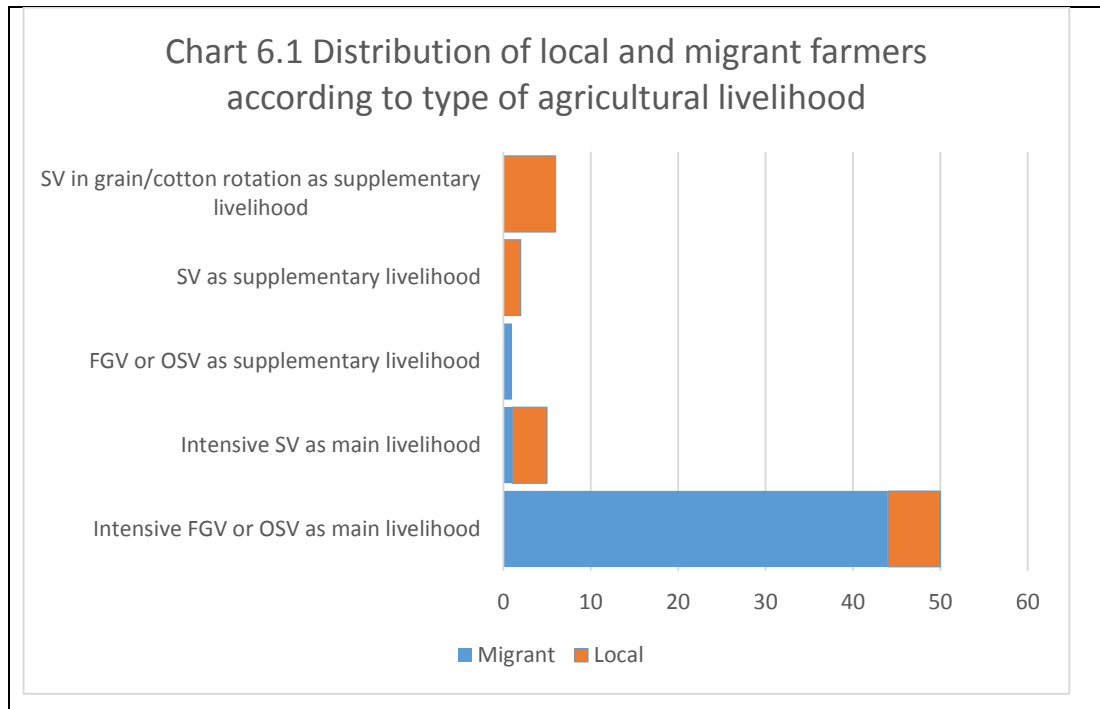
### ***Introduction***

The previous chapter showed that the roles of local and migrant farmers in the peri-urban vegetable system are quite different as reflected in the different livelihood strategies adopted by each group respectively. The interview data presented in this chapter illustrates how these different roles translate into different cropping systems (FGV, OSV, SV in rotations) and types of production (intensive or as a side-line activity) which in turn characterise the contrasting involvement of migrants and locals in what I have described as the incumbent sub-system of peri-urban vegetable production. The discussion emphasises the experiences and opinions of migrant peasant farmers as the main producers in the key sub-system centred on intensive production of FGV and OSV for local markets. While local farmers are also involved as producers (not just landlords) to some extent, they are nevertheless more often closely involved in SV production for sale across China and thus with less significance for Wuhan's urban food system. Conclusions are drawn about how the sub-system contributes to the different food system outcomes and the farmers' experience of shocks, stresses and constraints are interpreted in order to assess the structures upon which resilience of those outcomes depends (see diagram 6.1).



The following chart 6.1 shows the distribution of local and migrant farmers according to different types of agricultural livelihood. Using NVIVO a node was created for each interviewee and a set of characteristics were attributed to each node based on the interview data. *Hukou* status was used to separate them into the two groups of ‘migrant’ and ‘local’ farmers shown in orange and yellow boxes below. Next, they were categorised by cropping systems: FGV or OSV under polytunnels (fast growing leafy vegetables and off-season vegetables), SV (staple vegetables, usually open field), rotation cropping involving grain, cotton and some vegetables. Finally, the interviewees were categorised according to type of production: intensive and continuous cultivation or cultivation as side-line activity alongside other non-agricultural activities. The resulting bar chart shows that nearly all the migrant farmers were engaged in intensive cultivation of FGV and OSV (i.e. protected under polytunnels) as their main or sole livelihood while local vegetable farmers displayed a variety depending on their specific circumstances. Some grew a mixture of FGV and OSV intensively as their main source of income while others grew SV intensively as their main livelihood or as a side-line activity to supplement other income sources or instead incorporated vegetable cultivation in rotations with grains or cotton.





Intensive cultivation of FGV and OSV took place on areas closest to urban markets (marginal and inner peri-urban land) and formed the main or sole source of livelihood for migrants. On outer peri-urban land the pattern tended to be for local farmers to grow SV or other vegetables as part of a broader mix of agricultural and non-agricultural incomes. The pattern of involvement this implies is summarised in the table below (Table 6.1) which indicates how migrant and local peasant farmers contribute to the production of different crops for different markets and in different spaces. The role of private and state enterprises and co-operatives is left in question to be clarified in chapter 7.

Table 6.1: Food system involvement (the picture so far)				
Spatial distribution of production activities	Markets >  Crops √	Wuhan's markets	National export	International export
Outer peri-urban land	SV	Local farmers (as part of main agricultural income or mixed agricultural & non-agricultural incomes)		
Marginal & inner peri-urban land	OSV	<div>Locals as landlords</div> <div>↕</div> <div>Migrant tenant farmers (as main or sole source of income)</div>		
	FGV			
			?	<div>Private &amp; state enterprise</div> <div>/ co-operatives?</div>
<b>Key to table:</b> Yellow shading = local farmers' involvement; Orange shading = migrant farmers' involvement; Blue highlighted text = potential growing involvement of private and state enterprises. Black two-way arrow indicates relationship between local farmers and migrant farmers. Red arrows indicate hypothesised movement of private and state enterprises into different types of production for different markets.				

This table shows that migrant farmers play an important role in peri-urban production of FGV and OSV for Wuhan's markets thus making a key contribution to urban food security. Local farmers are less important as producers but still retain a key role as landlords to the tenant migrant farmers. Thus the emphasis of this chapter dealing with the incumbent sub-system is on the production and distribution of FGV and OSV in which migrant farmers are the main actors. Three nested case studies are presented using data from interviews and observations on three types of location around Wuhan providing a broad view of the range of situations in which migrant farmers live and farm set against a contrasting case of local vegetable farmers. These are presented in section 6.1. and include: 1) a large vegetable base on marginal peri-urban land managed through the village committee system; 2) the largest area of state farm managed vegetable bases on inner peri-urban land; 3) two locations on outer peri-urban land where the main vegetable producers are local peasant households farming SV as part of mixed agricultural/non-agricultural livelihoods. Section 6.2 explores the livelihood outcomes of the incumbent sub-system in terms of the 'livelihood potential' available to peasant farmers, particularly migrants, and their 'livelihood security'. This leads on to section 6.3 which introduces the initial features of the system which contribute to environmental and food security outcomes. Finally, section 6.4 draws analysis of these outcomes together and discusses briefly the nature of their resilience.

## 6.1 Nested cases

### *Nested case 1: marginal peri-urban vegetable base*

The largest area of vegetable production on marginal peri-urban land was a 1,840 ha site situated between the river to the north, Wuhan's steel manufacturing complex to the west, a new oil refinery under construction to the east and a collection of factories making furniture and other products to the south. At the time of my visit the construction of a multi-lane road linking the city with the refinery was underway indicating the impending redevelopment of the area.



Image 6.1: Vegetable base in industrial zone. **Key:** area of vegetable fields in green shading, observation routes in red, interview locations in yellow, former agricultural land converted to urban use in grey.

Migrant farmers had moved to the area in the late 1980s and 90s to rent land for intensive vegetable cultivation. Farmer GY-03 explained he had arrived in 1987 having seen an advert in the provincial paper which indicated that there was an area of 6,000 mu of land which needed farming as national policy forbade letting it become waste land. The local authorities invited peasant farmers from beyond Wuhan to settle here as vegetable producers. They were given formal use rights to the land and were permitted to build their own small single storey (pingfang) houses next to their fields and they also received technical training and support to help them become established as vegetable producers (FWD, 2013, pp. 18–23; GY-03, 2012).

The interviewees estimated that the whole area of agricultural land was home to approximately 1,000 migrant households all of whom were engaged in vegetable cultivation (approximately 3-4,000 people based on average household sizes) (FWD, 2013, p. 19). There were also locals living in the area but they lived in substantial houses in the villages clustered along the main roads through the area and apparently had nearly all abandoned agriculture for

urban employment. Locals, however, still played a key role as landlords. In the past few years the land use rights had been returned to local farmers by the local government (probably to ensure they retained access to compensation arrangements on seizure of the land for redevelopment). Local farmers had then rented the land back to migrant farmers at the relatively modest sum of 2-300CNY per mu. Nonetheless, there was some considerable resentment expressed at this state of affairs. Many migrants had been there two decades and felt they had some right to the land (FWD, 2013, pp. 18–23).

The farmers here grew ‘conventional’ unlabelled OSV under polytunnels for sale in the nearest wholesale markets. The reasons given were that FGV required too much labour, were vulnerable to pests and required more irrigation than was easily accessible on that land. By contrast OSV such as eggplant, cucumber, beans, tomatoes and chillies grown under polytunnels to extend the season had relatively high prices and stable yields and do not require as intensive in-field management (GY-01 to GY-10). On the other hand, OSV generally require a higher level of knowledge and skill than FGV. Because this is a long established vegetable base and the migrants who had been there from early on benefitted from technical support and training provided by the local government they have been able to gain the necessary experience to cultivate more technically demanding crops and they also displayed a consideration for maintaining the quality of the soil reporting that common practice was to combine the use of chemical with locally available organic fertilisers. Nevertheless, some farmers reported that soil fertility was declining and one observed an increase in soil transmitted plant diseases (GY-01, 2012).

Images 6.2: Photographs of peri-urban agriculture in industrial zone.	
	
Industry surrounding the agricultural land	The new oil refinery being built on the banks of the river





New multi-lane road to the oil refinery



Factories very close to fields



Housing in the village



Housing in the village



Migrant housing next to fields



Migrant housing in close up

### ***Nested case 2: inner peri-urban vegetable base***

The largest area of intensive vegetable production on inner peri-urban land is in Dongxihu district spread out between the urban centre of the district in the east and the Han river to the south stretching between the third and outer ring roads. The land is flat, well irrigated with a good network of hard surfaced access roads. The land is managed by state farms and home to a mixture of local farmers living in the clusters of two storey village style housing along the main roads and migrant farmers living in tents, shacks and pingfang (single storey brick or breezeblock housing) on the edges of the fields they cultivated as the tenants of locals. The area here was not as long established as the first case study site and historical satellite imagery showed that fields had been converted from grain to vegetable production relatively recently with the arrival of migrants. Sites on four separate state farms were visited revealing a range of situations and experiences.

The first, WJS farm, was nearest the urban centre of Dongxihu and some parts of the land were already in the process of being abandoned in advance of redevelopment. Nevertheless, there were a mixture of new arrivals and those who had been there some years as evident by the presence of temporary tent dwellings among the more substantial pingfang housing. Once an area has been assigned for redevelopment the local government typically enacts a ban on housing construction to prevent peasant farmers filling their fields with shells of houses in a bid to obtain higher compensation when land clearance takes place. This means that migrants who arrive once the ban has already begun are unable to construct homes or even toilets and have no option but to live in temporary dwellings such as shacks or tents.

Two interviewees who had been living on WJS farm since the early 2000s explained that in the beginning there were subsidies and some financial support for producers (DX-02, 2012). They had come to the farm on the introduction of friends and developed a relationship with the production brigade management. Farmer DX-02 himself had been designated an ‘Advanced Producer’ (zhongzhi xianjin geren 种植先进个人) for two years in a row obtaining cash prizes of 300 and 800CNY each year respectively. Lately, however, the local management and government’s interest has tailed off although the polytunnel subsidies have increased bring down the cost of construction (DX-02, 2012; DX-03, 2012).

One of the new arrivals, the household of Mrs Lee, lived in a tent by the side of the field they rented. She explained that they had moved to the area just 6 months ago having previously started their new lives as vegetable producers in another area of Wuhan in 2007. On arrival in WJS farm they were unable to build a more substantial dwelling (or even a toilet outbuilding) due to the ban on house building. They had saved enough money to construct polytunnels on some of their land. As newcomers to vegetable production in Wuhan they had not received any training but learnt basic techniques from other farmers (DX-05, 2012).

Interviewees estimated that around 80% of the vegetable farmers in that area were migrants and they mostly grew FGV as the main crop group but also some OSV such as beans, tomatoes and zucchini. These were taken by farmers themselves by electric tricycle to be sold in the nearby wholesale market 12 km away. Land rents for migrants ranged from 600 to 800CNY per mu, some of the highest reported in the interviews.

All of the farmers reported using chemical pesticides (high levels are required for FGV) and most relied on chemical fertilisers and the crops they grew were unlabelled and to be sold as 'conventional' vegetables in Wuhan's wholesale markets. The soil fertility was reported to be low and declining as a result of continuous cropping such that farmers were dependent on chemical inputs (DX-03, 2012). DX-04 explained that organic fertilisers were too expensive although another farmer who had received training from government technicians made a point of using organic fertiliser in combination with chemical fertilisers (DX-07, 2012).

Interviews on farms revealed a similar situation to that observed on WJS farm. JH farm was already in the process of being redeveloped so that remaining migrant farmers were cultivating the land rent free as the management were expecting to clear the area imminently. Vegetable production had started here in the 1980s through the invitation of the local production brigade who provided technical training for the first few years as migrants began to arrive (DX-08, 2012). Newer arrivals learnt in turn from those already established (DX-09, 2012). Farmers grew OSV under polytunnels and sold to field-side traders or took produce themselves to the nearby wholesale market.

CH, ZML and XG farms were further out from urban areas but it appeared that even here migrant farmers were the majority of vegetable producers. A similar contrast in housing conditions was observable all over these areas with the homes of local farmers being substantial two or three storey dwellings clustered in villages while migrant farmers lived in shacks or brick build pingfang homes alongside their rented fields. On one site some of the migrant farmers rented accommodation as well as fields from the farm management. Differences in the cost of land use were also reported with locals paying relatively low annual rents (or nominal land tax) of between 100-200CNY per mu and migrants paying between 300 and 400CNY.

Migrant farmers on these other farms also grew OSV and FGV, often under polytunnels, which they transported by electric tricycle to local wholesale markets. Declining soil fertility due to continuous intensive cultivation was a common observation (DX-12, 2012; DX-13, 2012; DX-16, 2012; DX-17, 2012). One farmer claimed that pest problems had increased after the period of continuous cultivation (DX-20, 2012). Another explained that he would not use organic fertiliser because its effect was too slow (DX-21, 2012). Nearly all farmers said vegetable production depended on chemical fertilisers and pesticides largely due to low and declining soil fertility.



In contrast to the situation in the first nested case, many of these farmers were on their second move since arriving in Wuhan to become vegetable producers. Some had arrived in Wuhan in the late 1980s or early 1990s starting off on land in the central districts before being displaced as the land was redeveloped for urban residential use and infrastructure projects. Others had arrived more recently in the late 1990s and 2000s and had either come straight to the present location or started off elsewhere, closer to urban areas. The later arrivals had all come on the introduction of friends and contacts rather than through formal invitation by production brigades as characterised by the stories of the earlier migrants. All these farms were due to be redeveloped in the next 1-5 years so that migrants who had recently moved to those areas would soon be forced to move on again.

Images 6.3: Photographs of peri-urban agriculture in Dongxihu.



Fields & houses with polytunnels in background



Two storey houses along main roads



One family's tent home with electric tricycle used for transporting produce



Small bamboo polytunnel





Medium sized steel frame polytunnel with rubber hose in foreground used for crude spray irrigation with tiny holes punched in it all along its length



Tent dwellings of recently arrived migrant farmers



Migrant housing which has since been demolished



The house of one of the interviewees



Houses of local farmers. Rotavated soil. A large drainage channel



Close up of the local farmers' houses

### ***Comparative cases: outer peri-urban SV production***



In Xinzhou district an urban town centre in the east of the district gives way to a large area of agricultural land and villages of an almost entirely rural character interspersed with lakes. There is a large area of vegetable production alongside the Yangtze river to the south and the main road running east-west to the north of the river. This area was designated an ‘outer suburb vegetable production base’ (远郊蔬菜生产基地) in 1997 from which time local farmers were encouraged to switch from growing cotton and wheat to growing vegetables for Wuhan’s markets as well as for export to national markets (XZ-04, 2012).

Here farmers cultivated their own very small plots of land and grew a variety of SV and FGV such as green beans, Chinese leaf (大白菜), pak choi (小白菜), cucumber, eggplant, bell peppers and spinach. Unlike migrant farmers cultivating state farm land, only some of these local farmers derive their main incomes from agriculture while for many vegetable production is mainly a side-line activity supplementing the main household income from urban employment or running small businesses. Consequently they cultivate less intensively and are more inclined to use organic rather than chemical fertilisers. None of the farmers reported problems with soil fertility. Farmer XZ-03 explained that soil fertility is maintained through use of organic fertilisers. XZ-04 claimed that all the farmers there who grew amaranth and beans (two of the main crops) used 70% organic fertiliser (such as pig, chicken and cow manure) for the long term stable effect on soil fertility while supplementing this with 30% chemical fertiliser to speed up plant growth. There was also widespread evidence of field-side composting.

In Jiangxia district, south of the Yangtze river, there were only a few small communities of migrant farmers who grew FGV and OSV (FWD, 2013; JX-01, 2012; JX-08, 2012). The vast majority of farmers were locals who typically grew SV – pumpkin, cabbage (包菜) and Chinese leaf (大白菜) – in rotation with rice and maize on their own land and on land rented from other locals who had given up farming to work in the city. The rotation of pumpkin, cabbage and Chinese leaf with maize helps to preserve soil quality and grain production provides a stable (if relatively low) income while the vegetables, although involving more market risk, will often add considerably to the farm income if prices are favourable. Further, pumpkin and cabbage have the advantage of being storable and transportable over long distances in large quantities thus allowing local farmers to obtain the best possible prices by having more control over when they sell and access to markets beyond Wuhan. They will normally sell to traders who come with large trucks to transport the vegetables to northern or southern China depending on seasonal conditions and the state of the national vegetable market (JX-02, 2012).

The sales channel described by farmers in ZW village in Jiangxia were long distance traders who used 30-40 ton trucks and local traders using smaller 2.5 ton three wheel trucks buying

from the field-side and using the village weighing station. Relationships with traders were closely guarded as source of competitive advantage and had been developed over time. The village also had a vegetable broker who advised other local vegetable producers and helped to arrange sales (H-09, 2012; JX-03, 2012; T-01, 2012). The local trader explained that each day he and around 10 other traders drove their small trucks down to Jiayu (the county just beyond Wuhan's borders and adjacent to Jiangxia district) from which point they returned along the two lane road back towards Wuhan stopping at villages along the way to buy whatever crops were ready for harvest or already waiting to be sold. The crop may be loaded directly from the field to the truck with the farmer's help. It is then weighed at the village weighing station and the trader pays the farmer directly in cash. The traders continue in this manner until their trucks are full and then continue on to Baishazhou wholesale market to sell their loads (T-01, 2012). These villagers estimated that 40% of their vegetables are sold locally in this way while the other 60% is sold to long distance traders who come from other provinces.

Images 6.4: Photographs of peri-urban agriculture in Jaingxia.	
	
Local's houses lining the main road	The vegetable broker's house





Cabbages are harvested and loaded immediately with the help of the trader



Stacking cabbage, outer leaves are left behind



The weighing station



Truck on the weighing station

## 6.2 Livelihood outcomes

### *Migration*

Nearly all the migrants interviewed shared three things in common. First, they had left their home villages to escape poverty or as the result of displacement by infrastructure projects and had given up their land and homes to become landless. Second, they had no previous experience of vegetable production, having previously grown grains, but had come to Wuhan with the explicit purpose of becoming intensive vegetable farmers in the hope of improving their livelihoods. Finally, they had migrated as whole households as they were able to effectively become small scale entrepreneurs running their own family farming businesses while also able to build small homes next to their fields. Keeping the family together was integral to the pattern of migration and livelihood strategy.

This final point is very significant because it contrasts starkly with the characteristics of rural-urban migration which is most often discussed and researched in relation to China. The latter form of migration involves individuals, mostly young men and women, who migrate to urban centres to become wage labourers and often leave their young children behind in rural villages to be cared for by elderly relatives or older siblings. This has severe impacts on the lives of these children and on the stability of the family unit as a whole since husbands and wives are often separated from each other and their children for most of the year apart from one or two short periods of time during the two main public holidays. Children are therefore left with little supervision and lack parental support while underfunded and lower quality rural schools struggle to provide them with an education and make up for the deficit of parental care. These children are referred to as ‘left behind children’ (liushou ertong 留守儿童). The result is that “surveys show that the country has about 61 million left-behind children and another 36 million who live with their migrant-worker parents in their adopted cities but do not enjoy the same public services, such as education and health care, as people holding local residence registration documents. This means nearly 100 million children – one in every three in the country – are living an insecure life.” (Caxin, 2015).

What rural-to-peri-urban migration for vegetable production offers is the opportunity to limit the impacts of migration on children by keeping families together. A husband and wife are able to obtain a relatively good and stable livelihood while living together with children and elderly relatives on the land they cultivate thus maintaining the mutual support of multiple generations and providing a relatively secure family environment for their children. Nearly all the households interviewed had 1 or more dependents (up to 4 or 5 in some cases) living with them and at least 2 household members involved in vegetable cultivation. Many migrant households had children or grandchildren at school or university locally (for example DX-02, 2012; DX-04,

2012; DX-12, 2012; DX-13, 2012) and some also had family members employed locally. The positive socio-economic and psychological impacts on migrant families of this household-scale migration should not be underestimated and thus the positive contribution to social wellbeing arising from the incumbent sub-system, though difficult to measure, is obviously considerable.

### ***Livelihood potential***

Once migrants have arrived in Wuhan with their families the potential for gaining a good livelihood has been good and improving. Nearly all the migrants claimed to make enough income to meet their basic needs and many said that their incomes were enough to continue improving their living standards and that income from vegetable production was increasing year on year. Annual household incomes reported by migrants spread over a wide range from the lowest of 10,000CNY to joint modes of 20,000 and 30,000 and some even reported net incomes of between 50-80,000CNY. Different household sizes mean that income per head varies and the wide range of incomes and the level of variability from year to year mean that it would be relatively meaningless to estimate an average income per head represented by this data. Nevertheless, by way of comparison the Dongxihu district average annual income per head for rural residents was 8,637CNY (W-DXH, 2011) which for a family with two dependants would imply around 34,500CNY as a typical household income. By contrast the common annual wage for waiting staff in a restaurant in Wuhan at that time was around 16-18,000CNY per year with free dormitory accommodation while a university graduate could expect to earn between 36-48,000CNY. The range of annual income per head from the interview data as a whole compares with government statistics of rural incomes as shown in the table below, sitting squarely in the middle of the range of rural incomes.

Table 6.2 Per capita annual net income of rural households in 2011 (CNY). (WSB, 2012)	Percentage of households
Below 800	2.9%
800 - 1500	1.3%
1500 - 3000	3.4%
3000 - 4000	4.7%
4000 - 5000	6.0%
5000 - 6000	6.6%
6000 - 7000	9.0%
7000 - 8000	7.4%
8000 - 9000	8.0%
9000 - 10000	8.4%
10000 - 12000	11.6%
12000 - 15000	12.9%
Over 15000	17.9%
This shows the proportion of surveyed households within different income ranges. The shaded cells represent the range of per capita income reported in the interview data.	

There is, however, the potential for migrants to significantly improve their livelihoods through co-operation and careful development of links with retail markets. Notably, one migrant farmer interviewed in Huangpi district, through co-operation with friends and relatives who also grew vegetables in the same area and by building a good relationship with a local retail wet-market, had managed to grow a successful informal co-operative making over 200,000CNY a year income for his household (more than five times the income obtained by his children in urban employment) (HP-01, 2012). A migrant farmer and his wife in Jiangxia was able, by careful selection of crops and links with a local market, to earn an annual profit of 120,000CNY purely from vegetable production.

Those local farmers in Jiangxia with higher incomes had diversified their household livelihoods, combining incomes from agriculture and urban employment. JX-03 explained that his household annual income included 20-30,000CNY from agriculture (mostly his wife's activity) and 70-100,000CNY from his work for part of the year in a coal mine in the distant

province of Guizhou. Another farmer estimated his income from vegetable farming at a very variable 18,000CNY while his three children each earned 30,000CNY a year bringing the total household income to 90,000CNY. However, if a farmer has the inclination and opportunity to scale up vegetable production it is clearly possible to generate a relatively high income from agriculture. Farmer JX-02 managed 100 mu of land in his village and ran his farm as a small business employing up to 40 local farmers as seasonal labourers. With his wife helping with the farm and his son working as a driver he estimated his household income at between 150-200,000CNY.

The point of the above discussion is to show that migrant vegetable farmers have the opportunity to make a relatively good livelihood as peri-urban producers and can expect incomes comparable with those of many local farmers. For these migrant farmers their greatest challenge is not chronic poverty caused by low crop prices. Even their unequal status compared to locals and the higher land costs this imposes does not prevent them from obtaining incomes of 30,000, and even 80,000CNY and above which are considered by farmers themselves to be adequate or more than adequate to meet their daily needs and even improve their lives. On the other hand, the stability and security of their livelihoods are deeply affected by their status as non-*hukou* holding tenant farmers.

### ***Livelihood security***

There was considerable agreement among farmers (migrant and local) across all locations on the main challenges they faced to their livelihoods. The most significant were the volatility of vegetable prices which made sales income very unpredictable and the rising cost of chemical inputs and seeds which reduced profit margins. There were also multiple environmental threats including the frequent heavy summer rains which could quickly waterlog fields and destroy entire crops. Winter snows also damaged polytunnels and could freeze open field crops. Droughts were common but could be mitigated by increased irrigation from ground water accessed by wells, although this added significantly to the burden of labour. Soil degradation was a common complaint and in many cases pollution of air, soil and surface water from nearby industry and construction projects were also cited. The most frequently repeated phrase when farmers were asked how they coped with such challenges was “没办法，只能看运气” “there is nothing we can do but count on luck”.

It appeared that none of these transient shocks were severe enough to cause large-scale loss of livelihoods in themselves. They had seasonal short term impacts which reduced farmers’ annual incomes and increased the burden of labour or added to input costs. Many farmers were aware that there was some kind of arrangement for the government to provide financial or material assistance to help farmers recover from the impacts of extreme weather events. However, most farmers claimed that they had in fact received no such assistance from the government.



Migrants explained that because they lacked local *hukous* they were excluded from financial assistance (DX-03, 2012; DX-22, 2012; GY-10, 2012; JX-01, 2012; JX-08, 2012) and of the locals only three reported receiving any kind of emergency assistance (DX-20, 2012; JX-09, 2012) and even then it was minimal. One local farmer in the village in Jiangxa mentioned that the government would help organise purchasing of produce when prices fell too low for farmers to make a profit (JX-06, 2012). In general however, whatever compensation there is does not find its way to the farmers themselves. This indicates that whatever policies are in place to help farmers cope with the extremes of weather and markets are inconsistently implemented at best and even when they are implemented they do not reach one key group of producers, migrant farmers.

Policies designed to enhance farmers' ability to adapt to meet such challenges also appear to have little effect. Neither local nor migrant farmers benefited directly in any way from the vegetable basket policy measures or other measures outlined by government officials with the exception of polytunnels subsidies and green transport routes (绿色通道). Even with these two policies, experiences were mixed. The peasant farmers set to benefit the most from the green transport route policy were migrants. While local farmers typically sold through field-side traders, migrants tended to take produce to the wholesale markets themselves using electric tricycles. However, to guarantee exemption from road tolls under the policy the farmers need to obtain official registration and for that the vehicle needs a registration plate. Both registration processes require fees and migrants may not bother to try to go through the complex processes involved. Several farmers in Dongxihu explained that they were unable to benefit from the green transport route policy because they were unable to register their vehicles (DX-01, 2012; DX-02, 2012; DX-03, 2012). A further hindrance for small scale producers is the fact that the motorised or electric tricycles typically used are not allowed on highways. Thus, on their journeys to market farmers often risk incurring fines or having their vehicles confiscated for being unregistered as well as for using the highways in the first place. Even the farmer who had organised an informal co-operative and transported his produce to local market in a small van said he didn't benefit from the policy and paid the tolls himself (HP-01, 2012).

There is a similar mismatch between policy and potential beneficiaries in the case of polytunnel subsidies. Those farmers involved in the types of cultivation which could be enhanced through use of polytunnels were mostly migrants growing FGV and OSV. Many of the migrant farmers had constructed polytunnels and benefitted from subsidies. However, some explained that they were unable to obtain subsidies or unwilling to construct polytunnels even though the subsidies could reduce the cost. They faced two challenges when trying to take advantage of polytunnel subsidies. Firstly, subsidies could only be applied for after the polytunnels had been constructed so farmers were required to fund the full cost of construction

themselves before applying to the local government office and would then have to wait to see if their application would be accepted or not. This meant that a certain amount of capital was required in order to take advantage of the policy in the first place. It also presented a considerable risk, especially for people used to being discriminated against. The second challenge was that when the land came to be cleared for redevelopment whatever assets migrant farmers had on their rented fields (polytunnels and indeed houses) would be lost and would be unlikely to attract compensation.

Although the challenges of extreme weather, volatile markets and lack of access to government support measures generally make life harder for migrants than locals perhaps the most significant inequality is in the way compensation for loss of homes, assets and livelihood is arranged when land comes to be redeveloped. Officially, local farmers are entitled to be financially compensated for loss of land according to the area they own and to be provided with replacement housing and may also have their *hukou* transferred from rural to urban with all the benefits that accompany it. Arrangements are negotiated with local village committees and signatures are required to validate sale of land-use rights. For example farmer DX-04 said he expected to receive 10,000CNY per mu compensation and some arrangement for replacement housing all of which would be discussed and agreed between the farmers and the local government (DX-04, 2012).

In practice however, the compensation provided does not always satisfy all locals and the benefits are not always considered to be distributed equally among local villagers. Migrant farmers have very few rights under such circumstances as they do not have official ownership documents for their homes and are merely tenants on land owned by others. For example a migrant farmer, DX-15, claimed that when the land he farmed would be redeveloped 1 or 2 years later the local farmers expected to receive replacement houses of equivalent floor area along with compensation payments while migrants would most likely receive nothing. Consequently, when re-appropriation of land occurs they lose homes, livelihoods and material assets like polytunnels and are forced to relocate and set up their livelihoods from scratch with whatever savings they have managed to accumulate during the few years of farming in the previous location.

In every location where migrant farmers were interviewed the land was due to be seized for redevelopment within 1-5 years. Nearly every migrant farmer interviewed, when asked about their expectations for the future, spoke of the impending loss of livelihood as land would be cleared and that their future was uncertain as they tried to find new places to start growing vegetables again. One farmer described the common situation faced by migrant farmers in this way:

‘不久，政府将征用我们赖以生存的土地，计划给 XX 公司来建汽车工厂，作为“边缘人”的我们担心不会得到补偿，因为我们在老家洪湖已经没有了土地，到这里来是租了 CJ 村的土地来种植蔬菜的，我们自己并没有土地，政府的补偿也只是给当地拥有土地的村民。这样我们考虑是否要重新选择租其他地方的土地来种菜，这意味着要重头再来，但是我们两夫妇都年近 50 岁，已经没有精力去重新开始了。’

*‘Not long from now, the government will seize the land upon which our lives depend. They plan to give it to XX company to build a car factory. As people on the margins we worry that we won’t get any compensation. In our home town of Honghu we have already lost our own land. We are here renting land from CJ village in order to grow vegetables. We have no land of our own. The government only offers compensation to local farmers who own the land. So we are now considering whether to start over looking for another place to grow vegetables. We would have to start again from scratch. But we are both nearly 50, we have already run out of energy to start over again.’*

*Mr Lan and his wife, migrant farmers from Honghu (JX-01)*

Local farmers have legal ownership of their homes and land use rights providing them with a certain level of security since they have the potential to convert these assets into financial benefit. In contrast, migrants have no such security from assets such as homes or land and thus their only source of financial security is from the profits they make from agriculture.

## 6.3 Environmental and Food Security outcomes

### *Environmental integrity, food safety & affordability*

The state of uncertainty and insecurity created by the continuing displacement of migrant vegetable farmers results in a strong disincentive to cultivate the land in a way which is environmentally sustainable in the long term. The only response open to migrant farmers is to cultivate intensively, depending on heavy applications of chemical fertilisers and pesticides and repeated cropping on the same land in order to gain the quickest returns. Where there is an incentive to conserve soil fertility – on outer peri-urban land where local farmers own use rights – the type of cultivation is less likely to be of FGV or OSV for local markets and more likely to be SV for national markets. Migrant farmers as producers of ‘conventional’ FGV and OSV intensively for Wuhan’s markets are responsible not only for a large proportion of the supply of the most affordable category of vegetables available in Wuhan, but as a result of the system structures and trajectory, they are also those least able to take advantage of the policies designed to enhance the quality (and safety) of vegetable supplies.

Their role in the peri-urban food system makes them more vulnerable to both market and environmental threats and their ability to cope with the impacts is hindered by their unofficial status. The greatest threat of all though is the continuing process of urban expansion. The most important impact of their non-local *hukou* status and their position as tenant farmers is to limit

their ability to accumulate assets and, most significantly, realise the value of what assets they do have when they are forced to move on to make way for redevelopment. This in turn creates an incentive structure which encourages migrant farmers to adopt farming practices which produce the highest incomes in the shortest time periods over the short term with no incentive to preserve soil fertility or limit other environmental impacts of farming. Migrant farmers especially relied heavily on chemical fertilisers, pesticides and repeated, continuous cropping to boost incomes and many noted the impact this had on declining soil fertility and increasing disease problems. Observations also showed clearly the impact of chemical based agriculture on surface water as the irrigation channels, canals and other surface water in every location showed signs of heavy eutrophication and many farmers avoided using such water for irrigation by digging wells to access ground water.

The overuse of agro-chemicals also has implications for the safety of vegetables produced which is one of the main reasons for the government initiative to promote a hierarchy of labelling through which to control the quality of vegetable production by limiting pesticide use and prescribing levels of processing and cleaning etc. However, the higher technical requirements to qualify for such labels also act as a barrier to peasant farmers upgrading their cultivation techniques. Most farmers simply did not consider it worth bothering to try to change their techniques to comply with labelling requirements. One local farmer who was otherwise committed to continuing vegetable production explained that switching from conventional to 'green' vegetable cultivation (绿色蔬菜) requires both a certain level of capital and some technical support to help develop the necessary skills and apply appropriate technologies. The only way he would consider trying to grow 'green' vegetables would be with the guarantee of substantial government support (DX-17, 2012). One of the most frequently mentioned needs expressed by both migrants and locals was for more technical support to help improve their farming methods and the most often cited reason for not changing the types of crops grown was lack of familiarity and lack of relevant skills or knowledge. Migrants are even less likely than local farmers to benefit from technical training provided by local government and yet they are the group of producers most closely connected with the cultivation of FGV and OSV for which the labelling scheme could have the greatest impact on food safety.

The methods of cultivation contribute to safety issues, especially in the case of leafy vegetables for which pests are a major problem, typically dealt with by high and frequent doses of pesticide. In addition, FGV are the type of vegetables most likely to be grown in close proximity to sources of industrial pollution and thus present an added risk of contamination. However, before vegetables reach consumers they pass through the wholesale markets as the main channels for distribution to Wuhan's smaller markets. Wuhan's wholesale markets are equipped with the facilities to perform pesticide residue tests. An interview with a trader at one

such wholesale market illustrated the difficulties with guaranteeing the relative safety and quality of vegetables sold through these channels.

***Distribution: contributing to resilience of food supply and issues of food safety***

Baishazhou wholesale market (武汉白沙洲农副产品大市场) is one of Wuhan's largest wholesale farm products markets. Its current location is further out from the city centre than it once was. It moved to its current location between 2003 and 2005 onto what was previously used for wetland agriculture. The market has over 360 vegetable stalls (dankou 单口). Some trading companies have their own vegetable production bases which specialise in particular crops such as Hong cai tai (红菜苔 a leafy green native to Hubei) or the local staple vegetables (dalucan, 大路菜). Most traders, however, operate as representative buyers who buy from farmers who bring their crops to the market and also communicate by phone with provincial markets outside Wuhan to source vegetables for Wuhan's local markets (BSZ Trader, 2012).

One such trader, Mr Sun, was interviewed at Baishazhou. He explained that there is never any real shortage of produce as the market is linked to other supply channels throughout the country. When locally produced vegetables hit the city's wholesale markets like Baishazhou, imported vegetables cannot compete on price. But when local supply declines in the winter and spring, vegetables are mainly imported from outside Wuhan from provinces such as Shangdong and other areas in Hubei. Because of the easy communication with outside markets and the ready access to production across China's hugely diverse climates provided by the extensive highway system there are no significant disruptions to transportation and sales (BSZ Trader, 2012).



	
Trading lot	Pumpkins awaiting collection

In Mr Sun's opinion, the biggest worry is the safety of vegetables. While there is spot test monitoring of pesticide residues conducted by the market management, this does not protect consumers from contact with pesticide residues on vegetables. Non-polluting vegetables (wugonghai, 无公害) are a misnomer in his opinion. Most vegetables are highly susceptible to pests, especially leafy vegetables, and farmers will always spray copious amounts of pesticides to preserve the appearance of their produce and protect yields. He claimed that all the leafy vegetables on the market are covered in pesticides. There is no other way to grow them without them being eaten by pests so the labels are in fact meaningless (BSZ Trader, 2012).

### ***Displacement, soil fertility and polytunnels***

The ongoing displacement of production activities combined with the effect of urbanisation in encouraging migrant farmers to take up livelihoods as semi-formal intensive peri-urban vegetable producers leads to some negative feedbacks between system outcomes. First, as peri-urban vegetable production is displaced onto formerly grain producing land further out from the city the migrant farmers who convert the land to vegetable production face a number of issues. Soil formerly used for grain crops is likely to be inadequate to support the higher nutrient demands of vegetable crops. In order to maintain yields farmers naturally turn to increased fertiliser application which has an impact on production costs and further damages soil fertility in the long term. The increased distance from markets also increases production costs through the cost of transportation. Second, the push to expand the area of covered cultivation through use of polytunnels creates problems as well as benefits. Polytunnels do help to extend the growing season and speed up plant growth. However, this may be at the expense of food safety. To gain the greatest benefits from use of polytunnels farmers need to learn new skills in crop and pest management. Farmers typically lack these skills and the technical support which could

help them acquire them is patchy at best and inaccessible to most migrant farmers. Poly tunnels not only increase potential yields but also increase pest and plant disease problems which require careful management. The most straightforward response to such problems is for farmers to apply more pesticides. Indeed, every interviewee that mentioned pest problems said they simply applied extra pesticides in response. Thus increased use of poly tunnels without the relevant training and skills support may be expected to contribute to a decline in food safety and increased risk to consumers (HN Academic 1, 2012).

There are also increased risks to farmers' livelihoods associated with the use of poly tunnels. Heavy snowfall, high winds and ice can all damage poly tunnel structures and the physical burden of work inside poly tunnels in warmer months is increased due to the intense heat and humidity they create (HN Academics 2 & 3, 2013). Along with greater vulnerability to extreme weather, the pressure on farmers' incomes grows with the increasing dependence upon pesticides as production costs rise. This is compounded by the rising production costs associated with increasing distance from markets, declining soil fertility and inappropriate use of technology.

Therefore, the most significant incumbent sub-system of peri-urban vegetable production (intensive FGV and OSV) appears to be the least amenable to the measures designed to enhance food safety and most susceptible to the perpetuation of environmentally degrading and unsafe agricultural methods linked to declining security of livelihoods for the most marginalised producers.

## **6.4 Summary of outcomes and resilience**

The evidence presented in this chapter helps to answer part of this third research question. The interactions between sub-systems will be explored more fully in the following chapter after the emerging sub-system has been discussed. This chapter has identified an informal sub-system centred on intensive production of FGV and OSV, mainly involving migrant farming households on rented land and for sale through Wuhan's wholesale markets. The nature of the food system outcomes linked to this sub-system can be summarised in the following table 6.3 and radar diagram (chart 6.1).

**Table 6.3: Incumbent sub-system outcomes and stakeholders.**

<b>Outcome</b>	<b>Score &amp; description</b>	<b>Stakeholders</b>
Safety	<p>(0) Ambiguous</p> <p>There is no guarantee of the quality and safety of vegetables produced and sold in this sub-system. As they have no classification as ‘non-polluting’ or ‘green’ vegetables they are the products with the lowest and most variable quality produced locally. FGV in particular are more vulnerable to contamination both from agri-chemicals (heavy use of pesticides and fertilisers are required) and from industrial pollution (FGV are often grown on land close to or within industrial zones).</p>	<p><b>Most urban consumers.</b></p> <p>As these vegetables are sold through wholesale markets they go mainly to supply local wet markets but also find their way into most other outlets including supermarkets and distributors. Thus all but the most selective or privileged consumers are exposed to this risk.</p>
Affordability	<p>(2) Highly positive</p> <p>The vegetables produced through this sub-system are the cheapest available. Because quality is not the goal of production and because farmers are price-takers the prices at which these vegetables are sold to wholesale markets is very variable. The wholesale markets, like Baishazhou, function to keep prices relatively low as they provide a context for competition between local and non-local produce. Thus, without a ready supply of locally produced cheap vegetables there would be a greater upward pressure on retail prices.</p>	<p><b>Most urban consumers.</b></p> <p>(and middle-men).</p> <p>The people who benefit most from the availability of cheap local produce are the people who buy from local wet markets where minimal processing is applied to vegetables which are bought through the wholesale markets. In addition, the middle-men in the supply chain gain a profit depending on the difference between field-side, wholesale and retail prices.</p>

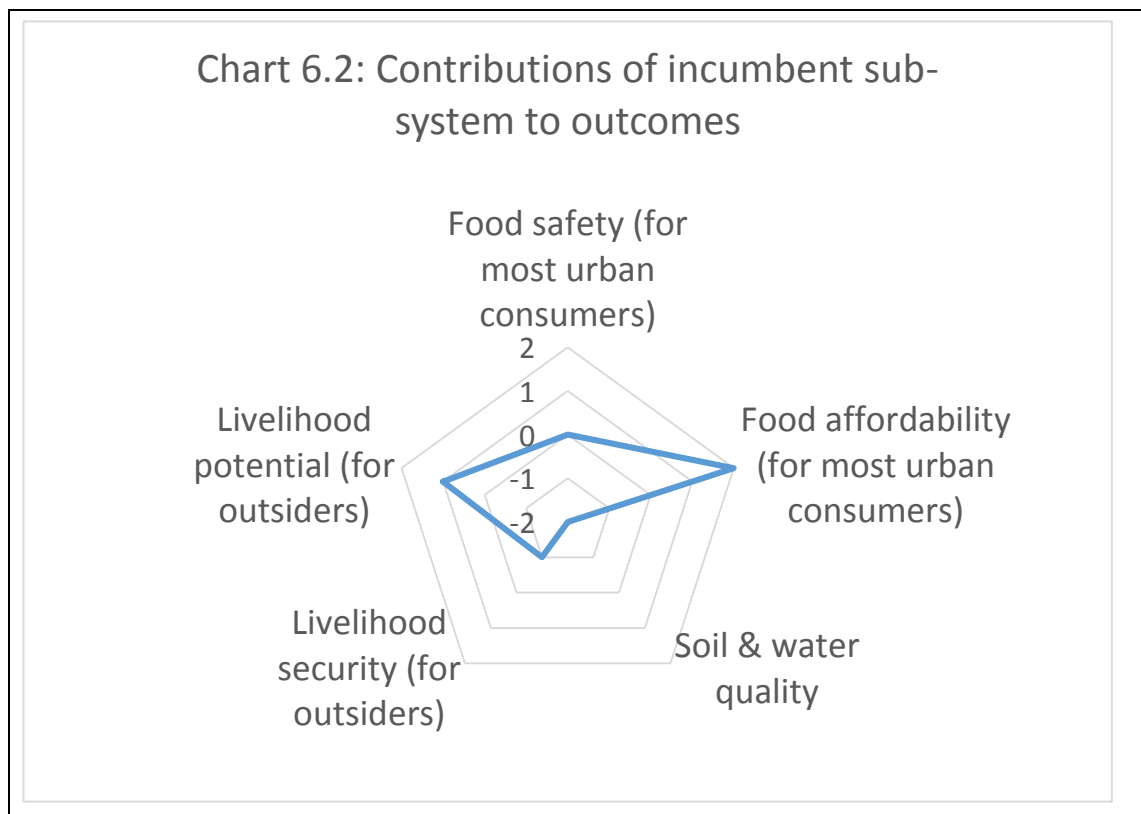


Protection of soil & water	<p>(-2) Highly negative</p> <p>The type of cultivation employed by migrant farmers is largely extractive and pays no attention to the need to limit pollution of soil and ground water. Chemical fertilisers and pesticides are used heavily as yields depend on these chemicals. Groundwater is used for irrigation and surface waters are contaminated by leached agro-chemicals.</p>	<p>The direct impacts of the degradation of natural resources is on the farmers themselves as soil fertility declines. The indirect effects are an increasing dependence on agri-chemicals maintain yields on degraded soils and this will have implications both for the health of farmers themselves and feedbacks to food safety for consumers.</p> <p>The longer term impacts are on biodiversity and groundwater contamination, the effects of which are as yet unclear.</p>
Livelihood security	<p>(-1) Moderately Negative.</p> <p>The security of migrants' livelihoods is relatively low and they are rapidly become less secure.</p> <p>Nearly all the migrants interviewed were expecting to have to move on within 2 or 3 years and to go further out from urban markets in order to continue growing vegetables and making a living. They did not expect to receive compensation when they moved but to simply lose their assets and livelihood.</p> <p>They are also vulnerable to price volatility as a sudden oversupply can cause prices to crash.</p> <p>Weather damages crop yields and quality as well as polytunnels and they have few resources with which to cope. They receive very little assistance from local government.</p> <p>Most farmers assumed they would look for new places to grow vegetables and many thought they would not be able to</p>	<p><b>Outsiders:</b> Migrant farmers.</p>

	<p>find factory jobs because of their age and inability to learn new skills.</p> <p>In the longer term, as farmers age and remittances from younger family members decline (with rising cost of urban living vs urban wages) their livelihood security is expected to decline further.</p>	
Livelihood potential	<p>(1) Moderately positive.</p> <p>It is clear from the interviews that migrant farmers who have the physical capacity and enough land available can make a satisfactory and steadily improving income from vegetable production.</p> <p>However, the work can be very hard and physically tiring under the harsh conditions of hot summers and cold winters.</p> <p>For ageing farmers the physical demands of the work will become a serious issue and will gradually limit the potential for an adequate livelihood.</p> <p>The widespread restrictions on house building mean that the potential for improving the quality of life for families is severely limited.</p>	<b>Outsiders:</b> Migrant farmers.

In summary, the sub-system based on production by migrant farmers provides them with relatively good incomes but these livelihoods are relatively insecure and becoming more so. Further, quality of life is significantly limited by the controls on housing as well as access to local services due to not having local *hukous*. The short term nature of the farmers' livelihoods on the land means that the soil and water resources are not protected but exploited for rapid profit. The lack of controls on agri-chemicals (and other polluting activities in the vicinity of agriculture) also means that consumers and farmers themselves are at greater risk of harm. The potential for contamination from agri-chemicals and industrial pollution is relatively high for

the incumbent sub-system, especially for FGV which are more likely to be grown on marginal land near industrial and commercial sites. The result (as summarised in chart 6.2 below) is that the incumbent sub-system can be seen as contributing very positively to the affordability outcome for urban consumers in general while making a moderately positive contribution to livelihood potentials for migrant farmers. However, this comes with highly negative environmental impacts as well as increasingly negative impacts on migrant farmers' livelihood security and an ambiguous contribution to food safety (particularly for produce sold through wholesale markets).



The positive outcome of a ready supply of relatively affordable vegetables channelled through the wholesale markets appears to be relatively resilient to extreme weather and market volatility for two key reasons. First, because of the wholesale markets' close links with national markets the supply of vegetables – especially those which can be transported longer distances – is secured by being able to make up shortfalls in local supply by importing from other regional markets. On the one hand, in the event of a major disruption of local production, wholesalers would simply call on outside suppliers. On the other hand, if local prices rise or fall, imports become competitive and vice versa meaning that, while the field-side price may fluctuate wildly, by the time produce reaches retail markets the effects have been smoothed out to a degree. Second, the diversity of production activities implied by there being a large number and

broad geographical spread of small scale farmers growing cheap 'conventional' FGV and OSV at overlapping cycles in which crops are staggered to spread risk may be expected to ensure that the impacts of weather damage are localised and affect crops at different stages of development differently. Indeed, one common complaint among farmers was that there were so many producers growing similar crops that prices frequently dropped so far that crops were not worth selling.

Conversely the negative outcomes of livelihood insecurity, environmental degradation and risk to food safety which are so closely linked are made quite resilient (a negative resilience in this case) by the very trajectory of the system itself. The short window of opportunity afforded to migrant farmers to make a living as peri-urban vegetable producers appears to be getting shorter as farmers are displaced for the second and often third time and find themselves moving on to outer peri-urban land which is rapidly becoming in line for redevelopment as urban expansion continues apace. As newcomer migrants arrive with little experience and the technical support provided to veteran migrants in the 1980s has tailed off, the prospect for improving environmental (and by extension) food safety outcomes is limited.

Livelihood potential as a positive outcome for migrant farmers can be said to be declining in resilience. Migrant farmers are becoming progressively more marginalised, loss of assets at each move from one site to another limit their ability to build up any capacity to make significant improvements in their livelihoods or prepare for the future and the physical impacts of ageing limit the ability of farmers, many of whom are nearing or beyond retirement age, to continue as vegetable producers in the medium to long term. The livelihood offered to migrant households by the peri-urban vegetable system is thus becoming more vulnerable and this will have knock on effects for the resilience of other outcomes which will become clear as the emerging sub-system is described and its links to the incumbent sub-system explored.

## Chapter 7. Step 3b – Emerging sub-system

***RQ 3. What are the characteristics of, and interactions between, the incumbent and emerging sub-systems in the peri-urban interface and how do they contribute to system outcomes and their resilience?***

*How do sub-systems contribute differently to food security, environmental and livelihood outcomes?*

*What shocks and stresses are experienced by system actors and how do these impact outcomes?*

*What does this imply about the resilience of these outcomes?*

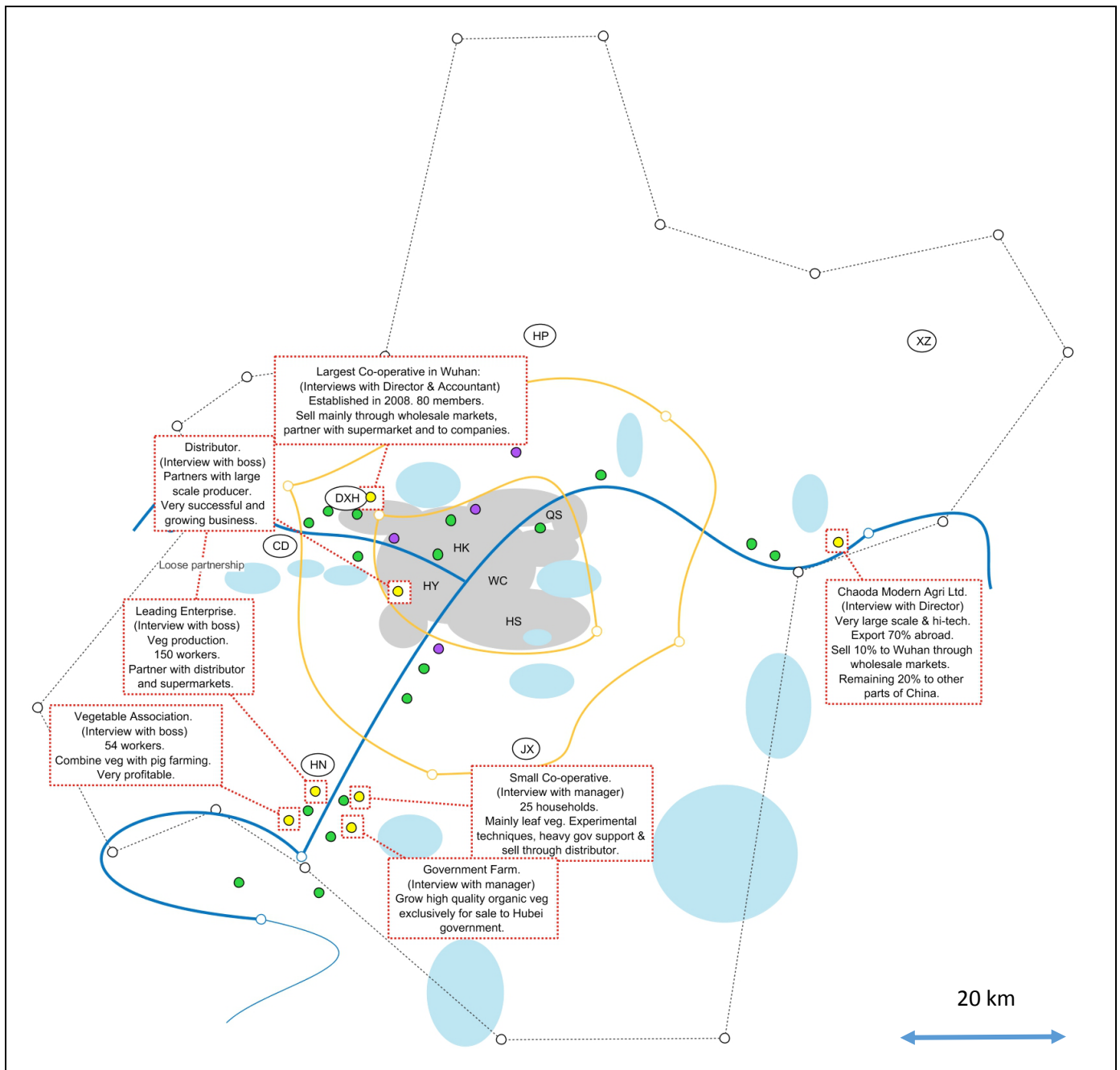
*What structures does the resilience of these outcomes depend on?*

### ***Introduction***

The range of policies designed to promote transformation of the system are aimed at promoting the role of private, state and co-operative commercial enterprises in both production and distribution in an attempt to create a more formal, standardised system in which products are traceable, labelled for quality and, by implication, safer. A number of such food system actors, representing this emerging sub-system, were interviewed and the data presented below provides insights into how such actors are beginning to play a particular role in the system as a whole.

In section 7.1 the emerging sub-system is identified with the central role played by private and state enterprises and co-operatives as mainstream producers within the sub-system. A series of brief nested case studies of several of these different commercial actors are presented in order to illuminate their role and involvement in the food system and how that compares with that of migrant and local peasant farmers discussed in the previous chapter. This is followed in section 7.2 by accounts of how these producers interact with distributors and the roles that some of the new forms of distribution play within the sub-system and how the emerging sub-system is linked to the incumbent sub-system. Section 7.3 discusses some further nested cases of niche producers which shed fresh light on system outcomes. The implications of the emerging sub-system for food system outcomes and the stakeholders who benefit from these outcomes are discussed in section 7.4.

## 7.1 Nested cases: mainstream producers



Map 7.1 Wuhan showing summaries of enterprise case studies.

**Key:** Urban centres of central urban districts: HK = Hankou, QS = Qingshan, WC = Wuchang, HS = Hongshan, HY = Hanyang.

Urban centres of agricultural districts: HP = Huangpi, XZ = Xinzhou, JX = Jiangxia, HN = Hannan, CD = Caidian, DXH = Dongxiu.

Green dot = site of farmer interviews. Yellow dot = site of farming enterprise interview. Purple dot = site of wholesale vegetable markets. Blue shading = lakes. Grey shading = urban areas. Orange line = inner and outer ring road.

The above map shows summaries of the enterprises visited. From the top clockwise these include the largest vegetable co-operative in Wuhan, a large national level leading enterprise called Chaoda Modern Agri Ltd., a small farmers' co-operative; a government run organic farm specifically supplying government departments' canteens; a vegetable association using integrated farming techniques; a district level leading enterprise; a distributor working in partnership with the district level leading enterprise. The most conventional of these large scale producers are the co-operatives, district level and national level enterprises. Together, these represent the kind of peri-urban vegetable production system which the government is actively promoting. These are the signs of things to come in the ongoing transformation of the system and allow a glimpse into the future of peri-urban vegetable production in Wuhan. Each of these will be discussed in turn.

### ***Co-operative 1***

The first enterprise visited was a Farmers' Specialised Co-Operative (FSC-1), the first one to be established in Wuhan as part of the WAB's promotion of FSCs and currently the largest co-operative in Wuhan. Farmers contribute a certain amount of finance and land effectively buying themselves shares in the co-operative and select someone among them to be its director to lead and develop the business. The co-operative members all have a say in the decision making process but ultimately the director holds final decision making power. Members are then able to share the co-operative's facilities, employ people to handle marketing, orders, sales and buying of inputs and equipment on behalf of the co-operative.

Buying in bulk and with a basic level of capital they can get better prices for inputs and improve the co-operative's facilities and equipment. Farmers can also plan their planting more efficiently and gain access to markets which would otherwise be closed to an individual farmer but become viable once they join forces. In this way they can sell in greater volumes on order direct to clients and thus avoid simply being 'price takers' by selling to traders or wholesale markets. They can begin to sell direct to supermarkets, restaurants, companies and schools etc. which gives them more stable prices and a predictable sales revenue (FSC-1 Director, 2012; WAB Director, 2012).

FSC-1 is a good example of how the FSC concept is intended to work. It was started in 2008 with 56 member households cultivating 312 mu (20.8 ha) of FGV (kuai sheng cai). At the time of my visit they had expanded to over 1,000 member households, 80 employees (expecting to employ a further 23 in 2012), and approximately 10,000 mu (667 ha) of land producing fast growing 'non-harmful vegetables'. Most of the land was covered with polytunnels including more than 20 ha of metal frame polytunnels. In 2008 they received a visit from a city mayor and have benefited from high levels of government subsidy for all kinds of equipment including solar powered insect traps, petrol powered rotavators and metal-frame polytunnels. At the time

of my visit they had just purchased a high-tech processing and washing machine which they were about to install in a newly constructed air tight, bacteria free processing facility.

Images 7.1: Photographs of farmers' co-operative 1.	
	
Courtyard	Truck with green transport route logo
	
Management office	Government subsidised rotavators





According to the interviewee, the benefits for the co-operative members are very significant. They include reduced working hours, more security from production and market risks and higher income. He estimated average yearly profit for co-operative members to be 65,000 - 75,000CNY per household (100,000CNY gross income minus 30,000-35,000CNY production costs). Most of the produce (70%) is sold through the co-operative while the remainder is sold independently by the farmers themselves. The co-operative has its own fleet of trucks and its own sales outlets at the main wholesale markets in Wuhan (Bai sha zhou, Han kou bei, Huang jin tang, Si ji mei). In addition to selling through the wholesale markets, they also sell on order directly to three of the biggest supermarkets in Wuhan (Wushang liang fan, Yi chu lian hua & Zhong Bai), to a noodle company, large restaurants, Wuhan weather forecast bureau and Wuhan cigarette company as well as several local Universities. Some of their produce is even exported abroad under their own brand name. Their development strategy for the future is to progress from producing 'green vegetables' to 'organic' and seek out more export markets for their products (FSC-1 Director, 2012).

However, while it is a model of the way the FSC is supposed to work, it seems to be a very exceptional case. The interviewee explained that, although that district had over 100 FSCs they were mostly very small scale and consisted of not much more than the minimum necessary to obtain co-operative status and access government subsidies. The extent of their 'facilities' was often simply a name board next to a field without much organisation or co-operation behind it (FSC-1 Director, 2012). At the other end of the scale from FSC-1 is the next co-operative visited.

## Co-operative 2

The second FSC visited was very different from the first. Managing approximately 26 ha of cultivated land it was much smaller scale and lacked the facilities of the first. However, it held the status of a national level vegetable demonstration base and had received close interest and support from national, provincial and city level agricultural bureaus. It was partnered with a vegetable distribution company in the city which had been founded in 2004. The production base had been running for 3 years (since 2009) and had 30 member households who had been recruited by the partner company (FSC-2 Director, 2012).

Like FSC-1 it produced mainly FGV (kuai sheng cai) of the ‘green vegetable’ quality. Most of the fields were covered with polytunnels and irrigated with sprayers made from rubber pipes punctured with small holes along their length. They used organic fertilisers to reduce dependency on chemical fertiliser and solar powered pest traps to reduce pesticide usage. Motorised rotavators were used to turn the soil. There was also a large greenhouse with a cooling unit, fans and lamps. One of the polytunnels covered a field of sand used for experiments in soil-less cultivation. A large portion of the capital required for setting up the base and purchasing equipment (metal frame polytunnels, machinery, irrigation technology) came from government support and the WAB has sent technical specialists to provide guidance and technical training (FSC-2 Director, 2012; Field Diary, 2013).

The distribution company handled marketing, sales and distribution of the co-operative's produce, selling mainly to Wuhan's supermarkets including Zhongbai, Wushang liangfan and a distributor Ru yi. In this fashion a member household with two workers can manage 5-6 mu (1/3 ha) and earn a gross income of 100,000CNY a year, a production value of around 20,000CNY per mu. Taking into account the cost of production that amounts to a similar net income as reported by FSC-1.

Images 7.2: Photographs of farmers' co-operative 2.



	
Rotavator	Greenhouse (lights centre and fan at far end)
	
Spray irrigation	Experimental cultivation in sand

When local farmers nearby were visited they claimed that the co-operative did not actually produce much. As far as they could see its main purpose was to enable the distribution company in the city to obtain government subsidies and grants (Field Diary, 2013). Of course these are simply allegations without evidence but the fact remains that the co-operative is heavily dependent on government subsidies for its operation and its function as a demonstration and experimental base is possibly more important than its actual productivity and profitability. Other enterprises, however, were more clearly focused on profit.

### ***District level leading enterprise***

In Hannan district I visited a district level leading enterprise which was approximately half the size of FSC-1 with 5,000 mu (333 ha) of cultivated land and similarly focused mainly on producing FGV (especially leaf vegetables). The company owned 500 mu (33 ha) of core land



itself which was cultivated by company employees, 30 management and marketing staff and 70 'responsibility system' workers. The other 4,500 mu (300 ha) was farmed by peasant farmers who grew produce on a contract basis for the company (DLLE Director, 2012).

The company's management employees received annual salaries of 50,000CNY while a peasant couple responsible for 10 mu of covered land (i.e. with polytunnels) could expect to earn a gross income of around 120,000CNY per year between them. In addition to the 'responsibility system' farm workers, the company also employed around 100 seasonal labourers to cope with busy planting and harvesting periods. The other contracted farmers were responsible themselves for the labour and inputs while the company provided them with technical guidance and handled distribution and sales. Contracted farmers could then sell directly to the company itself at a pre-agreed price (specified in the contract) or they could receive a share of the profits from final sale of the produce at a percentage of 60% to the grower, 40% to the company.

The company sold produce through four main channels (1) Wuhan's wholesale markets (Bai sha zhou, Huang jin tang), (2) through a partnered vegetable distribution company in the nearby urbanised part of Wuhan, (3) directly to dealers, (4) through their own stalls or shops in local communities and vegetable markets. The future development plan for the company is to expand its retail operations aiming to have 10 shops in 2013 and expand to 50 before 2017.

In a similar way to the enterprises described above, this business model focuses on production of high quality vegetables which are processed, cleaned and prepackaged according to clients' specific needs. The economic logic behind all these enterprises is to bypass the wholesale markets and sell directly to discerning clients who will pay a premium for a better quality product.

There is no incentive to sell higher quality products through the wholesale or normal local markets which deal in conventional quality vegetables because quality differentiation is virtually impossible in such markets and consumers buy based on price above any other criteria. Their best option for making profits is to seek out business-to-business sales in order to cut out the middle-man and sell their added value products at higher prices than conventional vegetables. This producer did this through partnership with a specialised vegetable distributor who was also interviewed and is written about below.

### ***National level leading enterprise***

My final interview with a large scale producer was in Xinzhou district north of the Yangze river on the east side of Wuhan. Vegetable production there is almost entirely small scale and by local farmers. However, driving further east away from the urban area I stumbled on a sign post to a "large scale modern agriculture company". Turning off the main road, there was a large

greenhouse housing a plant nursery opposite a large courtyard surrounded by a management building and warehouses. The general manager was at lunch but was happy to talk with me about the farm and about the state of vegetable production in Wuhan.

The farm belongs to a state owned agricultural group with over 15 production bases across China which specialises in producing high quality brand name vegetables and fruit for export and domestic markets. The Wuhan base, which was opened in 2005, covers a very large area of covered cultivation (although the interviewee would not specify how large). 70% of the farm's produce is exported abroad, mainly to Japan but also Malaysia, Korea, Hong Kong and the UK. 20% is sold to other parts of China beyond Hubei and the remaining 10% is sold through the vegetable markets in Wuhan (NLLAE Manager, 2012).

The farm operates what they call a factory style production system in which workers are employed just as they would be in a factory. Employees have work contracts and keep time sheets to record what work is done by whom and how many hours each worker has completed to determine wages. The farm uses the group's own so called 'comprehensive production system' in which the group controls all aspects of production and sales from developing its own varieties, producing inputs and developing technology through to managing processing and final sales of their products and even has its own R&D department.

The manager explained that the reason they focus on export markets is that the vegetable market in China is still relatively immature and there is little awareness among consumers of vegetable brands or differentiation of higher quality products. With the volume and quality of vegetables their group produces they get better returns if they sell to markets like Japan in which consumers place more value on higher quality branded products. Furthermore, in the domestic vegetable market public trust is so low that consumers are unwilling to pay higher prices for products that claim to be higher quality because they simply do not trust the label.

This final example demonstrates most clearly of all how difficult it is under present conditions in Wuhan to produce good quality, safe vegetables at a price which low and middle income consumers will accept and still make a profit as a viable business. Even with the scale achieved by this national level leading enterprise there are limits to the economies of scale that vegetable production will allow. Many aspects of vegetable production are very difficult to mechanise and it is still a very labour intensive sector of agriculture compared with grain production which lends itself far more easily to large scale mechanisation. Add to this the market issues in Wuhan and China as a whole and lack of consumer confidence in quality certifications and it is easy to see why enterprises engaged in vegetable production in Wuhan tend to produce high quality, premium price products for export markets, business clients and the 'brand name' corners of domestic supermarkets.

The interviewee claimed that currently in Wuhan enterprise based production (as opposed to household scale production) accounts for around 20% of vegetables produced and it could be argued from the evidence presented above that the vast majority are producing high quality, high value produce sold to middle and upper income consumers through supermarkets, businesses etc. The remaining 80% of vegetables are produced by individual peasant households (including those working on state owned farms) and sold through wholesale and local markets as ‘conventional’ vegetables and vary hugely in their quality and safety (BSZ Trader, 2012).

### ***The emerging role of scaled commercial producers***

The emerging role of the producers discussed above can be summarised as shown in the table below in which the roles of local and migrant peasant farmers are shown by comparison. The table needs to be read with the pressure of urban expansion in mind. Urban expansion displaces migrants onto land which will soon become redeveloped leading to a shorter cultivation window while at the same time displacing larger scale producers (who have the cold storage facilities and trucks as well as the necessary sales channels required to allow longer distance bulk transportation) onto outer peri-urban land where they have a longer window for cultivation.

Table 7.1: Food system involvement (incumbent and emerging sub-systems)				
Spatial distribution of production activities	Markets >  Crops √	Wuhan’s markets	National export	International export
Outer peri-urban land	SV	Locals (as part of main agricultural income or mixed agricultural & non-agricultural incomes)		OSV/FGV on outer peri-urban land
Marginal & inner peri-urban land	OSV	Locals as landlords	Private & state enterprise / co-operatives  (beginning with support from local government, supplying Wuhan’s markets under labelling regime, targeting expansion into national and international export of high quality high value products)	
	FGV	Migrant tenant farmers (as main or sole source of income)		
<b>Key to table:</b> Yellow shading = local farmers’ involvement; Orange shading = migrant farmers’ involvement; Blue shading = involvement of private and state enterprises. Black two-way arrow indicates relationship between local farmers and migrant farmers. Red arrows indicate direction of private and state enterprises focus on FGV and international export markets.				

First it is worth noting that these large scale producers are often positioned on marginal and inner peri-urban land just as the migrant producers are and therefore suffer the same threat from urban expansion, although their response is different. When interviewed, the largest co-operative and the district level leading enterprise were both in the process of relocating as a result of land seizure for redevelopment (the co-operative for the second time). However, these larger scale producers, having better facilities for storage and transportation of crops than individual peasant households, are not limited to such close proximity to urban areas when relocating as are migrant farmers. Further, they are able to take advantage of generous government support mechanisms as they relocate and continue business. Finally, their focus on higher value, processed and packaged products for sale through established channels means that, for them, proximity to urban wholesale markets is less important than it is for peasant farmers who do not enjoy access to such sales channels.

However, the most significant difference between migrants involved in the incumbent sub-system and the larger scale producers of the emerging sub-system is that these private, state and co-operative producers tend to focus on the higher value vegetables for which the value added of quality labelling is most appropriate, namely FGV and to some extent OSV. Potential margins on many SV crops are simply too small. All these enterprises focused on high quality, high value vegetables rather than the conventional, lower quality vegetables, normally grown by peasant farmers and sold through wholesale markets. These higher quality products are categorised as ‘non-harmful vegetables’, ‘green vegetables’ and ‘organic vegetables’ in ascending order of quality. The main difference between these levels of quality are the amounts and types of chemical fertiliser and pesticides allowed, time required between final pesticide application and harvest and finally the level of processing (i.e. cleaning) required before the product is delivered to shops, restaurants etc. They are mainly sold through Wuhan’s supermarket chains and to business customers (e.g. hotels, restaurants, company and government canteens) as well as some being exported to other markets within China and abroad.

A more detailed understanding of the activity of distribution, its economic logic and interactions with the key system outcomes and system structures was gained through interviews with a number of different kinds of distribution enterprises.

## **7.2 Nested cases: mainstream distributors**

### ***Distributor 1***

The partner distributor of the district level leading enterprise mentioned above was based in the nearby urban centre of Zhuankou (one of Wuhan’s ‘town centres’). It was a local privately owned enterprise that worked in food and drink distribution, fast food delivery and vegetable distribution as well as providing food logistics consulting services to other businesses (e.g.

company canteens, schools, hotels and restaurants). The owner manager, Mr Huang, gave me a lengthy interview at his head office.

Mr Huang's company had been running for 20 years. He not only sourced vegetables from the aforementioned production base but also bought from the city's wholesale markets through trading companies for vegetable producers in the surrounding areas. The distributor also ran its own 'green vegetable' base in co-operation with Hua Zhong Agricultural Science Academy which consists of 100 mu (6.7 ha) of polytunnel covered land. In Baishazhou wholesale market they have a special purchasing base through which they buy 'green vegetables' and 'non-harmful vegetables' from Dongxihu, Wuchang, Wuhan's special development districts etc. as well as from individual farmers who bring their own produce to the wholesale market (FD Director, 2012).

This diversity of sources meant that he could counteract price fluctuations and seasonal variations in vegetable production and also maintain a competitive and stable price for his customers. Although such diverse sources bring risks in terms of the quality and safety of vegetables, he said he used his own testing machines to check for pesticide residues and guarantee the vegetable quality and safety. The distributor then process the vegetables themselves and packages for delivery to their clients which are mostly other businesses, schools, hotels etc. (FD Director, 2012).

Since the spread of polytunnel covered cultivation, the seasonal variations in FGV have reduced and these are now available all year round. While weather affects production, it has little effect on distribution since the distributor has access to a wide range of sources and national markets. There is very significant government support for vegetable production, although this is mainly aimed at producers and distributors are largely independent from government support. The government does, however, exercise control over prices but this mainly effects the state owned supermarkets. Because supermarkets form a key link in the chain between producers and consumers in the government's vision for peri-urban vegetable production, it is worth presenting a view of the vegetable production system from a supermarket buyer's perspective.

### ***Supermarket***

Wushang is one of the biggest supermarket chains locally with hundreds of wholesale and retail stores across Wuhan. I interviewed Mr Fan, one of the supermarket's purchasing managers. My first question was about how they source vegetables.

Wushang buys vegetables from three sources: 1) leading enterprises, 2) Farmers' Specialised Co-operatives, 3) the local wholesale markets. They preferentially source from leading enterprises and co-operatives (including the one visited in Dongxihu). If they are unable to meet



demand through the first two channels they make up the difference by buying through the wholesale markets such as Baishazhou. Mr Fan estimated that Wuhan itself can satisfy 40-50% of its demand for vegetables while the rest is sourced through the wholesale markets which link Wuhan to markets across China and provide a link between the small scale peri-urban producers and Wuhan's urban markets (WS Purchaser, 2012).

The direct purchase of vegetables from leading enterprises and production bases had only been possible in the previous 2 or 3 years. Previously, the only way was to buy from wholesale markets through which local and non-local produce flowed (WS Purchaser, 2012). This represents a very rapid and large scale change in the structure of the peri-urban vegetable production system. This and the rise of polytunnel covered production have helped to stabilise local supply chains and prices.

However, the challenges of price volatility and supply and demand mismatch remain two of the biggest issues for the distribution system. Extreme weather makes price variability worse, as can be seen most clearly in the 2008 snow and ice disaster. It closed down transportation routes so vegetable supplies into the city were disrupted. The government organised supermarkets and other large markets to go to local production bases to buy directly from farmers which gradually brought supplies back to normal.

Heavy government intervention and support at the formal end of the vegetable production system through its relationship with supermarkets and wholesale markets helps to control supplies and prices to consumers and also provide the government with an obvious way to control quality and safety of vegetables. However, the wholesale markets in particular link the formal vegetable production system to the vast number of informal migrant producers who it has been shown are responsible for a large proportion of Wuhan's vegetable production. This occurs not only through the links between wholesale markets and the supermarkets who use them to stabilise supplies, but also through links with distribution enterprises which claim to supply labelled 'non-polluting' or 'green' produce as revealed by the following case of one of Wuhan's main distributors which itself also supplies supermarkets in the city.

### ***Distributor 2***

During the course of my fieldwork I met someone who worked for one of the main vegetable distributors in Wuhan which supplied some of Wuhan's most prominent supermarket chains. This individual wrote a report for me about their experience and observations. He is referred to as Mr Lee in the following description (VD Worker, 2013).

The distributor, which was founded at the end of the 1990s, is a vegetable supplier to most of the nation's largest supermarket chains. It claims to have annual sales of over 120,000,000CNY (around £12 million), supplies 50,000 tons of vegetables annually and employs over 600 people.

It distributes vegetables in over 20 cities across China. The company has a 10 mu (0.67 ha) processing centre with two automatic vegetable washing machines, a 1,000 m<sup>3</sup> cold storage facility and a 2,000 m<sup>2</sup> processing and quality control centre.

In an effort to improve the quality and safety of vegetables they supplied, in 2009 the company invested 4,000,000CNY (£400,000) to set up a vegetable production base in Hannan district with a sowing area of 500 mu (33.3 ha). Here they grew mainly FGV such as pak choi (xiaobaicai, 小白菜), spinach (bocai, 菠菜) and lettuce (shengcai, 生菜). In this way they aimed to guarantee the quality of the vegetables they distributed to retailers. Soon after, they signed a contract with Starfarm to provide a European standard traceability system to further strengthen the safety standards of their products.

The company development has been aided by close consultation and co-operation with the city and district governments and agricultural bureaus at the city and district level. With the continuing support of these government actors the distribution company aims to expand their production base and continue the roll out of their traceability system. Their aim is to become Hubei's leading distributor of high quality, safe 'green vegetables' (lvse shucai, 绿色蔬菜).

Mr Lee explained that most of the vegetables processed and distributed through the company's workshop are sourced from the wholesale markets in Wuhan such as Baishazhou market and a proportion of the leafy vegetables from their production base in Hannan. Most of the vegetables sold in Wuhan are sold through Wushang and some through Metro and Walmart. Vegetables are processed through simple cleaning and vacuum packing.

The production base in Hannan is on land rented from farmers who are then employed to work the land while harvesting is co-ordinated by the distribution company according to their sales orders. According to Mr Lee, most of the farmers working there were around 60 years old. There were very few young people willing to work the land.

Mr Lee visited the production base several times and observed that it was in the process of being demolished, apparently in order to make way for a river port. The farmers who owned the land would be compensated and the distribution company would receive subsidies to help them relocate to another area.

He related a conversation with one of the farmers there, a man in his 50s from Xiaogan (a prefecture level city outside Wuhan) who had previously spent several years growing vegetables in Dongxihu:

Q: 您种菜赚钱吗? Do you make money growing vegetables?

A: 这些都是一些辛辛苦苦钱, 谈不上赚钱, 租的人家的地, 又不能得到政府的什么补贴, 补的钱均均被大公司转去了, 我们赚的是辛苦钱。The money we make is all

bitter money. Do not even talk about making profit. Renting other people's land, you cannot even obtain government subsidies. Subsidies are received by the big companies leaving us to make money the hard way.

Q: 辛苦，为什么还还种菜呢？ So why do you keep growing vegetables?

A: 我们不种菜，那城里人吃什么呢？我们也没有其他的技术，只能种菜呀。 If we do not grow vegetables what will the city people eat? Besides, we do not have any other skills, all we can do is grow vegetables.

Q: 您有听说这块地即将被征掉的消息吗？具体什么情况呀呀？ Have you heard that this land is to be redeveloped? What's the situation?

A: 这块地是要被征了，据说要用来建一个长江码头。不过也不清楚具体什么时候被征，不过应该也快了，如果真的被征了，我们又不不知道何去何从了。武汉市的市长是洪湖人，建议这里的老板到洪湖去种菜，，这个老板就建议我们去洪湖种，不过距离武汉太远了，所以也不愿意去，只能过一天算一天啦。 According to what people say, this land is going to be redeveloped as a river port. We are all unsure what to do next. The mayor of Wuhan is from Honghu and has advised the boss of this base to go to Honghu to grow vegetables. The boss has suggested we go too. But Honghu is far from Wuhan so we're not willing to go. We just take each day at a time.

Q: 您对以后种菜有什么看法吗？ What are your thoughts about growing vegetables in the future?

A: 担忧，担心以后我们农民去哪里种菜；担心未来没有人人种菜了，等我们老了，现在的年轻人将来也不愿意种菜，所以担心呀。 I'm worried. I worry about where us farmers will go to grow vegetables. I worry that in the future there will be no one to grow vegetables. When we are old, the young people will be unwilling to take over from us growing vegetables.

The above account shows that, while the key actors in the emerging sub-system are highly dependent upon government assistance they are also vulnerable to impacts of urban expansion. Not only that, but the livelihoods of peasant farmers involved in production under the management of commercial distributors are not necessarily better or more secure than those of independent migrant farmers and may in fact be less so. At the very least they are vulnerable to the same stresses and shocks experienced by migrant farmers in the incumbent sub-system.

Neither is the formalisation envisaged through the emerging sub-system quite as simple as might be hoped. As a major distributor to the city's supermarkets, this company actually sits at the intersection between the incumbent informal and the emerging formal sub-systems. Even though the company owns its own production base, it seems that the majority of FGV and OSV

produce it distributes are sourced from the increasingly marginalised migrant farmers through wholesale markets and undergo, at best, a relatively straightforward washing and packing process. The safety of vegetables supplied through the emerging sub-system is therefore far from secure as the following account confirms.

The same major distributor discussed above is required to test produce for pesticide residue and compliance is to be monitored by the government. If a government enforcement officer finds some vegetables with pesticide residues they are empowered to prevent the distributor from selling that particular type of vegetable. However, there is a problem within the company in that there is no comprehensive management system as it still operates as a family business with a less formal management structure. Their operational processes are relatively inefficient and there is a lack of risk awareness.

In a private conversation Mr Lee told me that the quality control facility which housed a simple machine for checking pesticide residue was very rarely used. In his opinion the safety of vegetables distributed by the company was no more trustworthy than the vegetables distributed through Baishazhou wholesale market which rank as the lowest quality level on the market:

Me: 你在XX实习时，看到了质量检测室吗？是怎么用的？ When you interned at XX did you see the quality monitoring room? How was it used?

Lee: 嗯，看到了，那基本很少用。用试管反复测试农药成分。仪器很普通，基本很少用！ Yes, it was used very rarely. Using a test tube to test pesticide composition, a standard apparatus. Very rarely used.

Me: 你觉得XX配送的蔬菜安全吗？ Do you think vegetables distributed by XX are safe?

Lee: 和白沙洲蔬菜一样的。 Same as Baishazhou vegetables.

Me: 那他们在汉南区的蔬菜基地是如何处理的？ What about the production base in Hannan?

Lee: 哪里只负责生产提供部分叶类菜。 It is responsible only for supplying a portion of the leafy vegetables.

The unrecognised links between the incumbent and emerging sub-systems through the wholesale markets and distributors mean that it will remain difficult to improve food safety outcomes for the majority of consumers for as long as the incumbent and emerging sub-systems co-exist. The following contrasting case studies show just how inaccessible a safe and affordable supply of vegetables is for the majority of Wuhan's urban consumers as well as revealing that there is, nevertheless, the potential to generate good and stable incomes for farmers while also improving food safety, given the appropriate use of technologies and

innovative business models.

### **7.3 Nested cases: niche producers**

#### ***State farm production brigade***

Nearby the FSC-2 was a state farm production brigade, a kind of branch farm of a state owned farm. The farm was set up in 1935 and in 1957 a large number of peasant farmers (90% of whom were from Hunan) came to help in a land reclamation project and develop agricultural production in that area. The production brigade began its current form of production in 2011 under strong government support and belongs to Wuhan's top tier of demonstration villages. The brigade has 2,000 mu (133 ha) and includes two specialised units. The first occupies 100 mu (6.7 ha) and was established in 2006 by Wuhan Supply and Marketing Agency and later rented to Zhongbai Group (which manages one of Wuhan's supermarkets) who currently operate it as a vegetable production base. The second, a 20 mu (13.3 ha) brand name organic vegetable farm was set up with over 300,000CNY of sponsorship from a number of government departments and directly supplies the canteens of some Hubei provincial government agencies (SF brigade Director, 2012) (see also WAB LXB, 2011).

The whole brigade, its 2,000 mu and 527 members and management staff, is managed by the Hubei provincial government and produces vegetables exclusively for government consumption, not available in public markets, which therefore fetch a higher price than normal quality produce. These vegetables are grown without any pesticide, chemical fertiliser or growth hormone and do not include any genetically modified varieties. The brigade members can be guaranteed relatively stable earnings of 10,000CNY per mu as the sale prices of their produce are typically 0.3-0.5CNY per jin (i.e. 6-10 pence per kg) higher than the public market price. If each farmer works 4 mu that would produce a yearly income of around 40,000CNY per worker which is similar to income reported for the FSCs above. Members also enjoy the benefits of having official farm worker status including access to insurance and pensions (SF brigade Director, 2012).

#### ***Vegetable association (integrated farming)***

Further away from the city but still in Hannan district I visited a vegetable association which was run by a migrant farmer from Hunan and is the only example found of so called circulating agriculture (循环农业). The more common term used for this kind of agriculture is integrated farming or integrated agriculture systems which refers to a farming system in which the waste or by-products of one unit are used as inputs in another unit. In this case vegetable and pig production are integrated by using the plant waste and off cuts to supplement pig diet and reduce feeding costs. Pig manure is processed in a biodigester to produce gas which is used for heating the polytunnels in winter. The solid and liquid outputs from the biodigester are used to

fertilise the soil and plants and significantly reduce reliance on chemical fertilisers. The woman in charge, Mrs Fan, claimed that this method can increase profit per mu per season by 2,000CNY, which is an increase in profits over a year with three growing seasons of 6,000CNY per mu. Use of manure derived fertiliser also helps to avoid the side effects of chemical fertilisers such as damage to soil structure and weakening of plants' resistance to certain diseases. In this way pesticide use can also be reduced (VA Director, 2012).

Mrs Fan set up the association in 2009 and by the time of my visit in the summer of 2012 she had 54 workers aged between 40 and 55 who were all local peasant farmers. Together they farmed 212 mu (14 ha) and raised 1,000 head of pigs (the pig production being managed by her husband who has some veterinary training). The local farmers rent their land to her at 600CNY per mu per year and she employs them each to work the land for her (60CNY a day for women, 70CNY a day for men). Each household rents out approximately 20 mu of land to her so with rent and wages each household can earn up to 60,000CNY net income.

Mrs Fan manages all other aspects of the business and keeps the profit she makes after paying for inputs, land rent and salaries. She passes on to her association members the training in new techniques that she receives from visits to Wuhan vegetable technology service station. She also handles the purchasing of inputs according to the technological service station's guidance and transports and sells the produce directly to Wuhan's markets which enables her to gain a better price than if she sold to traders. In 2011 she took a net profit of 490,000CNY and by the time of my second visit in January 2013 she was able to report a net profit for 2012 of 700,000CNY. It appears that despite producing a higher quality of vegetable with reduced chemical fertiliser and pesticide use and selling them at 'conventional' prices this integrated farming operation is able to make a profit and run independently of government financial support.

### ***Organic farm***

On an exploratory drive through the district we also came across an organic farm with a shop attached to it. The manager was happy for us to informally interview his assistant manager as she showed us round. The farm had been set up very recently and was yet to receive full organic status which requires 3 years of organic farming on land which has previously been used for non-organic farming. They employed 60 local farmers and cultivated 300 mu of polytunnel and greenhouse covered fields. They used integrated pest management techniques and organic fertilisers. Any losses due to extreme weather (such as damage from heavy snows) can be compensated for through the local district government.

The farm was set up using profits from the owner's seed company but had so far been struggling to make a profit itself. The reason for this was apparently that the cost of inputs is three times that for normal peasant farmers' production methods and yields are just 20% higher. However, the products cannot be sold at substantially higher prices because consumers would

not accept such high prices. She freely agreed that as a business model it was not very successful. It was more of a hobby project than anything else and those who wanted to buy their produce had to make the long journey to the farm shop themselves to buy these considerably more expensive vegetables.

## 7.4 Livelihood, environmental and food security outcomes

The business model encouraged within the emerging sub-system is one in which large scale producers sell direct to distributors or large buyers such as supermarkets and restaurant chains and is in line with the government's design for transforming Wuhan's peri-urban vegetable production. However, it is based on a rising middle-class demand for higher quality (and higher priced) value added vegetable products and is heavily supported by government subsidies to overcome the high cost of start-up capital and operating costs.

The preceding nested case studies show the workings of what can be seen as an enterprise based sub-system of peri-urban vegetable production. It represents the government's vision for a transformed vegetable production system in which consumers' needs are met (safety and affordability) and farmers' incomes are raised while simultaneously minimising environmental impact. Table 7.2 below sets out for each outcome, how this emerging sub-system contributes to outcomes for particular stakeholders.

<b>Table 7.2: Emerging sub-system outcomes and stakeholders.</b>		
<b>Outcome</b>	<b>Score &amp; description</b>	<b>Stakeholders</b>
<b>Quality-safety</b>	<p>(0) Ambiguous</p> <p>The quality of produce and its safety in terms of removal of pesticides is supported by the sub-system only as much as the producers follow through with their claims to control chemical use and stick to cleaning processes before packaging for sale.</p> <p>Further, because the sales channels include distributors who also buy from wholesale markets there is no control over which produce ends up in which retail outlets. Safe and less-safe vegetables become indistinguishable. The notable exception is the case of the</p>	<p><b>Middle-class</b></p> <p>The produce from this sub-system is accessible mainly to those who are willing to pay higher prices for value added, packaged and labelled produce in supermarkets, eat in the more expensive restaurants or work in large companies with canteens.</p>

	<p>local government run organic farm supplying government departments.</p> <p>It might also be expected that producers in the emerging sub-system would seek to minimise the risk of contamination from non-agricultural sources (industrial pollution of soils, water and air) but there appears to be little awareness of such issues so that there is no reason to believe that such risks (to which the majority of consumers are exposed) are lower than for the incumbent sub-system.</p>	
<b>Affordability</b>	<p>(0) Ambiguous</p> <p>The type of produce focused on by this sub-system is higher quality, higher priced vegetables. These may or may not be affordable for average consumers and are certainly not aimed at the poorest consumers.</p> <p>The highest quality and safest produce is obtainable only from an organic farm such as the privately run farm with its own market or the local government run farm.</p>	<p><b>Middle class</b></p> <p>(as above)</p> <p>Only a limited number of people with the resources, connections or status to know of, afford and have access to the private or government run organic farms can benefit from the highest quality produce.</p>
<b>Protection of soil &amp; water</b>	<p>(0) Ambiguous</p> <p>Soil and water resources are protected to some degree as a result of the drive towards 'green' and 'organic' certification. It is also in these producers' economic interests to monitor and limit chemical inputs, water use and find alternative methods of pest control, especially as they receive financial and technical assistance from the government to do this.</p>	<p>The direct beneficiaries of reduced degradation of soil and water are those producers with the capital, connections and knowledge required to take up new techniques promoted by the government.</p> <p>Indirectly, workers and some consumers may benefit from lower exposure to agri-chemicals as soil fertility improves. However, soil and water quality are also impacted</p>

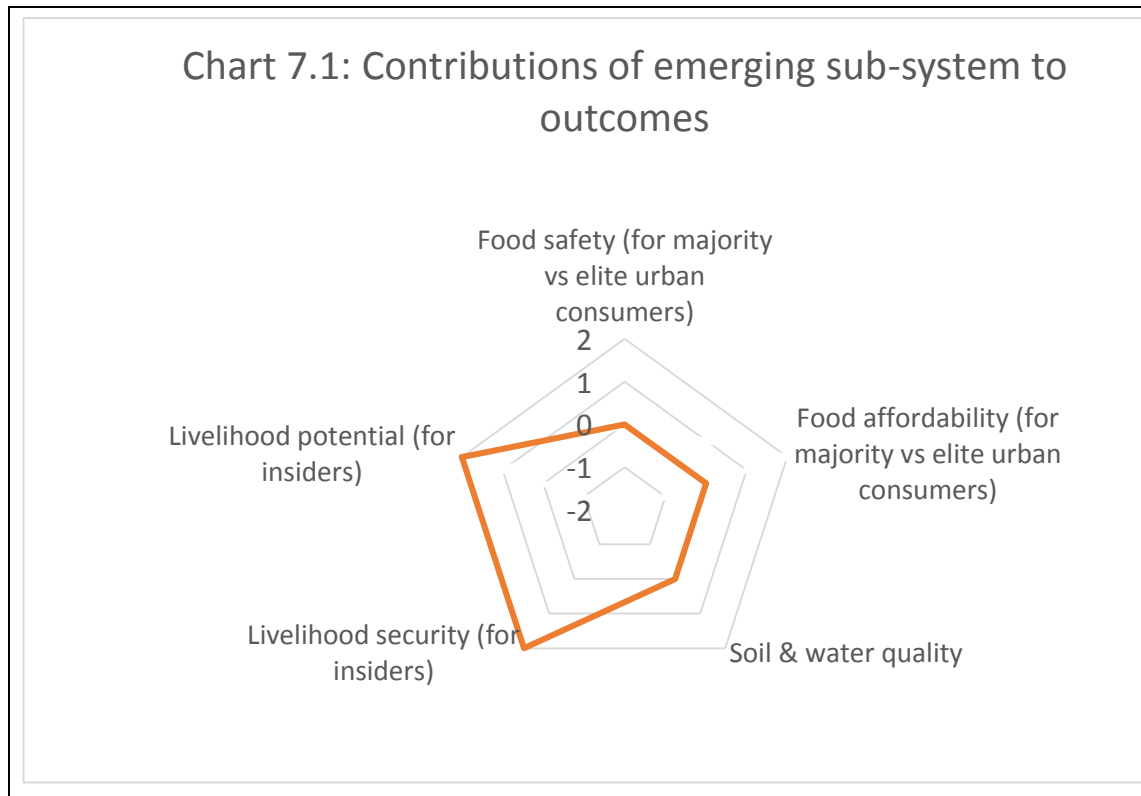


	<p>However, dependence on chemical fertilisers (and the resulting environmental impacts) is not eliminated as cultivation techniques are still conventional polytunnel based and intensive. Therefore the impact on soil and water quality is more likely to be simply reduced rather than having any positive impact on restoring soil fertility etc.</p>	<p>by industrial pollutants which create health risks for consumers in general which may outweigh the indirect benefits to consumers of less environmentally damaging agricultural practices.</p>
<b>Livelihood security</b>	<p>(2) Highly positive</p> <p>By bypassing the complex supply chain and linking large scale producers directly to distributors or retailers the problems of blind planting and volatile prices can be reduced. Production is done to order and prices are negotiated for fixed periods so price fluctuations are smoothed and profit is more stable. The high capital costs are subsidised through government policies. Government assistance is readily accessible.</p> <p>The main constraint on the businesses is access to finance.</p>	<p><b>Insiders</b></p> <p>The beneficiaries of price stability are both the large scale producers and the distributor/retailers.</p> <p>The government support and organisational resources necessary to set up large scale production is only readily accessible to ‘insiders’ - i.e. people with local <i>hukous</i> and who have good relations with government officials.</p>
<b>Livelihood potential</b>	<p>(2) Highly positive</p> <p>Livelihoods available to people involved in this sub-system are substantial. Farmers in particular can earn stable and relatively high incomes as members of co-operatives or working for leading enterprises.</p>	<p><b>Insiders.</b></p> <p>These livelihoods are only available to ‘insiders’ - i.e. local farmers with the right connections.</p>

The issues about vegetable safety monitoring raised in the interview with the wholesaler and distributor above suggest that the safety and quality of vegetables is not as closely connected to the ‘modernisation’ of the vegetable production system as the government would like. In reality,

safety is only guaranteed to those who shop directly from an organic farm, eat in a canteen supplied exclusively by trustworthy high quality suppliers or grow their own produce on their own land. Even for these consumers it is only the risk from contamination of agri-chemicals that is removed, while the threat from contamination from non-agricultural sources of pollution in soils, water and air are not addressed. For the vast majority of urban consumers it seems that the vegetables they consume are only as safe as the lowest quality of produce in the wholesale markets.

These conclusions are summarised in the following radar diagram (chart 7.1). This sub-system provides generous and secure livelihoods to select group of insiders while marginally reducing the negative environmental impacts and making an ambiguous contribution to food safety. On one hand, the quality of produce is pushed up and the affordability is pushed down by the economic incentive to seek out higher value added markets. But these same incentives drive a shift away from under developed domestic markets to higher value export markets. Further, the majority of urban consumers are not directly benefited by the quality improvements driven by the emerging sub-system as so-called 'green' and 'organic' produce cannot be guaranteed to be genuine or free from contamination from non-agricultural sources because most sales channels depend on the wholesale markets to make up supply. Thus only a small elite group of wealthy or well-connected consumers have guaranteed access to safe fresh vegetables. Finally, each of these outcomes are relatively resilient to the effects of market volatility and extreme weather as the sub-system is supported by access to government support. In the long term, however, due to its conventional mode of production (mono-cropping in polytunnels reliant on chemical fertilisers) the system may not be as resilient to the long term effects of declining soil fertility, climate change and rising costs of chemical inputs.



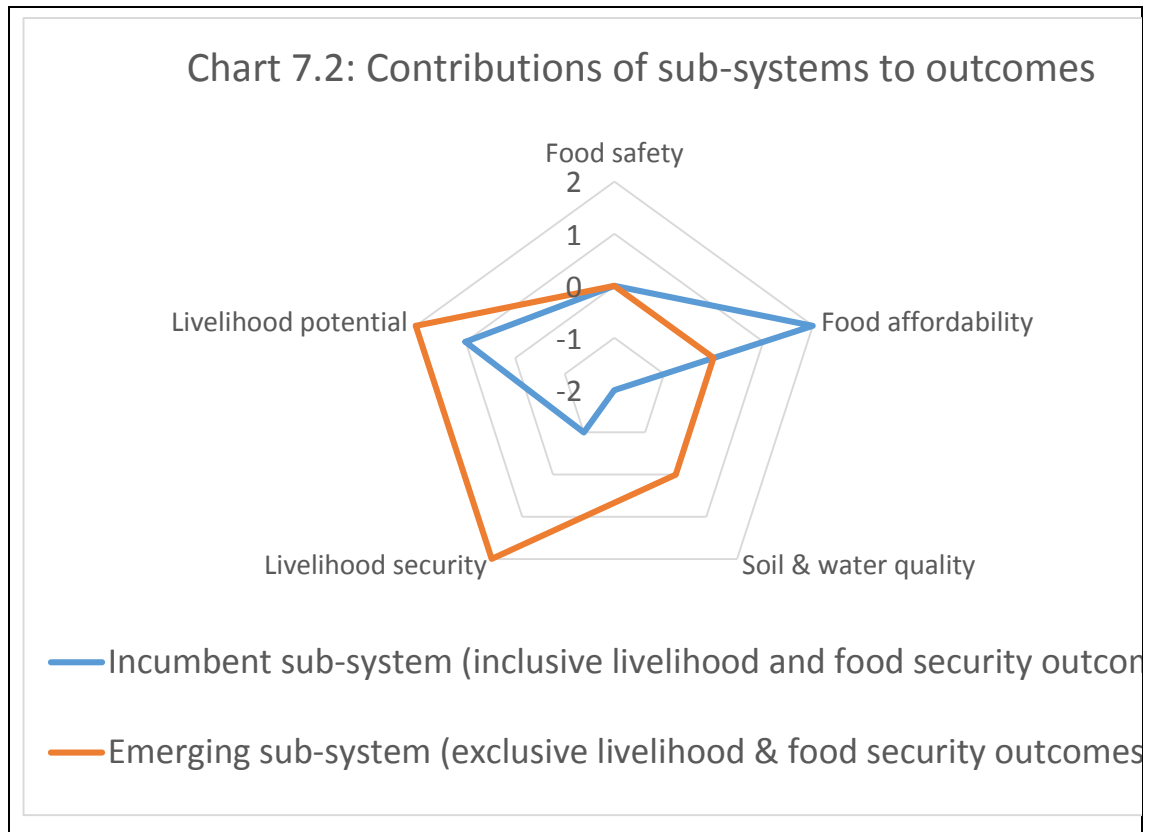
## Conclusion to chapter 6 & 7: incumbent and emerging sub-systems

In summary, the incumbent peri-urban vegetable system is characterised by a wide diversity of producers and distributors and linked through formal and informal structures – mainly through the wholesale markets – to Wuhan’s urban consumers (see chapter 6 and table 6.1 and 6.3). Different roles are played by different groups of actors. Migrant farmers in particular play a key role as producers in supplying Wuhan’s markets with the most affordable category of FGV and OSV while local farmers play a larger role in the supply of staple vegetables to local and national markets. This sub-system contributes positively to the affordability outcome for the majority of urban consumers who buy unlabelled ‘conventional’ vegetables in wet-markets or consume them in cheap restaurants and canteens. At the same time, the contribution of the incumbent sub-system to the food safety outcome is ambiguous at best because they are cultivated with high levels of agro-chemicals and often close to potential sources of industrial pollution. Further, there are inadequate mechanisms for monitoring crop contamination of unlabelled vegetable products and tracing their progress throughout the distribution system is impossible. The continuous chemical-intensive cultivation of FGV and OSV characteristic of this sub-system also has serious impacts on soil and water quality thus contributing to the negative environmental outcome of the system. Nevertheless, livelihood potential for migrant farmers in the incumbent sub-system is relatively high, albeit with a limited level of security as

vegetable cultivation is progressively displaced (see chart 7.2).

The emerging sub-system appears to be centred around larger scale commercial producers with direct links to distributors and supermarkets and characterised by a drive towards more advanced, technology intensive protected cultivation of high quality high value vegetable products under the ‘green’ and ‘organic’ labelling system (see table 7.1 and 7.2 in this chapter). Contrary to what might be expected, this emerging sub-system makes an ambiguous contribution to the food safety outcome due both to the inadequacies of the monitoring regime and the dependence of distributors and retailers on the wholesale markets for maintaining consistent vegetable supplies. Even though many of the vegetables produced within the emerging sub-system may be free from contamination and of higher quality than conventional vegetables there is no guarantee of the safety of what consumers are buying as ‘green’ or ‘organic’ in supermarkets or consuming in canteens. The links between the incumbent and emerging sub-systems through the wholesale markets mean that the impact of agricultural practices and peri-urban pollution on food safety under the former feed back into the latter. Indeed, the niche production cases show just how difficult it is to guarantee quality and safety of vegetables bought in Wuhan and highlight the ambiguous contribution of the emerging sub-system to the outcome of affordability as only a limited number of people are in a position have access to and/or be able to afford the highest quality and safest products. Despite this, there are likely to be less negative impacts on environmental outcomes than within the incumbent sub-system and there are very positive impacts on the potential and security of livelihoods. However the livelihood outcomes only benefit a select group of ‘insiders’ who have access to land, resources and connections necessary to take advantage of the opportunities presented by government support (see chart 7.2).

Chart 7.2 below summarises the comparison between the incumbent and emerging sub-systems so that the clear distinctions in outcomes and stakeholders can be seen. The outcomes linked to the incumbent sub-system are described as inclusive because they include ‘outsider’ producers (migrants) and the majority of urban consumers among those who benefit or suffer from these outcomes. For the emerging sub-system the set of outcomes are described as exclusive because there is a stark contrast in how the sub-system contributes to outcomes for the majority of producers and consumers vs ‘insider’ producers and elite groups of consumers.



Chapters 6 and 7 have analysed the characteristics of the main incumbent sub-system in Wuhan's peri-urban vegetable production and distribution system and shown how this compares to, and interacts with, an emerging sub-system which has begun to form in response to government policies aimed at system transformation. This analysis has begun to indicate, from a relatively static perspective, how each sub-system contributes differently to the five food system outcomes and their resilience as well as how these outcomes are linked to different groups of stakeholders. The next step is to develop a dynamic picture of the system trajectory as a whole, how marginalised peri-urban producers are impacted by it and the implications it has for the changing pattern of food system resilience. To this end, the following chapter draws together the evidence that has been built up at each step of the analysis so far to synthesise a holistic analysis of the system trajectory.

## Chapter 8. Step 4 – System Trajectory and the Changing Pattern of Resilience

*RQ 4. Within the context of the emerging system trajectory, what can be said about how resilience building policies impact the most marginalised peri-urban producers and what does this imply for feedbacks to other system outcomes and broader issues of sustainability and resilience in urban food systems?*

### **Introduction**

This chapter completes the analysis developed through chapters 4 to 7 by synthesising a narrative of the system trajectory and exploring its implications for the pattern of resilience that is emerging (see diagram 8.1 below). An analysis of the system trajectory is provided in terms of how various processes of transformation, adaptation and persistence at different scales unfold and interact to enhance or undermine the resilience of system outcomes for different stakeholders. The role of government policy in intervening in these processes is described and the resulting system trajectory and its implications for system resilience is analysed.

Three scales at which these three types of process unfold have emerged as important for understanding the system trajectory and its implications for food system outcomes and their resilience: context, structures and actors. The nature of these processes, their interactions across each scale and the ways in which they enhance or undermine the resilience of different system outcomes for different stakeholders can be abductively interpreted into an analysis of the system as a whole.

Section 8.1 sets out the processes of transformation unfolding at the scale of the system context followed by an analysis in section 8.2 of how these influence the processes of transformation and adaptation at the scale of different groups of system actors. Section 8.3 discusses adaptation and persistence within system structures and this leads into section 8.4 which directly addresses the emerging system trajectory and its implications for food system outcomes for different stakeholders and the changing pattern of food system resilience.

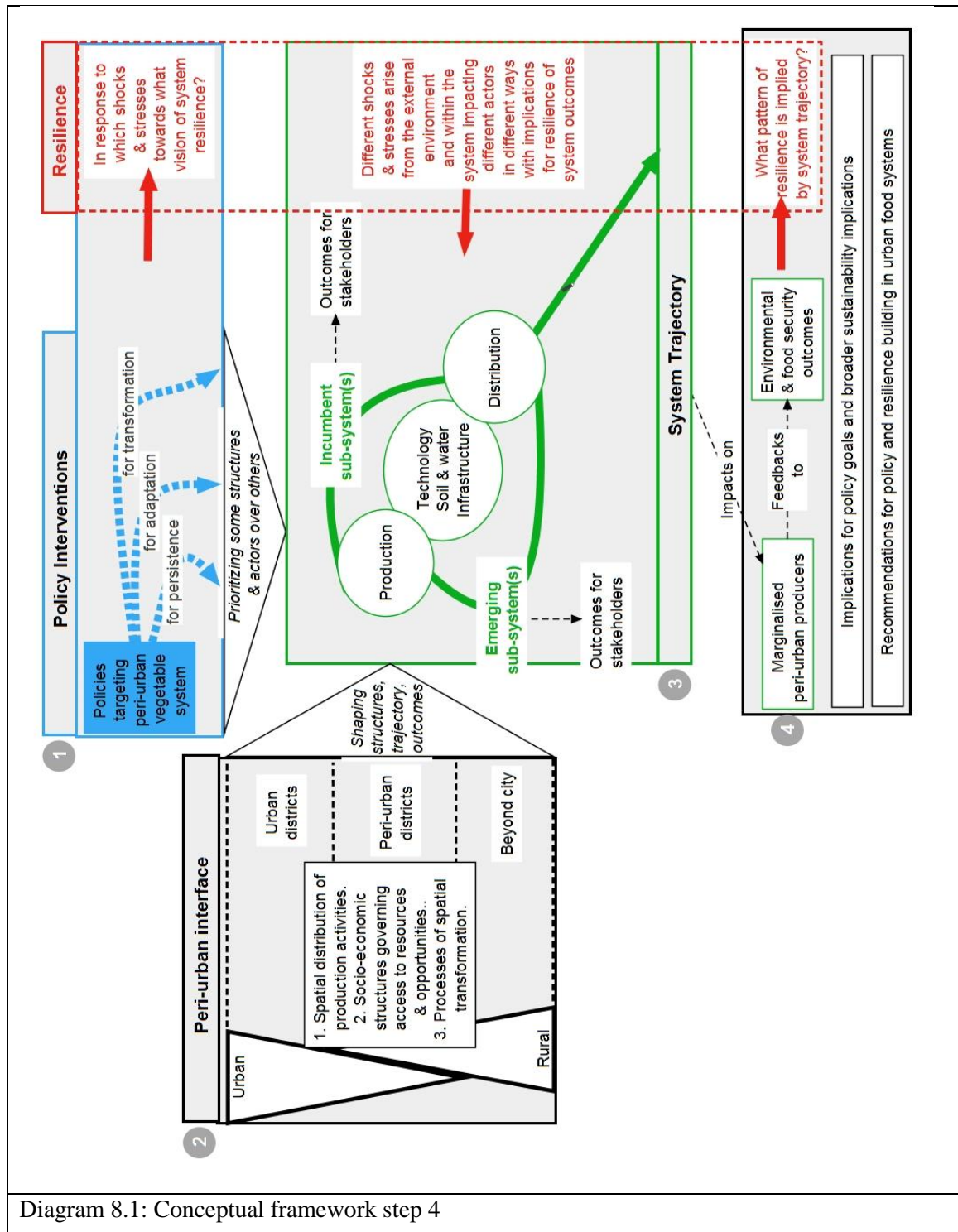


Diagram 8.1: Conceptual framework step 4

## 8.1 Peri-urban Transformations

### *Urban transformation of peri-urban space*

The data presented in the previous chapters reveal two connected processes of spatial transformation – one urban and the other agricultural – both stretching across Wuhan's urban and peri-urban districts and driven by the powerful forces of urban development. The first is an urban transformation involving a capital intensive reconfiguration of peri-urban space which extends urban infrastructure and activities into formerly agricultural or low density semi-urban land and integrates these newly urbanised spaces into the wider urban economy. The second is an agricultural transformation in which the set of actors, crops and technologies shifts, fundamentally changing the peri-urban food system into a highly productive urban-centric vegetable production system. These two processes are connected in a recurring two stage sequence of interactions, the first creative and the second destructive. The following sections outline the two processes and their interactions.

The first, the process of urban transformation, is infrastructure-led and directed by a coalition of municipal and district governments, real estate developers and investment companies in order to stimulate the urban economy, raise government finances and drive profits through investing in peri-urban areas to build new residential and commercial zones, industrial parks, research and innovation incubators and even to create entire new self-contained towns on the urban periphery.

This process is itself part of a broader pattern of urban development involving the redevelopment and redesign of urban space which spans the entire city and can be understood as a form of state-led citywide gentrification in which degraded neighbourhoods are being demolished and replaced by mixed use complexes of high-rise apartments, shopping centres, offices and business parks. The slogan often attached to this process is 'building a civilised city' which in practice appears to mean precisely the definition of gentrification: the creation of spaces of increasingly affluent consumption.

This urban transformation of peri-urban space, embedded within the broader urban political economy, can be clearly observed by researchers and urban planners alike and is immediate to the experience of urban residents as it leaves its indelible mark on the landscape, erasing what existed before and replacing it with new environments for urban life, work and leisure. The urbanisation of the suburbs and inner-city emphasises consumption, services and creative industries for which well-connected central city locations and high density population of relatively wealthy and highly skilled people are important factors. This often results in a rapid increase in the material conditions of life for many urban home owners (though renters suffer as



rents increase) as urban communities are compensated with cash payments and replacement housing in a rising property market, public transport improves and the urban environment is beautified and ‘modernised’.

In contrast, the urbanisation of peri-urban space emphasises industrial production and high-tech industries where such activities can benefit from clustering, access to large areas of land and where polluting activities can be relocated away from urban residents. People in the peri-urban districts may benefit from the increased opportunities for work, receive compensation and replacement housing and many rural *hukou* holders will be able to transfer to urban *hukous* giving them access to urban public services.

The two largest areas of FGV cultivation provide clear examples of the frontiers of this process of urbanisation of peri-urban space (see sections 5.3 and 6.1). In Dongxihu district a large area of once agricultural land had been redeveloped into apartments and commercial zones and the road infrastructure to support the planned remaining development was already under construction cutting across villages and fields. The GY site near Wuhan’s steel manufactural complex had been designated a chemical industries development zone for some time and the fields and villages were surrounded on all sides by urban developments including Wuhan Steel’s industrial complex, clusters of small-scale factories making furniture etc. and a large oil refinery was under construction on the banks of the river. A new road had been built through the middle of the agricultural lands indicating that the remaining land would soon become new commercial and/or residential plots lining the road which would link them to the city.

### ***Agricultural transformation of peri-urban space***

Alongside the process of urban transformation a triple shift occurs in inner peri-urban agricultural areas. This shift in actors, crops and technologies is from local to migrant producers, from grain to vegetable cultivation (especially FGV and OSV) and from open field seasonal cultivation and rotations to protected intensive and continuous cultivation. This agricultural transformation occurs as a less obvious and more transient transformation of peri-urban space than the urban one described above. It is linked to the process of urban development and expansion through both creative and destructive interactions at different stages in the process of transformation. Initially it is creative, as urbanisation brings peri-urban agricultural areas closer to the city and its markets. Later it is destructive, as urban areas continue to expand and displace agricultural activities outward in an expanding band of peri-urban agriculture. Further, this agricultural transformation occurs within a particular socio-economic and institutional structure unique to the Chinese context which brings a particular set of incentives, opportunities and constraints for different actors.

During the creative interaction, as proximity to urban areas increases urban markets become

more accessible and rising urban incomes drive demand for fresh vegetables which are readily grown in peri-urban areas. As a result the economics of intensive vegetable cultivation in those areas changes to make a shift to such activities more profitable. Simultaneously, the growth in work opportunities for local farmers in peri-urban areas encourages a move away from agriculture to urban employment. The *hukou* system which divides urban, rural and non-local migrant populations into three classes of citizens means that local farmers have priority access to local jobs, benefit from local social networks and have a degree of control over the land through the contract and responsibility system or direct relationships with state farms.

Migrants on the other hand, while not able to access the same opportunities, nevertheless benefit from the general unwillingness of local farmers to engage in the labour intensive cultivation of FGV and OSV for local urban markets. Migrants are able to rent land from local farmers, often informally, and set up as vegetable farmers themselves selling directly to the urban wholesale markets and sometimes even to local wet markets. By using plastic mulch and constructing bamboo or metal frame polytunnels and applying liberal quantities of chemical fertilisers and pesticides, migrant farmers can generate substantial and almost year-round incomes while having the added benefit of being able to migrate as family units rather than having to live as divided families in the manner of the majority of rural-urban migrants.

As can be seen in the Gongye site, for migrants who entered in the 1980s, peri-urban vegetable cultivation has provided a good and relatively stable household livelihood which has led to improved opportunities for household members and a higher standard of living than could have been expected from growing grains in the poor rural areas from where they migrated. For other more recent migrants who arrived in the 1990s or 2000s the livelihood has also been good but less stable.

The destructive stage of interaction begins with restrictions on house building on soon to be redeveloped land and culminates in displacement and loss of livelihood for migrant peri-urban farmers. Due to their informal status and the limited period of time they have on inner peri-urban land before it is seized for redevelopment, migrants are restricted in the quality of housing they are able to construct. Early arrivals may have been allowed to build single storey brick and breeze block dwellings with tiled roofs and basic toilet facilities on small plots of land on the corners of their rented fields. Later arrivals however, are likely only to be permitted to construct informal dwellings like shacks or tents on their rented land as the government bans construction of housing some years prior to redevelopment to prevent farmers 'growing houses' in their fields to 'harvest' compensation when land is seized. Building maintenance may also be restricted as one farmer explained that one year wind damage to his family's house required local government permission to fix which took several months to obtain. In some instances,

local farmers may also seek to appropriate ownership of the houses built by migrants on the land rented from them in order to increase their compensation (as was alleged in one interview).

The destructive stage of interaction is completed as urban infrastructure and land use expands into peri-urban areas and migrant peri-urban farmers are displaced and vegetable cultivation moves outwards onto other peri-urban agricultural land. While local *hukou* holders may expect some compensation and replacement houses as well as the possibility of transferring to urban *hukous*, migrant farmers on the other hand are forced to move on with no, or very little, compensation and their capital (land, polytunnels and housing) is destroyed and with it their livelihoods. For example, many of the farmers interviewed across Wuhan had moved several times already from more central areas to state farm land or village owned land further out. As a result, although a 5-10 year period of relatively stable cultivation might be expected before the need arose to move on to other land the disruption, uncertainty and loss of assets involved in this ongoing cycle of displacement deeply impacts the quality of life and livelihood decisions of migrant farmers.

The limited window of opportunity to make a living on each site before having to move on removes any incentive to preserve the quality of the soil. Further, as tenant farmers with only a temporary relationship to the land, migrants have no stake in its future. Added to this, as migrants, they receive even less state support than local peri-urban farmers and are thus highly vulnerable to disruptions caused by market volatility and extreme weather such as heavy rains, floods, snow and ice and high winds which damage yields and often cause destruction of crops. They are also price takers at the markets as produce is difficult to store without expensive cool storage and transportation facilities. The combination of these factors creates a situation in which migrant farmers have little choice but to do whatever it takes to guarantee the highest returns at the fastest rate while hedging against the periodic loss of crops or price crashes.

Many of these migrant farmers lack the skills, experience and capital required to move into production of higher quality 'green' (绿色) and 'organic' (有机) crops and so called 'jingcai' (精菜, choice vegetables) for the higher value markets and neither do they have access to the technical and financial support which might enable them to do so. Thus they have no way of increasing incomes and reducing risks apart from through boosting yields with their existing cropping patterns. The most appropriate strategy under these conditions is to maximise yields in the shortest amount of time, reduce the time from outlay to returns, and spread cropping and sales throughout the year to reduce the exposure to freak weather or price crashes. Fast growing leafy greens and off-season vegetables grown under polytunnels are the most appropriate crops for this strategy and the use of chemical fertilisers, pesticides and fungicides supports increased yields for long enough until the declining fertility and health of the soil and increasing pollution

of surface water (with both agro-chemicals and industrial pollutants) no longer matters once land is taken for redevelopment and agriculture is further displaced.

## **8.2 Transformation and adaptation among actors**

These dual processes of continual spatial transformation linked by recurring creative and destructive interactions form the dynamic context within which the urban food system and, in particular, the system of peri-urban vegetable production and distribution exists. The dynamic peri-urban context, characterised by large scale rapid transformation, generates significant disruptions to parts of the peri-urban food system most closely linked to marginal and inner peri-urban land. These could be seen as stresses to the system which are ongoing and thus relatively predictable. Added to these urban-driven stresses are the shocks of ‘normal’ and ‘freak’ extreme weather events and the unpredictable market variations generating extreme price volatility. Together these multiple stresses and shocks – originating from both the peri-urban interface and the wider economic and environmental context – drive smaller scale processes of transformation, adaptation and persistence (i.e. flexing or coping) at the level of both peri-urban food system structures and individual actors and households. Each of these multiple processes unfolding at different scales are characterised by both positive and negative impacts on various system outcomes for different stakeholders and can be understood as either undermining or enhancing the resilience of these outcomes.

### ***Transformation of migrant households’ livelihoods leading to lock-in to regressive adaptation***

The entry of migrant farmers into the peri-urban vegetable system in the first place involves transformative action on the part of poor rural households when they leave rural poverty in search of new opportunities. Instead of finding ways to persist in maintaining the status quo of their agricultural livelihoods, cultivating grain or adapting through changing agricultural practices in situ, they have entered new patterns of interactions within an entirely different social-ecological system in peri-urban Wuhan. Along with this household scale transformation come improvements in livelihoods and prospects for household members through a share, however small and fragile, in the benefits of urbanisation. For many migrant farmers (though by no means all) this initial transformation of household livelihood is a creative/progressive one which opens up new opportunities which would otherwise have been inaccessible and which reinforces their ability to persist and adapt in the face of disruptions and enact further creative transformations to take advantage of changing opportunities.

Once these migrant farmers become part of Wuhan’s peri-urban vegetable system, however, they must learn to adapt to the juggernaut that is the ongoing transformation of peri-urban

space. For many, it may seem that they have traded the certainty of rural poverty for potentially good but unstable and uncertain prospects at the peri-urban interface. For most migrant peri-urban farmers there is no way back to their former lives, having given up their rural lands and homes. Nearly all the migrant farmers interviewed explained that their only option is to continue to adapt to this cycle of displacement by locating new lands to rent to continue vegetable cultivation, re-establish their livelihoods and begin again to rebuild their capital assets (see sections 5.3, 6.3 and 6.4).

This enforced adaptation is accompanied by increasing challenges. Early in the process of urbanisation, when migrants arrived in the 1980s to grow vegetables on marginal and inner peri-urban state farm or village land, many migrants had the benefit of existing infrastructure designed to support vegetable production (irrigation, drainage, training opportunities, good access to roads, a certain level of maintenance provided by farm management). During the late 1990s and 2000s moving to new land they were more likely to have to rent from local farmers and village committees in conditions where there was no prior infrastructure for intensive vegetable cultivation. Maintenance of any irrigation, drainage and road facilities were not guaranteed and depended on either the goodwill of the locals or the ability of migrants to organise themselves to conduct larger scale maintenance projects. These challenges are likely to increase during the next phase of displacement in the peri-urban vegetable production system and will make migrant peri-urban farming livelihoods still more pressurised, vulnerable and uncertain as the spatial transformation of peri-urban space continues.

Further, for such transient communities this ongoing adaptation also has the effect of disrupting community cohesion and weakening social networks which will likely have disproportionate impacts on the most vulnerable people such as young children, the elderly, the sick and disabled and on the poorest families. As farmers age (many of the interviewees were in their 50s and 60s) their ability to continue the particularly labour intensive work of vegetable cultivation will decline. Combined with rising input costs and the added transport costs associated with displacement further from urban markets, their household incomes will inevitably decline and their ability to cope with the shocks of extreme weather and price variations will weaken. With very limited access to pensions and social welfare (due to their status as non-local rural *hukou* holders) their best hope for the future is that their children will be able to support them in old age. For some of them, their children will have been able to obtain university degrees in Wuhan or elsewhere and obtain graduate work or set up businesses in the city. The salaries obtainable however, compared to the rising cost of urban living, may well not be enough to support these ageing migrant households. Many households have only one or at most two adult children earning an income. For example, one farmer interviewed was in his 70s and still supporting his wife and sick son by growing vegetables. In fact, several

farmers interviewed claimed that they could earn more growing vegetables than their children could by working or running businesses in the city. The young people, however, are unwilling to take over the dirty and back breaking work of vegetable cultivation from their parents.

This process of adaptation by migrant peri-urban farming households can be characterised as a destructive (or regressive) form of adaptation forced by a destructive aspect of the transformation of peri-urban space. The data presented in chapters 5 and 6 indicate that the process of adaptation is costly and results in a declining ability to cope with the market and weather disruptions and adapt to future spatial transformation and the onset of old age. The end of this process will be one further transformation; this time not enacted as a step out of poverty but enforced by circumstances beyond their control. A transformation from a household livelihood based on the profitable and relatively stable (though increasingly less so) activity of vegetable production involving the productive labour of often two or sometimes three people, to one based on the transient and increasingly pressurised wage labour or business activities of one or sometimes two young adult children who often find themselves struggling as second or third class citizens in their adopted cities. Increasingly these young people are called on to support two sets of ageing parents and their own young children and so the pressure on the incomes of two young people at the beginning of their careers to support a growing number of dependents becomes still greater just as their chance to obtain the security of owning a house (which, since the most recent *hukou* reform would have allowed them to obtain a local *hukou* with all the associated benefits) in one of China's most rapidly developing cities vanishes with the rapidly rising price of housing.

### ***Transformation of local households' livelihoods and status***

Local peri-urban farming households by contrast experience a different kind of transformation process altogether. During the 1980s as urbanisation began to gain pace, local villagers, in what were then inner peri-urban areas (now thoroughly urbanised), would have been 'urbanised' effectively by default as their lands and homes were replaced with roads and rail infrastructure, city parks, apartment complexes and commercial areas, their rural *hukous* were converted to urban and they suddenly found themselves owning sometimes multiple city homes, learning to participate in the urban economy and benefiting from rapidly improving urban public services. As urbanisation progressed and Wuhan's administrative area expanded to cover larger areas of rural land, increasing numbers of Wuhan's peri-urban farmers became urban citizens and a large scale shift from agricultural activities to urban employment took place.

In addition, while waiting for the almost inevitable transformation to urban citizen, local farmers were able to use their relative control over their land under the contract and responsibility system to obtain greater value from it. Farmers could either let land to other locals

or to migrant farmers and themselves take up employment in local factories, construction etc. or occasionally rent from others to scale up agricultural production. Either option can be seen as a form of opportunistic adaptation to the continuing process of transformation which serves to increase their ability to cope with the impacts of extreme weather and price shocks until such time as they no longer have any kind of direct dependence upon agriculture for their livelihoods.

For these farmers the process of livelihood transformation is due more to the luck of the draw putting them in the right place at the right time, than to the kind of risky decision made by migrants. Also, in contrast to the situation faced by migrant farmers, the transformation process is preceded by new opportunities for adaptation which enhance rather than undermine the ability of local peri-urban farmers to cope (or persist) with disruptions.

Thus the same processes of spatial transformation driven by urban development led to contrasting outcomes in terms of livelihood potential and security for different groups. For those fortunate enough to be land and home owners in the right places as urbanisation progresses the likely, though not always guaranteed, outcome is that they will become wealthier, more secure, healthier (with access to the higher quality urban healthcare system) and their children will have better prospects through a higher quality education in urban schools. Whether they want it or not, local peri-urban farmers have been becoming urbanites at a rapid rate and are being catapulted into the urban economy as newly resourced and eager consumers. For others who do not have the same fortune of being born with local *hukous* in Wuhan's peri-urban districts and who must find their own difficult routes out of poverty, the opportunity is given to build a better life growing vegetables for the rapidly rising urban population. This opportunity provides the potential for significantly improved livelihoods but only for a limited period of time and with additional associated costs and risks. There are also risks to the health of peri-urban farmers from the heavy year-round use of agro-chemicals, from the polluted air and water that pervades many peri-urban environments and from the sheer intensity of the physical labour involved in growing vegetables in polytunnels in which temperatures rise to unbearable heights throughout the most productive growing seasons in spring and autumn. The cost of maintaining their role as producers in the peri-urban vegetable system as they are repeatedly displaced appears to be rising with every move onto new land further out from the city centre. For these farmers the future is far more uncertain and precarious than that of local farmers, yet these are the people who are responsible for supporting the resilience of a large proportion of the supply of vegetables to Wuhan's urban consumers.

### 8.3 Structural processes of adaptation and persistence

The peri-urban vegetable system which has developed as these linked processes of city wide spatial transformation and household scale transformation and adaptation have unfolded over the previous decades is one which has, in certain respects, become increasingly resilient to the disruptions of extreme weather and market fluctuations. The resilience of vegetable supply to the city (particularly in terms of the relative affordability of vegetables year round) has been secured through strengthening the persistence of particular system structures. Adaptations to the activity of production have been designed to increase persistence of local supply in the face of extreme weather. Adaptations to the activity of distribution and sale of vegetables have been designed to increase the persistence of non-local supply and to stabilise prices through a combination of increased competition and price controls.

The twin impacts of government investment in new agricultural technologies and in strengthening networks of urban wholesale and retail markets have been key to these adaptations. Local subsidies for stronger and more efficient polytunnels have helped to extend the growing season for vegetables and to protect crops from extreme cold, snow, heavy rains and strong winds. This has helped to reduce seasonality of production and stabilise supply to some extent by reducing vulnerability to extreme weather.

National investment in developing a better connected network of wholesale markets and local retail markets has helped to both reduce dependence on local supply for many crops while also giving farmers access to a larger market for their crops. This helped to stabilise prices for consumers through increased competition. It also allowed the government to control prices to a large extent through a formalised system of distribution through wholesale and retail wet markets. This control has extended with the growth of supermarket chains in the city.

These interventions can be seen as targeting two sets of processes within the vegetable system. The first helps to enhance the process of adaptation by peri-urban farmers to the disruptions of extreme weather and thus make the activity of production more persistent (i.e. improve farmers' coping capacity). In this process the livelihood potential and security for some producers are enhanced. Those farmers who can access and fully utilise the more advanced polytunnels are able to improve their incomes and reduce their vulnerability to extreme weather. The farmers most able to benefit are those who have a certain level of financial capital, the technical knowledge required to cultivate those crops which are best suited to protected cultivation as well as relatively long term access to agricultural land so that the returns on their investment can be fully realised.

The second helps to enhance the adaptation of vegetable system structures to changing



demand by formalising and improving the connections between the activities of production and distribution which makes supply and distribution more persistent in the face of disruption from extreme weather and market fluctuations. By supporting a more persistent supply of vegetables through local and non-local market channels and increasing the formalisation of distribution and sale of vegetables, prices to consumers can be stabilised and controlled to smooth out the impacts of price shocks at the wholesale markets due to shortages resulting from extreme weather or other causes. Strengthening both these sets of processes has gone some way to increasing the resilience of specific system outcomes.

In addition to the above mentioned government efforts to increase the resilience of food security and livelihood outcomes, the relatively large contribution of the informal production activities of migrant peri-urban farmers to the supply of FGV and protected OSV through the urban wholesale markets appears to play a significant role in enhancing the resilience of the food security outcome of affordability for the majority of urban consumers (see table 6.3). Due to the incentives to intensive, continuous cultivation of conventional vegetables (as opposed to green or organic) migrants are responsible for a large proportion of the supply of the most affordable category of these types of vegetables to Wuhan's markets. However, the intensive and chemical dependent cultivation with high levels of pesticide application have negative impacts on environmental outcomes in terms of soil fertility and water pollution as well as creating risks for food safety as vegetables are likely to contain high levels of pesticide and fungicide residue. A further risk to the food safety outcome is the location of FGV close to industrial sources of pollution.

## **8.4 Trajectories, outcomes and resilience**

### ***Trajectory of the incumbent sub-system***

Understanding the linked processes of change as outlined above allows for an analysis of the trajectory of the incumbent sub-system of peri-urban vegetable production in terms of changing five system outcomes (see table 6.3) and their resilience. The dual processes of peri-urban spatial transformation create both the opportunity and the increasing pressure on migrants to adopt the livelihood strategy which makes the supply of affordable conventional vegetables available yet at the same time increases the risk of damage to the environment and the health of consumers and farmers alike. The livelihood potential available to peri-urban migrant farmers is made resilient in that the peri-urban transformation continues to generate and the opportunities which make such livelihood potential possible.

As these processes continue to unfold, however, the positive impacts on affordability and livelihood potential are undermined by other processes. The regressive adaptation forced on

migrant farmers undermines their livelihood potential and security while also having negative feedbacks to affordability and food safety. It could be said that, for the incumbent sub-system, resilience of the affordability outcome is locked into a trade off with livelihood and environmental outcomes. This is because it is dependent upon the incentives driven by the regressive form of adaptation imposed on migrant farmers by broader peri-urban spatial transformations. The negative impacts of these processes on the livelihood and environmental outcomes, however, implies longer term feedbacks through the activity of peri-urban production which will undermine the resilience of affordability in the long term as well as threatening food safety for the less wealthy urban consumers dependent on conventional (unlabelled) vegetables.

The negative livelihood security outcome for migrant farmers is also made resilient by those same peri-urban transformations as the state of insecurity for migrant farmers is perpetuated and the system structures in which migrant farmers participate as vulnerable producers are made increasingly persistent. The negative food safety outcome is made increasingly resilient against intervention as migrant farmers are pushed into more chemical intensive agricultural practices and onto land likely to be close to non-agricultural sources of contamination. The environmental outcomes in terms of the impact on soil and water quality can also be expected to become worse and to be resilient to interventions to try to limit them.

Therefore, the longer term impact of these spatial processes is to constrain migrants' adaptation and ultimately degrade the livelihood, environmental, affordability and food safety outcomes as production costs rise and dependence on chemical inputs increases the risk of contamination from expanding industrial and commercial zones. The resilience of the affordability outcome against extreme weather would also be undermined as migrant farmers become less able to cope with shocks thus making supplies of conventional vegetables more unstable. On the other hand, the negative food safety outcome (an increasing risk of contamination from agri-chemicals and industrial pollution) can be said to be made more resilient in that it becomes more resistant to policy initiatives aimed at improving it (labelling, training etc.). Similarly, the negative livelihood security and environmental outcomes are made more resilient by these same processes just as the positive livelihood potential outcome is being degraded. Negative outcomes are perpetuated by the ongoing processes of peri-urban transformation and actor-level adaptation which can be understood as being an undesirable form of resilience: the kind of resilience-to-be-fought that Levine et al. (2012) discussed. On this basis, it could be said that the trajectory of the incumbent sub-system results in positive resilience (of affordability and livelihood potential) being undermined while negative resilience (of food safety, livelihood security and environmental integrity) is becoming more entrenched.

In conclusion, the outcomes from this sub-system have been relatively inclusive in that they

served a broad range of stakeholders: affordable produce is traded through wholesale markets without specifically restrictive pricing or sales channels and, despite the clear discrimination against migrants, livelihoods have nonetheless been available to and have often been improving for migrant farmers. As the processes of transformation, adaptation and persistence unfold however, these outcomes appear to be becoming less inclusive as migrant farming livelihoods become more vulnerable and production of affordable produce is displaced. For this sub-system, positive resilience (i.e. the resilience of positive outcomes) can be characterised as being both narrow and shallow. It is narrow in that there are a very limited range of outcomes which are resilient – centrally the affordability of FGV and OSV. It is shallow in that the resilience of that one food system outcome is built upon the vulnerability of the most marginalised actors and is dependent upon processes which undermine the resilience of other outcomes with negative feedbacks for the system as a whole. Thus the resilience of a narrow range of positive system outcomes to the threat of extreme weather and economic uncertainty is temporarily enhanced while being undermined in the long term by processes of change within the system and its context. In addition, even those processes which have been enhancing this narrow form of resilience also contribute to undermining the resilience of migrants' livelihood potential. Further, they strengthen the resilience of a set of negative outcomes (livelihood security for migrants, food safety for urban consumers and environmental outcomes) which become more entrenched within the system trajectory. Under the influence of policy interventions, the developing system trajectory appears to imply a further shift towards an increasingly exclusionary pattern of resilience.

### ***Government policy promoting an emerging sub-system and implications for system resilience***

Recent municipal government policy, in line with national policy, has set out to do more than simply strengthen the persistence or adaptation of system actors and structures. A transformed peri-urban vegetable system is envisioned which supports resilient food security outcomes with an emphasis on food safety while improving farmers' livelihoods. Some consideration for environmental protection is also given through efforts to control agro-chemical use.

These policies target the processes of transformation at the scale of actors and system structures. The main effort is in supporting commercial private and state actors and farmers' co-operatives to scale up more technologically advanced peri-urban production and increase the volume of direct formal sales through supermarket chains and distributors thus circumventing the convoluted and largely informal distribution channels linking farmers to wholesale and wet markets. The goal is to expand and modernise the intensive protected cultivation of FGV and OSV in peri-urban districts with the aim of enhancing urban food security and improving the

livelihoods of peasant farmers.

Transformation of system structures is stimulated through the introduction of a labelling system. This reflects a push for better quality control to both improve food safety for consumers and reduce the environmental impacts of production. The labelling system improves the incentives for larger, commercial production enterprises entering the system with government support to target the higher value markets for labelled 'green' and 'organic' produce which require a higher technical capability and specialised washing and packaging processes. These are sold through supermarkets and direct to distributors, company canteens and restaurants.

The emerging sub-system is expected to contribute positively to food safety outcomes as larger scale producers are encouraged to adopt stricter controls on agro-chemical use and invest in cleaning and processing technologies. The increasing formalisation of distribution channels through direct links between these producers and the distributors and retailers is also intended to make food safety easier to monitor. For those farmers who own land and are able to participate in co-operatives the potential livelihoods are very good and relatively secure as they are supported by government subsidies and assistance. Environmental outcomes are also relatively good compared to the incumbent sub-system as limited agro-chemical use and alternative techniques such as integrated pest management are encouraged.

On the surface this seems to imply the replacement of inefficient and environmentally damaging informal production of FGV and OSV (the incumbent sub-system) with efficient, technically advanced agriculture which protects peri-urban ecosystems, improves food safety and provides farmers with more secure incomes (the emerging sub-system) – in other words, a more resilient set of outcomes which improve the system's sustainability. Indeed, this is the goal of the policies aimed at transforming the peri-urban vegetable system.

However, such a conclusion could only be drawn by ignoring the set of processes described above that have given rise to the trajectory of the incumbent sub-system. Because small scale production by migrants and local peasant farmers forms the vast majority of peri-urban production of FGV and OSV not only are the most significant system actors displaced along with the activity of vegetable production but they are faced with competition for land with larger enterprises as they too are displaced. Neither do migrant farmers have access to the policy supports which are accessible to those larger scale actors. Yet, as the case studies in chapter 7 show, support for those private and state enterprises does not necessarily lead to better livelihoods for peri-urban farmers nor provide any guarantee of improving food safety.

Government policies aimed at system transformation lead to two, perhaps unforeseen, adaptations by those larger scale producer/distributors central to the emerging sub-system. First, aided by government subsidies and technical support, larger scale producers are able to improve

production techniques and obtain 'green' or 'organic' certification allowing them to access higher value domestic markets. As a result, they also have the potential to exit these, as yet underdeveloped, domestic markets and instead export abroad in search of higher profits where their higher quality products can obtain better prices. This was the strategy of the largest farmers' co-operative described in chapter 7.

Second, an alternative strategy involves an opportunistic adaptation of the labelling system whereby a producer/distributor obtains 'green' or 'organic' certification for a portion of their land while the remainder of their production remains 'conventional'. They may then exploit the weak monitoring regime to sell all of their produce under the label even though the majority is still grown in the conventional way. A variation on this strategy can be seen in the example of the distributor described in chapter 7. The company set up a 'green' or 'organic' vegetable base in order to gain the certification which they then apply to all their distributed product, much of which is sourced through the wholesale markets as conventional produce.

There is a further structural process of persistence which creates a crucial link between the incumbent and emerging sub-systems that generates a negative feedback between the outcomes for migrant farmers' livelihoods and the food security outcomes for the system as a whole. In order to maintain supplies in a volatile market and smooth seasonality the supermarkets and distributors in the vanguard of the emerging system source produce through the wholesale markets.

The result of the combination of these relatively informal and unrecognised processes of adaptation and persistence is that, as the safety of the most affordable conventional vegetables is compromised, this also threatens consumers of the more expensive labelled products, some of which are bought from wholesale markets and repackaged as labelled produce. Thus the process which enhances resilience of affordability also undermines the resilience of the food safety outcome for the majority of consumers including even the more affluent. Quite the opposite, the processes of peri-urban transformation, informal processes of adaptation and persistence among distributors actually generate negative resilience; a negative food safety outcome which is becoming more entrenched and resistant to the very policies designed to enhance it. With this negative resilience comes increasing inequalities. Even as the majority of consumers are exposed to increasing health risks associated with food contamination the distribution of risk will become more disproportionately heavy on the urban poor whose source of affordable fresh vegetables becomes further side-lined. Thus an increasing inequality in access to affordable safe vegetables appears likely to emerge with middle and low income urban consumers set to suffer the most. Associated with this are entrenched negative outcomes in terms of livelihood security for the most marginalised peri-urban producers and undermined resilience (or greater

vulnerability) of livelihood potential.

## Conclusion

This chapter has completed the fourth step in the analysis of Wuhan's peri-urban vegetable system. It has shown how government policies designed to achieve a specific vision of resilience have begun to unfold in the context of ongoing peri-urban transformations which continue to have a powerful influence on the activities of peri-urban production. The resulting system trajectory has been analysed in terms of the multiple processes of persistence, adaptation and transformation operating at different scales from system context through to structures and actors. These processes have been shown to contribute differently to the resilience of specific system outcomes and to have diverse positive and negative implications for different groups of stakeholders as the transformation of the system progresses.

The evidence suggests that a more complex system is developing in which the emerging sub-system enhances food security for a select few who are able to guarantee the source of produce (for example, through the state run organic farm which supplies government departments or the canteens of large companies that buy direct from the co-operative) and offers government sponsored livelihoods for insiders (those with the resources, status and connections to take advantage of the new opportunities). In contrast, the incumbent system is becoming further marginalised resulting in an increasing resilience of negative livelihood outcomes for migrant peri-urban producers as their vulnerable status is perpetuated. As the production of affordable FGV is displaced to marginal land at risk of industrial contamination and locked into dependence on agro-chemicals food safety risks increase. The declining resilience of livelihood outcomes for the most marginalised peri-urban producers is linked in the form of a negative feedback to declining resilience of food safety for the majority of urban consumers through the very processes of transformation, persistence and adaptation which enhance the resilience of affordability. As the system progresses along such a trajectory it can be inferred that this undermined resilience of limited safety outcomes will become a form of negative resilience as the processes which contribute to a negative food safety outcome become further entrenched. Thus the majority of consumers are at increasing risk from contaminated produce whether they buy vegetables labelled as 'green' or 'organic' or conventional unlabelled produce through wet markets or if they consume them in cheap staff canteens or street restaurants. Further, the contribution to environmental outcomes for both sub-systems are largely negative and resilient to intervention. The negative impacts on soil and water quality by the incumbent sub-system are resilient because they are driven by pressures on the livelihoods of marginalised peri-urban producers which are only becoming greater. The emerging sub-system also maintains a negative

impact, although likely reduced relative to the former, because it remains dependent upon mechanised and chemically enhanced agricultural techniques.

## Chapter 9. Conclusions and further research

### *Introduction*

This thesis began by highlighting the issues around applying a resilience approach to urban food systems. While it is clear that urban food systems need to be made resilient so that broader sustainability goals can be maintained over time, it has been a matter of debate as to how resilience should be conceptualised when applied to social-ecological systems (see Davoudi et al., 2012; Levine et al., 2012; Smith and Stirling, 2010). The danger is that, by uncritically adopting the language of systems and resilience into urban food system governance and research, the notion of ‘resilience building’ may become aligned with the interests of the powerful and influential few while the interests of the urban and peri-urban poor are obscured. Resilience of one set of outcomes defined at the level of an urban or peri-urban food system may reflect only a narrow set of interests and even be linked to negative outcomes for marginalised groups and thus degrade the broader sustainability goals of social justice and environmental integrity.

This presents two challenges and one opportunity (see section 1.1) in relation to enhancing resilience and sustainability in urban food systems. There is a normative challenge in framing resilience in relation to system-level outcomes if broader sustainability goals of environmental integrity and social justice are to be met. How can policy goals reflect the relevant diversity of actors and outcomes in order that resilience building contributes to enhanced sustainability? Assuming that an inclusive set of policy goals for system outcomes which reflect a broad framing of sustainability can be deliberated there is then the analytical challenge of generating an understanding of the system which is comprehensive enough to take into account the multiple processes of change unfolding at different scales throughout the system and its context. The opportunity then, is that such an inclusive framing of system goals and a comprehensive understanding of system structures and processes may reveal potential for aligning diverse interests around common goals to form new synergies between urban and rural activities and policy goals at the peri-urban interface. What is needed is a resilience approach which encourages an opening up of the normative framing of the system and its outcomes while also providing a heuristic for deepening the analysis of the complexity and dynamics of food systems in peri-urban contexts.

This research develops and applies a resilience based conceptual framework for peri-urban food systems analysis in order to explore the potential for an enhanced understanding of resilience that can support a more inclusive normative framing and greater analytical richness. This chapter summarises the conclusions drawn from the empirical analysis and discusses the implications for the theoretical and conceptual issues introduced in the first two chapters in



order to answer the central research question of the thesis:

*What are the implications for peri-urban producers of policies to promote food system resilience and what are the lessons for enhancing sustainability and resilience in urban food systems?*

Through answering this question, the conceptual contribution to knowledge made by this thesis is first to show how the notion of resilience and associated approaches can help or hinder the promotion of sustainable urban food systems. Second, it is to advance approaches to analysing and understanding resilience in urban food systems which can enhance the contribution of resilience building interventions to sustainability and particularly to social justice.

A diverse set of relevant insights were drawn together through a review of the literature around resilience, food systems analysis and peri-urban studies. These were developed into the conceptual framework for the research which formed the approach to analysing resilience in peri-urban food systems. This approach was implemented through a four step case-study design applied to the case of Wuhan's peri-urban vegetable system which employed qualitative interview data with multiple stakeholders, secondary literature and official documents, satellite imagery, census data and photographic evidence. Four sub-level research questions guided each of the four analytical steps through which an accumulative base of evidence and analysis was built up in order to answer the main research question. Through this analytical process a rich explanation of the system in its context was constructed which then allowed for the exploration (in chapter 8) of how the conceptualisation of the system (outlined in chapter 2) could enable an understanding of the interactions between resilience building interventions, system trajectory and outcomes for marginalised stakeholders.

Section 9.1 revisits each sub-level research question in turn to summarise an answer to the first part of the main research question. This is followed, in answer to the second part of the question, by a discussion of the lessons for conceptualising resilience in urban food systems and SES more generally (section 9.2). Section 9.3 provides some reflections on the methodology and section 9.4 outlines some policy implications for resilience building. The final section 9.5 briefly discusses the limitations of the research and suggests priorities for future research in developing an enhanced resilience approach to urban food system sustainability.

## 9.1 Answering the sub-level research questions

*RQ 1 What vision of resilience are policies designed to achieve and how do they promote persistence, adaptation and transformation to these ends?*

Government policy has been designed to achieve a limited form of resilience for a narrow set of outcomes. The valued food system outcomes are limited to maintaining stable consumer prices, improving the level of safety (in terms of reduced agro-chemical residues) and improving the livelihoods of peasant farmers. The key threats to these outcomes, against which they are to be made more resilient, are extreme weather and market volatility. The main purpose of resilience building policies is to support adaptation among peasant farmers and in particular promote the transformation of system structures towards larger scale protected production of FGV linked to formalised distribution channels organised within a system of labelling designed mainly to guarantee food safety.

*RQ 2. How do peri-urban dynamics shape the livelihoods of peri-urban producers and activities of vegetable production?*

The government's vision for a resilient 'modernised' peri-urban vegetable system ignores the existing system dynamics which are driven by urbanisation. The spatial, structural and temporal dynamics of the peri-urban interface shape the activities of vegetable production in several ways. Spatial characteristics influence where certain types of vegetables are cultivated as FGV are most profitably grown on marginal and inner peri-urban land with access to urban markets and water sources. The institutional structures which govern land management and the distribution of livelihood opportunities and constraints influence who is involved in cultivating these crops and the role such cultivation plays in their household livelihoods. Land is managed by state farms and local village committees in ways which give local farmers the opportunity to diversify livelihoods by renting to migrant farmers or other locals and seek urban employment. Under the *hukou* system migrant farmers are excluded from many urban opportunities and from access to formal land rights or tenancy arrangements so they are encouraged to rent informally from local farmers and most depend entirely on vegetable cultivation for their livelihoods. The temporal characteristics of the peri-urban interface mean that the livelihoods of migrant farmers, dependent as they are on FGV on marginal and inner peri-urban areas, are continually disrupted by urban expansion. This insecurity of livelihoods incentivises intensive chemical based agricultural practices aimed at short term profit maximisation with little incentive to preserve soil or water resources for the long term. Thus, the livelihoods of peri-urban producers (in particular those of migrant farmers) are at once made possible and made insecure by peri-urban dynamics. The implication is that those peri-urban producers on whom a large proportion of Wuhan's supply of fresh leafy vegetables depends are themselves the most vulnerable actors

within the peri-urban food system. Further, the government policies designed to promote food system resilience ignore these peri-urban dynamics and fail to address the issues faced by a large constituency of marginalised but indispensable stakeholders.

*RQ 3. What are the characteristics of, and interactions between, the incumbent and emerging sub-systems in the peri-urban interface and how do they contribute to system outcomes and their resilience?*

As government policies aimed at transforming the system unfold in the context of such peri-urban dynamics an emerging sub-system can be identified alongside the incumbent sub-system. The incumbent sub-system is characterised by a diversity of producers linked through formal and informal structures to urban markets. Local farmers on outer peri-urban agricultural land play a larger role in cultivation of SV (staple vegetables) while migrant farmers on inner and marginal peri-urban land are the majority of FGV producers. The wholesale markets are key to supporting the resilience of affordable SV supplies while the role of migrant farmers in intensive FGV is key to supporting the resilience of affordable FGV supplies. In this respect it can be argued that the incumbent sub-system contributes positively to the affordability outcome of the urban food system for the majority of urban consumers. On the other hand, food safety is compromised in the incumbent sub-system, in particular for FGV, as cultivation is dependent upon heavy use of chemicals and often takes place on land close to sources of industrial pollution. Relatively good livelihoods are available to the marginalised peri-urban farmers although these are comparatively insecure and becoming more so and these are at the expense of the environmental outcomes as soil and water resources are degraded.

The emerging sub-system also reveals some diversity in that, among the new larger scale commercial enterprises involved in production and distribution, some have moved into ‘green’ vegetable production while others have targeted ‘organics’. Although these enterprises are organised in different ways (co-operatives, associations, private and state companies) their business model tends to focus on the protected cultivation of high value crops for high end markets or for export. Despite this, the connection through the wholesale markets with the incumbent sub-system required to maintain stability of supplies combined with inadequate regulation allows a feedback from the informal production of FGV on marginal and inner peri-urban land. Thus, whatever impacts the safety of vegetables in the incumbent sub-system has an impact on food safety in large parts of the emerging sub-system.

*RQ 4. Within the context of the emerging system trajectory, what can be said about how resilience building policies impact the most marginalised peri-urban producers and what does this imply for feedbacks to other system outcomes and broader issues of sustainability and resilience in urban food systems?*

The empirical evidence and analysis presented in this thesis reveals a far more complex and ambiguous relationship between the resilience of system outcomes and the processes of change at the level of system context, structures and actors than is normally envisaged when conceptualising social-ecological resilience. In Wuhan's peri-urban vegetable system the resilience of each system outcome (or function) for the different groups of stakeholders is dependent upon different processes of persistence, adaptation and transformation unfolding at different scales. Processes which have so far enhanced the resilience of one outcome (affordability) have had increasingly negative impacts on the resilience of livelihood outcomes for the most marginalised producers and on food safety risks for urban consumers.

Government policy has failed to recognise these interactions and interventions have engaged only with promoting those processes which appear to most directly support the narrow framing of resilience reflected in policy goals. Adaptation among local peasant farmers and especially larger scale state owned and private production enterprises is enabled through subsidies and technical support in order to promote what are perceived to be safer, more environmentally sound and economically profitable and efficient forms of vegetable production. Transformation of system structures towards more formal and traceable distribution channels linked to larger scale commercial production is driven by the introduction of the quality labelling regime and support for direct sale links and commercial distribution enterprises.

However, these policies have contributed to a system trajectory characterised by a changing pattern of resilience in which the broader normative sustainability goals are undermined while a narrow set of outcomes for a limited number of privileged stakeholders are enhanced. A particular framing of the system and its outcomes have guided resilience building policy initiatives to promote certain structural processes of persistence, adaptation and transformation which have inadvertently generated a number of unintended consequences and feedbacks. Broadly speaking, this means that resilience building policies are generating greater inequality in food system outcomes which in turn will undermine the positive resilience of system outcomes for the majority of stakeholders and even contribute to the negative resilience of outcomes for the most marginalised.

The policy driven transformation towards a potentially more resilient food system can also be seen to have disruptive and negative impacts on a significant group of system actors (the migrant farmers) who themselves are integral to the resilience of a valued food system outcome (the abundant and affordable supply of vegetables for low and middle income urban consumers). While in principal the type of system envisaged as the target of transformation may offer enhanced resilience of certain valued food system outcomes (although in a very limited way) that potential future comes at a cost to the majority of stakeholders which is

disproportionately born by migrant peri-urban producers. The emerging pathway to that imagined future also has serious negative impacts on the most marginalised system actors.

Thus it can be said that the system trajectory – involving a reconfiguration of system actors, structures and processes of change – is driven by peri-urban spatial transformations and municipal policies to generate the resulting trend towards a pattern of resilience which is shallow and increasingly narrow and exclusionary. It is shallow in that the processes enhancing the positive resilience of a particular set of outcomes are undermined by other processes and simultaneously contribute to the negative resilience of other outcomes. It is moving toward a narrow and exclusionary pattern of resilience in that the resilience-enhancing processes are linked to outcomes for a limited set of stakeholders while other outcomes are becoming less resilient. Therefore, as they unfold in the context of ongoing processes of transformation, adaptation and persistence within the system and its context, government policies designed to drive the transformation of the peri-urban vegetable system to a more resilient state have the effect of reinforcing the processes that undermine the resilience of the outcomes those policies are designed to promote and fail to address those processes which lead to increasing resilience of negative outcomes for marginalised stakeholders.

In conclusion, the evidence of this research suggests that the current approach to governance of Wuhan's peri-urban vegetable system is building an increasingly exclusionary pattern of resilience. It is a form of resilience building which is likely to undermine broader normative sustainability goals around social justice and environmental integrity and have mixed future implications for food system resilience as a whole, particularly in relation to livelihood outcomes for peri-urban farmers and food safety outcomes for urban consumers in general. What then are the lessons which can be drawn from this analysis?

## **9.2 Lessons for conceptualising resilience**

The empirical evidence presented in this thesis highlights the potential for the concept of resilience to support either a narrowing down or an opening up of normative framings of system outcomes and demonstrates some of the negative implications that can have for sustainability goals. Similarly, the way in which resilience is defined and applied can either obscure the complexity and dynamics of the system or reveal them. This is particularly problematic in the context of urban food systems and urban resilience more generally because the concept of resilience is in danger of becoming something of a multi-purpose tool in the hands of powerful urban elites to bolster support for the neo-liberal vision of urban growth. This ambiguity stems from the conceptual problems outlined in chapter 2 of this thesis.

The theoretical contribution made by this thesis is to offer an approach to analysing resilience in human dominated SES that resists a narrowing down of normative system framings and

enables hidden complexities and trade-offs to be revealed. This is relevant beyond the immediate context of peri-urban food systems because it addresses some of the more general conceptual challenges outlined in (and levelled against) the broader literature on social-ecological resilience and offers a helpful alternative to current mainstream approaches to SES analysis, particularly in human dominated SES in contexts of rapid change.

***Opening up normative framings through a functional definition of resilience***

The case study of Wuhan's peri-urban vegetable system shows clearly how a narrow framing of resilience and system outcomes can lead to a misguided targeting of policies to particular structural processes which generate negative outcomes for marginalised producers with further negative feedbacks to other system outcomes. This highlights the danger that resilience can be employed to elevate a narrow set of issues to the status of system-level outcomes and justify an intervention agenda which neglects a whole range of other important outcomes, actors and processes. At first glance it may be plausible that such a vision of system resilience is achievable and may indeed raise farmers' incomes, improve food safety and protect the environment. However, once the question of who really benefits from these outcomes is asked and a closer look is taken at the diversity of system actors, this vision is revealed as reflecting only the interests of a privileged few. This demonstrates the importance of disaggregating outcomes according to the multiple diverse stakeholders and recognising the potential conflicts between different system outcomes for different stakeholders. If resilience is defined according to specific outcomes for specific groups of stakeholders, a distinction is made between system outcomes (or functions) and structures and an emphasis placed on mapping out the diversity of formal and informal urban food system stakeholders (in particular the most marginalised) then this dangerous narrowing of framings may be largely avoided. Contemporary approaches to resilience, however, are hindered from opening up normative framings by conflating functional and structural resilience.

The issue of conflating function and structure in definitions of resilience was highlighted by Smith and Stirling (2010). The empirical case presented in this thesis illustrates this issue by showing that the resilience of outcomes (functions) are variously supported and undermined by multiple processes of change at different scales enacted at the level of the system context, structures and actors. Walker et al.'s definition – “the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity.” (2004, 2006, p. 2) does not work in this case. Resilience defined at the level of system structures does not correlate with resilience of system functions or outcomes.

This system-level definition, in which resilience is seen as a property or capacity of the system as a whole, appears to be central to the most widely cited approaches coming from the Resilience Alliance, Stockholm Resilience Centre and others (Anderies et al., 2013, p. 4; Biggs

et al., 2015, p. 13; Elmqvist, 2014; Nelson et al., 2007, pp. 396, 400; Walker et al., 2004, 2006, p. 2). These approaches focus on analysis of system-level capacities or characteristics. For example, Walker et al. (2004, 2006) refer to resilience as the capacity to maintain structure or function, adaptability as the capacity to manage resilience and transformability as the capacity to create new systems when the current regime is undesirable. Nelson et al. (2007) talk of adaptive capacity for which self-organisation, capacity for learning and capacity to absorb change become important. Anderies et al. (2013) helpfully distinguish between sustainability as defining a set of normative goals and resilience as a non-normative concept. However, they also continue to define resilience as a system-level property generated by the capacity of the system to “learn, adapt and transform” (Anderies et al., 2013, p. 4).

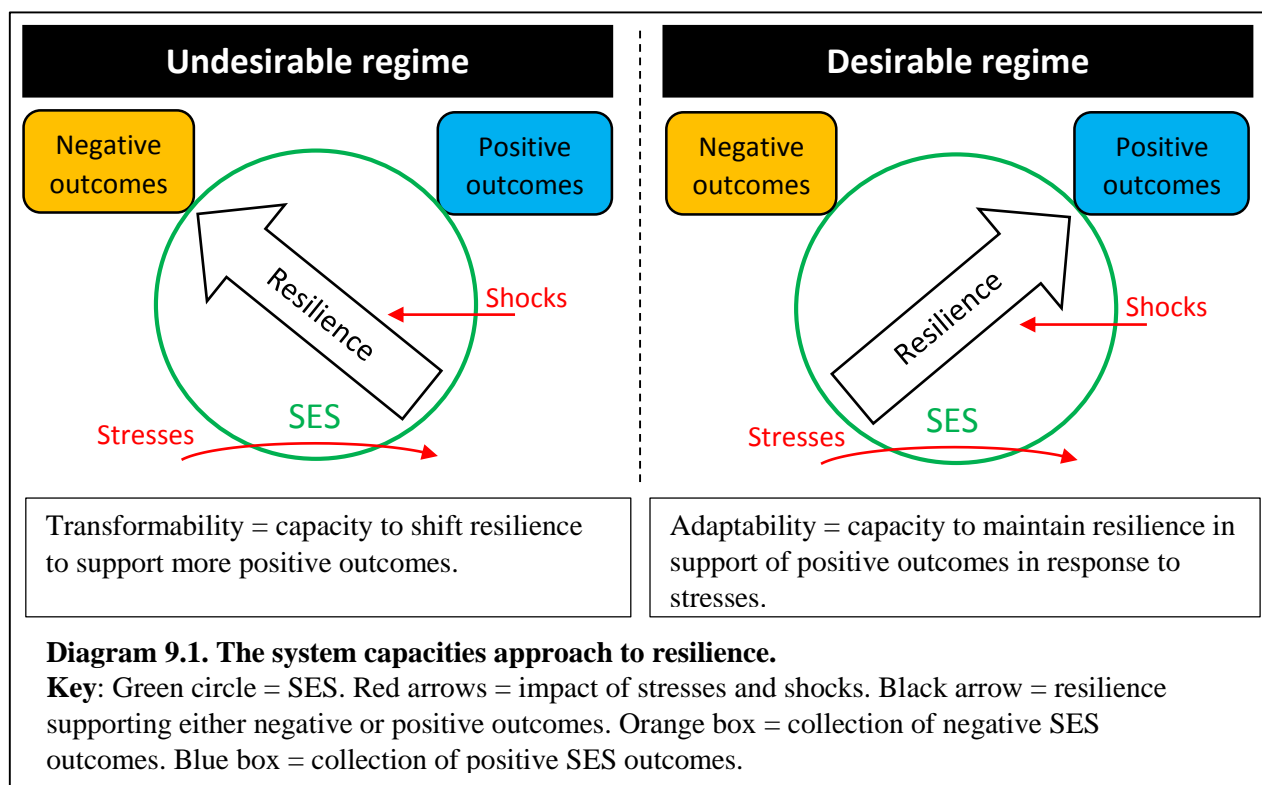
More recently, Biggs et al. (2015) have outlined an approach to social-ecological systems which builds directly on these previous approaches and which draws on a wide range of empirical evidence to support seven principles for building resilience in SES. They too emphasise resilience as a system-level property and the set of principles for building resilience read like a list of system-level capacities: e.g. the abilities to maintain diversity and redundancy, manage connectivity, encourage learning and experimentation (Biggs et al., 2015). However, their focus is more specifically on how system resilience can be built in order to maintain ecosystem services.

Writing in the same book Schoon et al. (2015, p. 32) acknowledge that not all ecosystem services can be made more resilient simultaneously and trade-offs are inevitable. They then discuss the politics of resilience building in terms of decision making processes about which sets of ‘ecosystem service bundles’ are prioritised and how the benefits are distributed – suggesting that by incorporating learning, participation and polycentric governance in resilience building strategies power asymmetries can be resisted.

While this approach may be appropriate for certain types of SES such as Schoon et al. call an ‘ecosystem-service landscape’ (2015, p. 45) – e.g. a national park habitat – when analysing more heterogeneous human dominated SES such as peri-urban and urban food systems it becomes problematic. This approach seems to sidestep the issue of how multiple system outcomes (not only ecosystem services) may be in conflict and connected through the multiple processes of change unfolding within SES and their context. Neither does it ask how capacities themselves may be unevenly distributed in ways that allow some to manipulate resilience building activities in order to accumulate power. For example, system-level adaptive capacity may be greatly enhanced by replacing low-skilled under-resourced farmers with higher skilled, better resourced agri-businesses rather like replacing a faulty part in a car or upgrading your computer memory and discarding whatever no longer serves the broader goal.

The underlying assumption behind all these approaches is that SES behave like complex adaptive systems in that they “have the capacity to self-organize and adapt based on past experience” (Biggs et al., 2015, p. 6). As such, the focus of analysis and resilience building action is to strengthen the capacity of SES to “[recover] from unexpected shocks and [avoid] undesirable tipping points, but also the capacity to adapt to ongoing change and fundamentally transform SES if needed” (Biggs et al., 2015, p. 6). The outcome of strengthening these capacities is then to maintain or move towards a SES which is able to satisfy a normative set of goals despite shocks and stresses. Or as Nelson et al. (2007, pp. 400–1) put it: “system adaptedness, the level of effectiveness in the way a system relates with the environment ... and meets the normative goals of system managers and stakeholders.” Even in the most recent application of the concept of resilience to cities as complex systems this fundamental approach remains intact thus perpetuating the problem of conflating structure and function (see Elmqvist, 2014, p. 27; Ernstson et al., 2010, p. 533; Meerow et al., 2016, p. 39).

The logic of this system capacities approach to resilience can be represented in a simple diagram below (Diagram 9.1). The diagram depicts resilience as a system property which preserves either negative or positive system outcomes against shocks in an undesirable or desirable regime. Transformability needs to be built in order to shift from an undesirable resilient regime to a more desirable one. When the desirable regime is attained, adaptability needs to be built in order to maintain resilience in response to stresses.





When resilience is defined in this way as a system property, it assumes a prior evaluation of the normative goals for system-level outcomes. Resilience of the system is separated conceptually from assessment of the desirability of the outcomes produced by the system. In order to then design action to build resilience it must be implicitly assumed that system structures and processes are capable of collectively maintaining this set of desired outcomes simultaneously. This approach to resilience building seems to naturally tend towards defining a narrow set of relatively aggregated system-level outcomes and specific external disturbances which can be made to fit neatly into the coherent model of a resilient system.

As this thesis has shown, rather than being seen as a system-level attribute, resilience may be more helpfully defined as an aspect of an outcome (e.g. peasant livelihoods are resilient; affordable food supply to the city is resilient; or perhaps inequalities are resilient etc.) rather than defined as an attribute of a system. This opens up normative framings of resilience by allowing for the disaggregation of system outcomes with reference to different stakeholders which can then be analysed separately to demonstrate the ambiguities inherent within the system as different negative and positive outcomes for different groups are becoming more or less resilient. It also enables the analysis to shift away from attempting to define and measure resilience as an intangible and difficult-to-observe property emerging from complex interactions. Instead the focus becomes examining the more tangible processes of change unfolding at the level of system actors, structures and context which variously contribute to or undermine the resilience of quite clearly defined positive and negative outcomes.

### ***Deepening analysis through an emphasis on processes of change, sub-systems and system trajectory***

By shifting the analytical lens from resilience as a system property to an aspect of outcomes the role of ongoing, multi-scale processes of persistence, adaptation and transformation in enhancing or undermining resilience of various outcomes becomes the new focus of analysis. Distinguishing in this way between the resilience of outcomes for particular stakeholders and the processes of change unfolding across the levels of actors, system and context provides space for a more nuanced way of thinking about the system and its trajectory.

When an urban food system is undergoing rapid change, the system can be thought of as travelling along a trajectory in which system actors, structures and change processes are being reconfigured and outcomes for different stakeholders are also changing in negative and positive ways. In this context, resilience cannot be understood as a sliding scale in which the system is seen as having a certain level of resilience. Rather it may be understood as a shifting pattern of resilience in which different positive and negative outcomes are becoming more or less resilient simultaneously. Thus any urban food system may be characterised by a shifting pattern of both positive and negative resilience of different outcomes for different stakeholders. This shifting

pattern of resilience may be mutually re-enforcing so that it is simply not possible to separate “resilience-to-be-supported” from “resilience-to-be-fought” (Levine et al., 2012, p. 2) because prioritising the resilience of one set of positive outcomes may actually entrench the negative resilience of others (as can be seen in the case study).

The case study highlights that, as the system trajectory continues, shocks and stresses originating from the system context and structures can be equally significant for the most marginalised actors as those external shocks and stresses against which resilience building measures are aimed. By recognising that resilience can be potentially positive or negative a greater range of processes which support these two types of resilience comes into view allowing a more comprehensive analysis of the system. Explicitly considering not just external shocks and stresses but analysing how system structures and context generate disruptions to actors’ livelihoods can also add to the depth of understanding of the processes of persistence, adaptation and transformation unfolding at different scales.

This thesis has shown how top-down policies designed to promote resilience at the level of a food system are not necessarily compatible with building resilience at every scale or working towards transformation for the benefit of all stakeholders. This is partly because the framing of food system outcomes may not reflect the range of system outcomes at all and will often reflect the interests of a narrow set of actors and thus ignore important aspects of social justice, environmental sustainability and food security. It is also due to the reality that the processes of persistence, adaptation and transformation that support the resilience of some outcomes will simultaneously degrade the resilience of others or contribute to the resilience of negative outcomes for particular groups. Therefore, efforts to enhance the resilience of a narrow range of outcomes at the scale of an urban or peri-urban food system may often turn out to be incompatible with reducing the vulnerability of the most marginalised groups of system actors when such resilience is contingent upon the perpetuation of actor-level vulnerabilities. This implies that the scale at which resilience is conceptualised is important because the processes which generate resilient ‘system-level’ outcomes also themselves generate a whole range of positive and negative outcomes for different groups of actors as well as for peri-urban ecosystems which have further implications for the system as a whole.

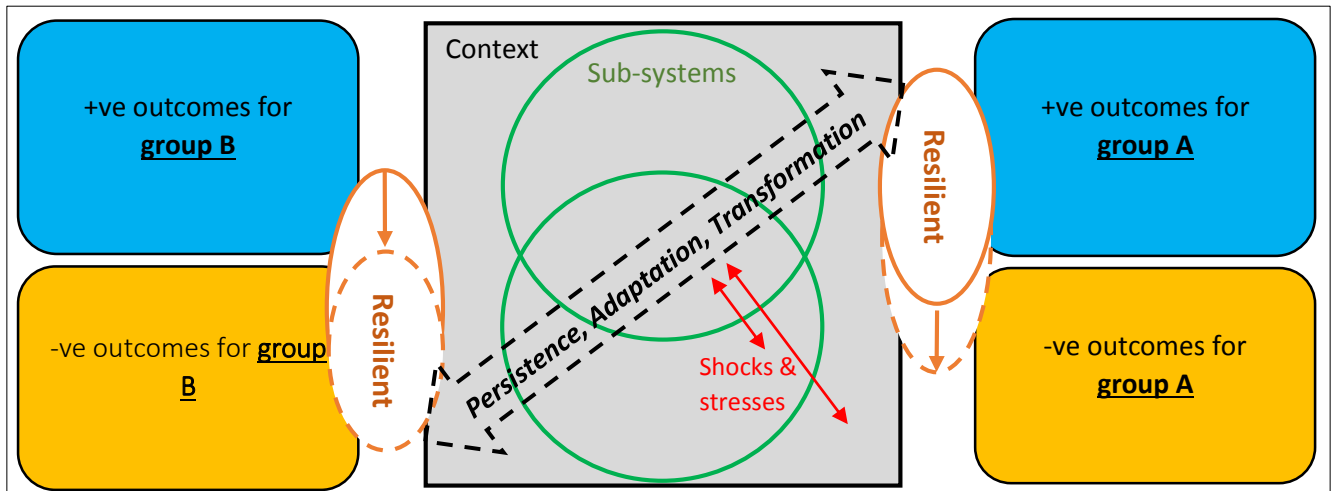
In light of these features highlighted by the case study, it is difficult to see how such a SES can be conceptualised as a relatively coherent unit functioning as a complex adaptive system the way envisaged by Biggs et al (2015), Anderies et al (2013) and others. Nevertheless, it is a common feature of current approaches to resilience that they see the SES more or less as a functional whole. The risk is that, in the process of abstraction to obtain workable simplified models of the SES, diversity and conflict is downplayed unless it fits the overall picture of a

coherent system. This could potentially bias the formal framings of the system which seek to present a unified conceptual model amenable to measurement and regulatory control but which may obscure the messy reality.

This approach has two problems. First, by foregrounding system coherence it obscures internal contradictions and ambiguities. Second, the system trajectory and any potential pathways to transformation tend to be understood in these terms as a system wide reconfiguration of those system actors and interactions that are included in such a model. Any other actors or interactions that don't fit neatly into the coherent model – e.g. marginalised groups and informal sectors – are at risk of being excluded.

In contrast, the approach developed in this thesis foregrounds 'system incoherence' by: 1) focusing analysis on two or more sub-systems representing the diversity of system actors ranging from formal to the more informal and marginalised groups; 2) analysing the linked and conflicting processes of change at the level of actors, system structures and context and which may cut across these sub-systems; 3) emphasising a narrative account of system trajectory and the direction of change in outcomes and their resilience as driven in different ways by these processes. The result is that this approach helps to deepen the analysis of SES and avoid some of the dangers of oversimplifying complex reality.

The diagram below (diagram 9.2) presents the approach to resilience developed in this thesis in the form of a visual heuristic tool to guide resilience analysis in human dominated SES more generally. It represents the SES as a set of co-existing, connected and potentially conflicting sub-systems bounded within a dynamic context and linked by processes of change (persistence, adaptation and transformation) unfolding at different scales from the level of actors to system structures and context level. Shocks and stresses emerge from within and without. Positive and negative outcomes are disaggregated for multiple groups and the resilience of these outcomes are indicated as being in motion (increasing or decreasing, widening and narrowing) driven by the change processes which variously undermine or enhance resilience of multiple outcomes in different ways. Positive resilience for some may be linked to negative resilience for others. The goal for resilience analysis and policy is not simply to determine how to make one narrow set of outcomes more resilient but rather to identify the processes which generate negative and positive resilience, how they are linked and how they might be decoupled and reconfigured in such a way that the whole diversity of positive outcomes for different groups can be supported.



**Diagram 9.2 Heuristic for analysis of resilience in human dominated SES.**

**Key:** Green circles = SES / sub-systems. Red arrows = impact of stresses and shocks. Black dotted arrow = multiple processes of change unfolding at different levels and across multiple scales. Grey box = system context. Orange boxes = collection of negative SES outcomes for specific groups. Blue boxes = collection of positive SES outcomes for specific groups. Orange oval = solid outline indicates resilience of particular positive or negative outcomes while dotted line and arrow indicate direction of change in resilience between positive and negative outcomes.

The above discussion highlights the importance of explicitly acknowledging the dualities in the way that resilience thinking can contribute positively or negatively to normative and analytical framings. This is particularly so when seeking to develop an enhanced resilience approach to human dominated SES. Resilience should never be used to displace discussion of sustainability in normative terms and it is important to recognise that resilience can contribute both positively and negatively to sustainability, even when resilience building projects have seemingly inclusive aims. When conceptualising resilience in human dominated SES it is important to recognise that resilience in itself is not necessarily good for all and that system-level goals will almost inevitably reflect a particular range of interests and not necessarily include those of all the most significant actors. The evidence presented in this thesis shows clearly how, in the context of peri-urban dynamics, system outcomes can be very diverse, highly specific to different stakeholders and often locked in conflict through the processes of change unfolding within system context and structures and at actor-level.

This heuristic seeks to demonstrate how the approach to resilience developed in this thesis can help to both open up normative framings of a SES and its outcomes while also deepening the analysis of system complexities and dynamics. It helps to reveal the hidden connections between different system outcomes for various stakeholders. Further, it allows for the identification of which forms of resilience need to be challenged and which promoted and, by doing this, aids the discovery of interventions at both actor and system level which can build new synergies to decouple negative and positive resilience and help generate more sustainable

and equitable outcomes. It is in the process of research design and methodology, however, that such a heuristic becomes most powerful so it is therefore important to also provide some reflections on the methodology used in this thesis.

### **9.3 Reflection on methodology**

Reflecting on the methods used in this research highlights four aspects which seem to have been the most important factors in obtaining data of the quality required for this type of analysis.

First, as a foreign researcher, proficiency in Mandarin Chinese was vital to the whole project because of the exploratory nature of the research. For many other types of research in China such as deductive theory testing using surveys and/or specialist interviews, it may be adequate to have good interpreters to support interviews, to help supervise research teams and aid communication between Chinese and foreign researcher partners. However, relying on translation adds an extra layer of interpretation between the researcher and the data which often involves non-experts making decisions about rendering concepts and terminology from Mandarin to English before the researcher can begin to even interpret the data themselves. Further it delays the researcher's interaction with the processed data while transcripts etc. are translated for analysis thus making flexible and responsive fieldwork difficult.

The method of data collection and analysis in this thesis involved such an iterative process of observations, and interviews interspersed with ongoing reflection on accumulating data, that it was necessary to avoid these two issues as much as possible. Having the ability to converse in Mandarin with both the interviewees and research assistants as well as to read relevant documents and translate the data myself from Mandarin to English largely solved these problems. It gave me more direct access to the data itself as well as enabling me to engage more deeply with the data collection process than if I had had to rely on an interpreter.

Although this is an extreme example of cross-cultural research, the same principles in data collection and analysis could be expected to remain relevant even when not operating as 'foreign researcher'. There will always be value in minimising the distance between the people involved in the collection and analysis of data and the cultural and linguistic context of the empirical case even when no national cultural barriers are being crossed. When seeking to learn about the practices of diverse SES actors and their interaction with multiple processes of change it is important to recognise the disconnects in world-view and day-to-day experience between the researcher and those being 'researched'. Therefore, the kind research advocated here should always include some aspect of 'language learning' and cultural familiarisation early on in the research design.

Second, in contrast to the difficulties presented by relying on translators, the research assistant role of local students in recording interviews through note-taking instead of relying on audio recording and transcription added a level of interpretation to the data collection process which was in fact very helpful. Simply recording the interviews would have resulted in a relatively opaque set of verbatim transcripts which would have led to a much longer data analysis process as well as creating a high risk of misinterpretation of the data once detached from the field. With some training from myself and due to their cultural fluency and familiarity with the research field and the local context the research assistants were able to record farmers' responses in more direct language which captured their meaning while minimising the risk of later misinterpretation.

In the research process this type of intermediate step in the interpretation of data often occurs long after fieldwork is completed when data is being processed and organised ready for analysis and thus introduces an additional risk of bias in the analysis. However, placing this step directly into the fieldwork process helped to reduce that risk by putting it closer to the context of its communication. The trade-off with this approach is that the 'voice' of interviewees may be easily lost but this risk was offset by the design and use of the interview tool allowing for the verbatim quotes of farmers to be included when appropriate. Overall, this approach did significantly speed up the analysis process and seemed to reduce the risk of misinterpretation by the 'foreign researcher' and could prove helpful in other cross-cultural research settings. It would also help increase the efficiency of the data collection and analysis processes in similar kinds of research in which extensive fieldwork with diverse actors is required for the collection of large amounts of qualitative data.

Third, the first investigative phase of fieldwork involving semi-structured interviews and site visits proved so helpful in the design of the interview tools and later fieldwork that, in future research of a similar nature, I would place this phase of fieldwork much earlier in the research process before spending much time on design of research tools and fieldwork strategy. This first phase functioned like a pilot study and helped to identify key system actors and issues as well informing the method for identifying other relevant fieldwork sites.

In peri-urban food systems research in which a complex system with diverse actors is spread over large geographical areas this model of iterative research design seems highly appropriate. Further, because many of the most significant system actors are dispersed and hard to find, the use of satellite imagery in this process (as demonstrated in this thesis) could be particularly helpful if incorporated as part of a systematic strategy for guiding the qualitative research methods.

One weakness, however, was that the government stakeholder interviews were conducted too

early on in the process. It might have been more helpful to have these discussions about policy and vision much later in the fieldwork when it would have been possible to direct the interviews more intentionally based on my newly acquired knowledge of the empirical case.

A second weakness was that the first investigative phase of fieldwork was probably too narrow and it might have been better to have extended it further. It would have been helpful to trial different ways of engaging with interviewees such as using visual aids to stimulate discussions and purchasing samples of agri-chemicals and seeds from the supply shops to show farmers in order to enhance discussion of agricultural practices. A wider set of issues could have been explored and a broader range of actors could have been interviewed at this initial stage which would have contributed to the design of the tools and strategies for the second investigative phase.

Fourth, during the interviews with farmers and business people the sections of the interview tools which asked about previous experiences and future expectations actually revealed a lot of interesting information which would not otherwise have come to light if interviews had focused solely on the immediate issues of agricultural practices and economic circumstances. Placing farmers' and business people's observations of present circumstances within the context of their past and future gave a richness to the data without which a lot of important interpretation would not have been possible. In retrospect, I would have asked in much more detail about interviewees' histories and journeys to their current situation and given more space for them to share their opinions, expectations and hopes for the future. These narrative accounts powerfully illustrated the role of multiple political, economic, environmental and social processes in shaping day-to-day life. In order to enrich these accounts, it would also have been helpful to visit the previous places some of the interviews had lived and farmed, tracing their journeys in more detail and observing how conditions had changed since they had left.

In future research to implement the approach to resilience analysis developed in this thesis, it would be worth experimenting with research designs which improve upon the iterative process used here. This process would begin with a relatively unstructured exploration of the empirical case with the goal of identifying the range of diverse actors and some of the key processes and themes which should be investigated in more detail. This would be followed by short, alternating phases of intense fieldwork and analysis which, step by step, built up a picture of system actors, structures and processes of change. Once a narrative of the system trajectory had been constructed, this would be presented in some form to policy-makers, local academics, community and business stakeholders to reflect on the authenticity of the analysis and whether it adequately captured different people's experience and understanding of the system. Once a credible account of the system and its trajectory and pattern of resilience had been agreed on

this could then be used to guide debate and the search for new synergies among actors and between policy interventions which might move the system towards a more sustainable trajectory. Some initial lessons for policy which have emerged from this thesis are discussed below and these illustrate the kind of potential synergies which could be revealed by such research.

## **9.4 Policy lessons for resilience building**

It should first be acknowledged that Wuhan and Chinese cities in general have a strong foundation upon which to design much more effective policies for enhancing the resilience and sustainability of urban and peri-urban food systems. The administrative structure of Chinese cities – in which large areas of agricultural land are governed by the peripheral municipal districts with oversight and resources coming also from the central municipal agricultural bureaus and technology extension offices – means that there is a support infrastructure in place for peri-urban agriculture which is often missing in other national contexts. The vision of city-region planning for urban food systems advocated by Wiskerke (2015) and others is perhaps more possible within such an institutional structure than in many other countries.

However, this thesis has revealed the weaknesses of current policy towards the peri-urban food system in Wuhan and similar weaknesses could be expected across China. Measures designed to promote persistence of structures against extreme weather by providing emergency assistance and controlling retail prices give the most benefit to urban consumers and a minority of local and larger scale farmers while the majority of the most vulnerable producers – migrant farmers – are unrecognised and unsupported. Policies aimed at supporting adaptation among producers not only fail to reach the majority of the most significant producers for FGV supplies but also promote technologies which do not address the negative environmental outcomes of the system. Transformation of the system is narrowly aimed at creating a formalised, modernised, scaled up and linked up system of production and distribution focused on FGV but does not address the interests of the majority of system actors or tackle the risks associated with contamination of food grown near sources of industrial pollution.

Based on the findings of this thesis an opportunity exists to create a synergy between promoting positive livelihood outcomes for the most marginalised producers, improving the affordability and safety of FGV and transforming the relationship between farming practices and soil and water resources from one of degradation to regeneration. This opportunity is revealed by two innovative examples of migrant peri-urban producers, one of which is recorded in chapter 7 section 7.3 (the vegetable association) and the other was discovered in HP district through an interview with HP-01.

The vegetable association (reported in section 7.3) was run by a migrant farmer in co-



operation with local farmers and employed a method of integrated farming which combines pig rearing with vegetable cultivation, reusing wastes from each activity as inputs to the other. This has the benefit of reducing input costs, diversifying revenue streams, improving soil fertility over time and reducing the severity of pest problems thus reducing dependence on pesticides. The production site is far from obvious sources of pollution and can be assumed to produce vegetables with lower risk of contamination from heavy agro-chemical use. The success of the venture is partly due to its scale which makes the bio-digester more efficient, the technical support received through a close relationship with local agricultural extension technicians and its direct link to a local wet market. The enterprise was entirely independent from financial support from government or distribution companies and was a self-sustaining profit making business.

Farmer HP-01 was a migrant who had formed a co-operative with friends and family renting land on the same base. They had learned new techniques to grow 'green' vegetables, invested in polytunnels and bought a van together to transport their produce in bulk. They had developed a relationship with a local wet market which they supplied most of their produce to directly. HP-01 reported a higher than average income and his quality produce went directly to local consumers, supplying most of the wet market's produce. Thus for the ordinary consumers at that market, the risk of buying contaminated vegetables sourced through the wholesale markets was largely removed.

These two examples were possible due to the entrepreneurial efforts of migrant farmers seeking to carve out for themselves a better livelihood. They show the potential for peri-urban migrant producers, given a long term stake in the land, to form innovative partnerships with other producers, distributors and retailers. While local farmers do not have such incentives, migrant farmers are in the position, given the right support, to be a positive part of a transformation that connects ground up grassroots innovation with top down interventions in such a way that more system outcomes can be linked not as trade-offs but by mutual support.

Government policy, therefore, should seek to promote those processes of transformation, adaptation and persistence which are mutually enhancing with a particular emphasis on ensuring that processes operating at the scale of system context and structures are adjusted to help support creative processes of change at actor level. In this way, for example, peri-urban farming households can be enabled to enact processes of persistence which are supported by accessible forms of assistance as well as engage in adaptive strategies which are not regressive but improve their coping capacity and strengthen their ability to adapt to both threats and opportunities. Ideally, the most marginalised producers need to be recognised for the innovative potential they hold and policies designed which are directed at enhancing their ability to adapt

creatively to the new constraints and opportunities brought by urbanisation. To begin with this means engaging with the broader context of change by including long term plans for peri-urban agriculture within urban planning. In Wuhan there is already an effort underway to incorporate vegetable production into long term urban planning but so far it fails to recognise the role of the informal vegetable system. To build a system characterised by inclusive and deeply rooted resilience, the government must find ways to secure places of stable long term agricultural activity with good access to water and infrastructure but a safe distance from sources of industrial pollution for which guaranteed long term leases may be offered formally to migrant peri-urban households in order to give them a stake in the future of the land.

The answer is not to ignore and further marginalise the migrant farmers in favour of larger scale commercial production. Rather, investment is needed in the production activities of migrant farmers to allow them to become more formally part of the system and to participate more in shaping its future. There is an opportunity to harness the entrepreneurial potential of the informal system through supporting technical and organisational/management capabilities and controlling the distribution networks to make them more appropriate for migrant farmers. Private and government enterprises should be supported to play a co-operative and assistive role to the informal system rather than to compete with it or replace it.

## **9.5 Limitations and recommendations for further research**

There are limitations to this research, some of which seem unavoidable and others may be remedied by better research design in the future which learns from those limitations. First, as noted in the previous section, the research would have benefited from a period of pilot fieldwork earlier on in the process of research design. More time than necessary was spent on planning when a quick entry into the field to do pilot interviews would have saved time and allowed for a more thorough coverage of Wuhan's peri-urban vegetable production lands with a greater number of structured interviews being conducted. This would also have allowed for a longer period of corroborative mini interviews and site visits to gain a more representative picture of migrant vegetable producers in Wuhan. Nevertheless, the number of interviews conducted was adequate to analyse the key issues relevant to this research.

Second, if extra time and resources had been available it would have strengthened the evidence around environmental outcomes of the two sub-systems if the polluting industries close to vegetable production sites had been surveyed to assess in more detail the risks of contamination of crops. Analysis of soil and water samples would also have helped in this regard although conducting such research in China usually requires official permission which is very difficult to obtain.

Third, a more participatory approach to defining the research objectives and exploring understandings and knowledge of the system would have given more of a voice to the marginalised peri-urban producers than this thesis has been able to do. However, in that regard there is also a trade-off to be made between spending the time required in a community to build up the necessary trust to successfully conduct participatory research and the need to cover the diversity of situations across a broad peri-urban landscape. In this research I opted for a rapid appraisal type of approach once the key issues had been distilled through pilot interviews. This has led to some sacrifice in the depth of the data but this seems unavoidable given the time and human resources available.

Finally, the context of the case study, that of a Chinese city, might be assumed to limit the relevance of this research to the Chinese context, and indeed it would have greatly enhanced the value of the research had I been able to make comparative case studies of two or more cities in different country contexts. However, given the exploratory nature of the research and the need to learn Mandarin in order to conduct the fieldwork it was not practical under the circumstances to attempt more than one in-depth case study. In spite of this, the issues that have been explored in this case are very relevant to urban food systems in multiple developing world contexts and for mega cities as well as smaller cities and towns because they reveal the common dynamics and complexities that can occur in food systems which are embedded in some way in the peri-urban interface.

Future research could build on the methods developed in this thesis for connecting top down data from satellite imagery with qualitative fieldwork on the ground. One of the things this thesis has shown is that, using freely available satellite images (without any need for specialist GIS software), it is possible to locate and gain an initial insight into potential fieldwork sites on peri-urban agriculture. Once interview and questionnaire data has been collected from the first few sites, satellite imagery can be re-examined and interpreted in the light of the new qualitative data. Visual indicators of different types of production and the presence of different types of producer can often be identified which allow a more informed analysis of satellite imagery for the whole of a city. This top down analysis can be done across peri-urban space for an entire city and through time going back up to ten years in many cases. Interestingly, the best satellite imagery coverages on Google Earth is for cities and their peripheral areas which cover large areas of peri-urban agriculture. This represents a rich resource for analysis of peri-urban food systems across the world in the future.

A fruitful avenue for future research, then, would be to conduct similar types of analysis based on, and further developing, the model developed in this thesis in order to investigate different country contexts and different levels of urbanisation and socio-economic development. Case

studies on China and South Asia could be helpfully compared to case studies on cities in South Korea, Taiwan and Japan as well as cities in other developed and developing countries. Each example of peri-urban food systems could help reveal alternative configurations of the processes of persistence, adaptation and transformation and the implications of these for the resilience of different outcomes. Such research would contribute to a knowledge base for other researchers and policy makers to be able to understand the hidden dynamics of peri-urban food systems across multiple contexts. This could further allow policy makers and planners to explore the diversity of options for policy interventions and improve awareness of the potential unintended consequences of narrowly framed resilience building policies.

In addition to this, some helpful open access tools could be developed on the Google Earth platform to allow researchers, communities, activists and policy makers to map peri-urban agriculture and generate graphical representations of peri-urban food systems as aids to understanding and communication. Collaborative work between local communities, public and private sector stakeholders and academic researchers could open up opportunities for action research to develop methods of engaging with peri-urban food system actors and planners in new, more participatory ways that could improve policy making and support community level action and interventions.

Drawing on the methods and conceptual approach developed in this thesis six priorities can be put forward for guiding future research into developing an enhanced understanding of food system resilience in the context of rapid urbanisation which can contribute to improving the governance of urban food systems for greater sustainability. Only once an analysis of the system has addressed these priorities can policies be designed which take into account the dynamics and complexity of urban food systems and explicitly engage with the trade-offs between diverse outcomes for multiple stakeholders. An enhanced resilience approach needs to:

1. **Disaggregate system outcomes with reference to different stakeholders to reflect the diversity of the system and take into account all relevant scales.** The case of Wuhan shows clearly how the interests of marginalised groups can be ignored with serious consequences for the impacts of resilience building policies. The interests of these groups need to be elevated to the status of system-level goals along with others in order for any understanding of resilience to reflect the diversity of system actors and outcomes.
2. **Differentiate system function and structure so that resilience is defined with reference to specific system outcomes.** If this is not done then the multiple ways in which processes of persistence, adaptation and transformation support or undermine the resilience of different outcomes may be ignored.
3. **Analyse positive and negative resilience.** Outcomes can be both positive and negative

and will be resilient against shocks and stresses just as they can be resilient against positive action to change them.

4. **Identify the shocks and stresses that arise not just from the wider environmental and economic conditions but also from the processes of change unfolding throughout the system and its context.** For example, in the case study some of the most disruptive shocks and stresses affecting marginalised groups arose from the processes of urbanisation and peri-urban transformation rather than extreme weather events.
5. **Analyse how the resilience of each outcome is enhanced or undermined by the interacting processes of change at the level of system context, structures and actors.** This final part of the analysis set out in chapter 8 revealed the close connections between the processes of persistence, adaptation and transformation at different scales and the changing pattern of resilience which clearly showed how positive resilience for some was built upon negative resilience for others. Until these connections are uncovered, ‘resilience-to-be-fought’ is liable to be neglected while efforts to enhance the ‘resilience-to-be-supported’ will cause multiple unintended consequences for the poor and marginalised which feed back to other system outcomes.
6. **Recognise the impacts of these processes on outcomes for marginalised actors participating in the system structures.** This involves examining how the current or potential pathways of transformation towards a more resilient set of normative outcomes impacts the redistribution of costs and benefits between system actors. Even when a system appears to be moving towards a more sustainable and resilient regime, the disruptive effects of transformation may often further disadvantage those groups who are already relatively marginalised.

## Conclusion

In relation to the broader debates on social-ecological resilience, the discussions above clearly highlight the potential conceptual difficulties brought about by uncritically adopting ‘resilience building’ as the new organising principle for development practice and for reframing sustainable development in terms of ‘systems’ rather than people (see section 2.1 (Levine et al., 2012, p. 1)). Nevertheless, there is potential for this trend towards systems approaches to understanding social and ecological change to be balanced by a more nuanced, dynamic and complex approach to understanding social-ecological resilience which recognises the importance of addressing different system framings and scales of analysis. This thesis has taken a step towards developing such an approach by combining insights from food system analysis with a number of conceptualisations of resilience and through reflection upon the detailed case study of Wuhan’s peri-urban vegetable system.

Beyond the analysis of resilience in urban food systems, the conclusions of this research are

relevant to the conceptualisation of resilience in social-ecological systems more generally because one common feature of many social-ecological systems is that, just as in this case study, they are evolving along a trajectory driven by multiple processes of change at multiple scales and include a diversity of actors with often competing interests and interpretations of which system outcomes should be valued and how resilience ought to be framed. Therefore, the approach to resilience developed in this thesis – which 1) disaggregates system outcomes, 2) differentiates function and structure, 3) analyses positive and negative resilience, 4) identifies external and structural shocks and stresses, 5) analyses resilience in relation to multiple and multi-scale processes of change and 6) recognises the impacts of those processes on marginalised system actors – can offer helpful insights for the ongoing theoretical work on social-ecological resilience and associated approaches to resilience building.

## Bibliography and references

- Adell, G., 1999. Theories and Models of the Peri-Urban Interface: A Changing Conceptual Landscape (Draft for Discussion).
- Adger, N.W., Kelly, P.M., 2001. Social vulnerability and resilience, in: Adger, N.W., Kelly, P.M., Ninh, N.H. (Eds.), *Living with Environmental Change: Social Vulnerability, Adaptation and Resilience in Vietnam*. Routledge, London and New York, pp. 19–34.
- Allen, A., 2003. Environmental planning and management of the peri-urban interface: perspectives on an emerging field. *Environ. Urban.* 15, 135–148.
- Anderies, J.M., Folke, C., Walker, B., Ostrom, E., 2013. Aligning key concepts for global change policy: Robustness, resilience, and sustainability. *Ecol. Soc.* 18, 8.
- Becker, E., 2012. Social-ecological systems as epistemic objects. *Hum.-Nat. Interact. Anthr. Potentials Soc.-Ecol. Syst. Anal. Lond.* Routledge 37–59.
- Berkes, F., Colding, J.F., Folke, C. (Eds.), 2003. *Navigating nature's dynamics: building resilience for complexity and change*. Cambridge University Press, New York.
- Berkes, F., Folke, C., 1998. Linking social and ecological systems for resilience and sustainability, in: Berkes, F., Folke, C. (Eds.), *Linking Social and Ecological Systems*. Cambridge University Press, Cambridge.
- Biggs, R., Schlüter, M., Schoon, M.L., 2015. An introduction to the resilience approach and principles to sustain ecosystem services in social–ecological systems, in: Biggs, R., Schlüter, M., Schoon, M.L. (Eds.), *Principles for Building Resilience: Sustaining Ecosystem Services in Social–Ecological Systems*. Cambridge University Press, Cambridge, pp. 1–31.
- Boyd, E., Osbahr, H., Ericksen, P.J., Tompkins, E.L., Lemos, M.C., Miller, F., 2008. Resilience and “Climatizing” Development: Examples and policy implications. *Development* 51, 390–396.
- Browder, J.O., Bohland, J.R., Scarpaci, J.L., 1995. Patterns of Development on the Metropolitan Fringe - Urban Fringe Expansion in Bangkok, Jakarta and Santiago. *J. Am. Plann. Assoc.* 61.
- BSZ Trader, 2012. Interview with a Baishazhou trader.
- Caxin, 2015. “Left-Behind” Children Need Our Attention Now [WWW Document]. Caixin. URL <http://english.caixin.com/2015-07-01/100824378.html>
- Chambers, R., 2006. What is poverty? Who asks? Who answers?, *Poverty in Focus*. UNDP International Poverty Centre.
- Christophe Bene, Rachel Godfrey Wood, Andrew Newsham, Mark Davies, 2012. *Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes*. IDS Work. Pap. 2012.
- Christopherson, S., Michie, J., Tyler, P., 2010. Regional resilience: theoretical and empirical perspectives. *Camb. J. Reg. Econ. Soc.* 3, 3–10.
- CMA, 2012. *China National Vegetable Industry Development Plan (2011-2020)*. 全国蔬菜产业发展规划 (2011-2020 年).
- Davoudi, S., Shaw, K., Haider, L.J., Quinlan, A.E., Peterson, G.D., Wilkinson, C., Fünfgeld, H., McEvoy, D., Porter, L., Davoudi, S., 2012. Resilience: A Bridging Concept or a Dead End? “Reframing” Resilience: Challenges for Planning Theory and Practice Interacting Traps: Resilience Assessment of a Pasture Management System in Northern Afghanistan Urban Resilience: What Does it Mean in Planning Practice? Resilience as a Useful Concept for Climate Change

- Adaptation? The Politics of Resilience for Planning: A Cautionary Note. *Plan. Theory Pract.* 13, 299–333. doi:10.1080/14649357.2012.677124
- Devereux, S., 2000. *Famine in the Twentieth Century* (No. 105), IDS Working Paper. Institute of Development Studies, Brighton.
- DLLE Director, 2012. Interview with Director of district level leading enterprise.
- Dreze, J., Sen, A., 1989. *Hunger and Public Action*. Clarendon Press, Oxford.
- Duit, A., Galaz, V., Eckerberg, K., Ebbesson, J., 2010. Governance, complexity, and resilience: introduction to special issue. *Glob. Environ. Change* 20, 363–368.
- Dupont, V., 2005. Peri-urban Dynamics: population, habitat and environment on the peripheries of large Indian metropolises. A review of concepts and general issues. (No. 14), CSH Occasional Paper. French Research Institutes in India.
- DX-01, 2012. Interview with peasant farmer DX-01.
- DX-02, 2012. Interview with peasant farmer DX-02.
- DX-03, 2012. Interview with peasant farmer DX-03.
- DX-04, 2012. Interview with peasant farmer DX-04.
- DX-05, 2012. Interview with peasant farmer DX-05.
- DX-06, 2012. Interview with peasant farmer DX-06.
- DX-07, 2012. Interview with peasant farmer DX-07.
- DX-08, 2012. Interview with peasant farmer DX-08.
- DX-09, 2012. Interview with peasant farmer DX-09.
- DX-10, 2012. Interview with peasant farmer DX-10.
- DX-11, 2012. Interview with peasant farmer DX-11.
- DX-12, 2012. Interview with peasant farmer DX-12.
- DX-13, 2012. Interview with peasant farmer DX-13.
- DX-14, 2012. Interview with peasant farmer DX-14.
- DX-15, 2012. Interview with peasant farmer DX-15.
- DX-16, 2012. Interview with peasant farmer DX-16.
- DX-17, 2012. Interview with peasant farmer DX-17.
- DX-18, 2012. Interview with peasant farmer DX-18.
- DX-19, 2012. Interview with peasant farmer DX-19.
- DX-20, 2012. Interview with peasant farmer DX-20.
- DX-21, 2012. Interview with peasant farmer DX-21.
- DX-22, 2012. Interview with peasant farmer DX-22.
- Elmqvist, T., 2014. Urban resilience thinking. *Solutions* 5, 26–30.
- Ericksen, P.J., 2008. What is the vulnerability of a food system to global environmental change? *Ecol. Soc.* 13.
- Ericksen, P.J., 2007. Conceptualizing food systems for global environmental change research. *Glob. Environ. Change* 18.
- Ernstson, H., van der Leeuw, S.E., Redman, C.L., Meffert, D.J., Davis, G., Alfsen, C., Elmqvist, T., 2010. Urban Transitions: On Urban Resilience and Human-Dominated Ecosystems. *AMBIO* 39, 531–545. doi:10.1007/s13280-010-0081-9
- FAO, 2011. *Food, Agriculture and Cities: Challenges of food and nutrition security, agriculture and ecosystem management in an urbanizing world*.
- FAO, 1996. *Rome Declaration on World Food Security and World Food Summit Plan of Action*. Presented at the World Food Summit 13-17 November 1996, Food and Agriculture Organization, Rome, Italy.
- FD Director, 2012. Interview with Director of a food distribution company.
- Folke, C., Colding, J., Berkes, F., 2003. Synthesis: building resilience and adaptive capacity in social-ecological systems., in: *Navigating Social-Ecological*



- Systems: Building Resilience for Complexity and Change. Cambridge University Press, Cambridge.
- Friedberg, S., 2001. Gardening on the Edge: The Social Conditions of Unsustainability on an African Urban Periphery. *Ann. Assoc. Am. Geogr.* 91, 349–369.
- Friedmann, J., 2005. *China's Urban Transition*. University of Minnesota Press, Minneapolis and London.
- FSC-1 Director, 2012. Interview with Director of FSC-1.
- FSC-2 Director, 2012. Interview with Director of FSC-2.
- Furlong, P., Marsh, D., 2010. A Skin Not a Sweater: Ontology and Epistemology in Political Science., in: Marsh, D., Stoker, G. (Eds.), *Theory and Methods in Political Science*. Palgrave Macmillan.
- Fussler, H.M., 2007. Vulnerability: A generally applicable conceptual framework for climate change research. *Glob. Environ. Change* 17, 155–167.
- FWD, 2013. Fieldwork diary and observations.
- Gallopin, G.C., 2006. Linkages between vulnerability, resilience and adaptive capacity. *Glob. Environ. Change* 16, 293–303.
- Glaser, B., Strauss, A., 1967. *The discovery of grounded theory: Strategies for qualitative research*. Aldine Publishing Company, New York.
- Gu, S., 2009. The Emergence and Development of the Vegetable Sector in China. *Ind. Innov.* 16, 499–524.
- Guest, G., Bunce, A., Johnson, L., 2006. How Many Interviews Are Enough? An Experiment with Data Saturation and Variability. *Field Methods*, Sage Publications 18, 59–82.
- GY-01, 2012. Interview with peasant farmer GY-01.
- GY-02, 2012. Interview with peasant farmer GY-02.
- GY-03, 2012. Interview with peasant farmer GY-03.
- GY-04, 2012. Interview with peasant farmer GY-04.
- GY-05, 2012. Interview with peasant farmer GY-05.
- GY-06, 2012. Interview with peasant farmer GY-06.
- GY-07, 2012. Interview with peasant farmer GY-07.
- GY-08, 2012. Interview with peasant farmer GY-08.
- GY-09, 2012. Interview with peasant farmer GY-09.
- GY-10, 2012. Interview with peasant farmer GY-10.
- H-09, 2012. Interview with peasant vegetable broker HH-09.
- HAB Director, 2012. Interview with a director at Hubei Provincial Department of Agriculture Vegetable Office (湖北省农业厅蔬菜办).
- Han, S.S., Wu, X., 2004. City Profile: Wuhan. *Cities* 21, 349–362.
- Harris, K., 2011. *Resilience in Practice. Operationalising the Ten Characteristics of Resilience Through the Case of Greening Darfur*. Brighton IDS, Strengthening Climate Resilience Paper 10.
- HN Academic 1, 2012. Interview with an academic at Huanong University.
- HN Academics 2 & 3, 2013. Interview with two academics from Huanong.
- Holling, C.S., 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems* 4, 390–405.
- Holling, C.S., 1973. Resilience and stability of ecological systems. *Annu. Rev. Ecol. Syst.* 4, 1–23.
- Hornborg, A., 2009. Zero-sum world challenges in conceptualizing environmental load displacement and ecologically unequal exchange in the world-system. *Int. J. Comp. Sociol.* 50, 237–262.
- HP-01, 2012. Interview with peasant farmer HP-01.

- HP-02, 2012. Interview with peasant farmer HP-02.
- HP-03, 2012. Interview with peasant farmer HP-03.
- HP-04, 2012. Interview with peasant farmer HP-04.
- Hudalah, D., Winarso, H., Woltjer, J., 2007. Peri-urbanisation in East Asia. *Int. Dev. Plan. Rev.* 29, 503–519.
- ICLEI, 2011. Resilient Cities 2011 - Congress results in brief.
- ICLEI, 2013b. Resilient Urban Food Systems: Opportunities, Challenges, and Solutions. Presented at the 4th Global Forum on Urban Resilience and Adaptation, ICLEI (author: Emily Dowding-Smith), Bonn, Germany.
- ICLEI, 2014a. ICLEI - Local Governments for Sustainability.
- ICLEI, 2014b. Resilient Urban Food Systems Forum.
- ICLEI, 2013a. Resilient Cities 2013: Congress Report. Presented at the 4th Global Forum on Urban Resilience and Adaptation, ICLEI (authors: Alice Balbo, Emily Dowding-Smith, Laura Kavanaugh), Bonn, Germany.
- Ingram, J., Brklacich, M., 2002. Global Environmental Change and Food Systems - GECAFS: a new interdisciplinary research project. *Erde* 113, 427–435.
- JX-01, 2012. Interview with peasant farmer JX-01 (Mr Lan).
- JX-02, 2012. Interview with peasant farmer JX-02.
- JX-03, 2012. Interview with peasant farmer JX-03.
- JX-04, 2012. Interview with peasant farmer JX-04.
- JX-05, 2012. Interview with peasant farmer JX-05.
- JX-06, 2012. Interview with peasant farmer JX-06.
- JX-07, 2012. Interview with peasant farmer JX-07.
- JX-08, 2012. Interview with peasant farmer JX-08.
- JX-09, 2012. Interview with peasant farmer JX-09.
- JY-01, 2012. Interview with peasant farmer JY-01.
- JY-02, 2012. Interview with peasant farmer JY-02.
- JY-03, 2012. Interview with peasant farmer JY-03.
- JY-04, 2012. Interview with peasant farmer JY-04.
- JY-05, 2012. Interview with peasant farmer JY-05.
- JY-06, 2012. Interview with peasant farmer JY-06.
- JY-07, 2012. Interview with peasant farmer JY-07.
- Leach, M., Scoones, I., Stirling, A., 2010. *Dynamic Sustainabilities: Technology, Environment, Social Justice, Pathways to Sustainability*. Earthscan, London and Washington, DC.
- Leach, M., Scoones, I., Stirling, A., 2007. *Pathways to Sustainability: an overview of the STEPS Centre approach*, STEPS Approach Paper. STEPS Centre, Brighton.
- Levine, S., Pain, A., Bailey, S., Fan, L., 2012. The relevance of “resilience”? *Overseas Dev. Inst. HPG Policy Brief* 49.
- Lipton, M., 1977. *Why Poor People Stay Poor: Urban Bias in World Development*. Temple Smith, London.
- Liu, Feng, C.P., Hua, L.F., Fan, J.Z., 2002. *Zhongwai xingzheng quhua bijiao yanjiu.*, in: *Comparative studies on Chinese and foreign administrative demarcation*. East China Normal University Press, Shanghai.
- Long, H., Liu, Y., Li, X., Chen, Y., 2010. Building new countryside in China: A geographical perspective. *Land Use Policy* 27, 457–470.
- Ma, L.J.C., 2005. Urban administrative restructuring, changing scale relations and local economic development in China. *Polit. Geogr.* 24, 477–497.

- Marshall, F., Waldman, L., MacGregor, H., Mehta, L., Randhawa, P., 2009. On the Edge of Sustainability: Perspectives on Peri-urban Dynamics. (No. 35), STEPS Working Paper. STEPS Centre, Brighton.
- Maxwell, S., 2001. The evolution of thinking about food security., in: Devereux, S., Maxwell, S. (Eds.), *Food Security in Sub-Saharan Africa*. ITDG Publishing, London, pp. 13–31.
- Maxwell, S., Slater, R., 2003. Food policy old and new. *Dev. Policy Rev.* 21, 531–553.
- McGee, T.G., Lin, G.C.S., Marton, A.M., Wang, M.Y.L., Wu, J., 2007. *China's Urban Space: Development Under Market Socialism*. Routledge, Oxford and New York.
- McGregor, D., Simon, D., Thompson, D. (Eds.), 2006. *The Peri-Urban Interface: Approaches to Sustainable Natural and Human Resource Use*. Earthscan, UK and USA.
- Meerow, S., Newell, J.P., Stults, M., 2016. Defining urban resilience: A review. *Landsc. Urban Plan.* 147, 38–49. doi:10.1016/j.landurbplan.2015.11.011
- Miller, F., Osbahr, H., Boyd, E., Thomalla, F., Bharwani, S., Ziervogel, G., Walker, B., Birkmann, J., Van der Leeuw, S., Rockström, J., Hinkel, J., Downing, T., Folke, C., Nelson, D., 2010. Resilience and vulnerability: complementary or conflicting concepts? *Ecol. Soc.* 15.
- Misselhorn, A., Aggarwal, P., Ericksen, P., Gregory, P., Horn-Phathanothai, L., Ingram, J., Wiebe, K., 2012. A vision for attaining food security. *Open Issue* 4, 7–17. doi:10.1016/j.cosust.2012.01.008
- Nadasdy, P., 2007. Adaptive Co-Management and the Gospel of Resilience., in: Armitage, D., Berkes, F., Doubleday, N. (Eds.), *Adaptive Co-Management: Collaboration, Learning, and Multilevel Governance*. University of British Columbia Press, Vancouver, pp. 208–227.
- Narain, V., Nischal, S., 2007. The peri-urban interface in Shahpur Khurd and Karnera, India. *Environ. Urban.* 19, 261–273.
- Nelson, D.R., Adger, N.W., Brown, K., 2007. Adaptation to Environmental Change: Contributions of a Resilience Framework. *Annu. Rev. Environ. Resour.* 32, 395–419.
- NLLAE Manager, 2012. Interview with Director of a national level leading agricultural enterprise.
- Norgaard, R.B., 1984. Co-evolutionary agricultural development. *Econ. Dev. Cult. Change* 32, 525–546.
- Phillips, D., Williams, K.E.A., 1999. Literature review on peri-urban conceptualisation and management approaches. Final Technical Report for Project R6949 for DFID Peri-Urban Production Systems Research - Natural Resources Systems Programme (PUPSR-NRSP). School of Geography, University of Nottingham and University of Liverpool, Nottingham.
- Resilience Alliance, 2010. *Assessing Resilience in Social-Ecological Systems: Workbook for Practitioners*. Version 2.0.
- Romney, A., Batchelder, W., Weller, S., 1986. Culture as consensus: A theory of culture and informant accuracy. *Am. Anthropol.* 88, 313–38.
- SC, 2002. Requisition on advancing the Vegetable Basket Project, 19 August 2002.
- Schoon, M.L., Robards, M.D., Brown, K., Engle, N., Meek, C.L., Biggs, R., 2015. Politics and the resilience of ecosystem services, in: Biggs, R., Schluter, M., Schoon, M.L. (Eds.), *Principles for Building Resilience: Sustaining Ecosystem Services in Social–Ecological Systems*. Cambridge University Press, Cambridge, pp. 32–49.

- Seeliger, L., Turok, I., 2013. Towards Sustainable Cities: Extending Resilience with Insights from Vulnerability and Transition Theory. *Sustainability* 5, 2108–2128.
- Sen, A., 1981. *Poverty and Famines: An Essay on Entitlement and Deprivation*. Clarendon Press, Oxford.
- SF brigade Director, 2012. Interview with Director of state farm production brigade.
- SF Manager, 2012. Interview with state farm manager.
- Shank, G., 2006. Praxical Reasoning and the Logic of Field Research, in: Hobbs, D., Wright, R. (Eds.), *The SAGE Handbook of Fieldwork*. SAGE Publications.
- Simon, D., 2008. Urban Environments: Issues on the Peri-Urban Fringe. *Annu. Rev. Environ. Resour.* 33, 167–185.
- Smith, A., Stirling, A., 2010. The Politics of Social-ecological Resilience and Sustainable Socio-technical Transitions. *Ecol. Soc.* 15, 11.
- Stirling, A., 2007. Resilience, robustness, diversity: Dynamic strategies for sustainability. Presented at the paper for the conference of the European Society for Ecological Economics, Leipzig.
- Swift, J., Hamilton, K., 2001. Household food and livelihood security., in: Devereux, S., Maxwell, S. (Eds.), *Food Security in Sub-Saharan Africa*. ITDG Publishing, London.
- T-01, 2012. Interview with local trader TT-01.
- Tacoli, C. (Ed.), 2006. *The Earthscan Reader in Rural-Urban Linkages*. Earthscan, London and Sterling, VA.
- Tacoli, C., 1998. Rural-urban interactions: a guide to the literature. *Environ. Urban.* 10, 147–166.
- Thapa, S., Marshall, F., Stagl, S., 2010. Understanding Peri-urban Sustainability: The Role of the Resilience Approach. (No. 38), STEPS Working Paper. STEPS Centre, Brighton.
- Thomas, F., Escudero, A.G., 2014. City Regions as Landscapes for People, Food and Nature. EcoAgriculture Partners on behalf of the Landscapes for People, Food and Nature Initiative., Washington, DC.
- Thomas, G., 2011. *How to do Your Case Study: A guide for students and researchers*, Kindle Edition. ed. SAGE Publications, London.
- Thomas, G., 2010. Doing Case Study: Abduction Not Induction, Phronesis Not Theory. *Qual. Inq.* 16, 575–582.
- Thompson, J., Millstone, E., Scoones, I., Ely, A., Marshall, F., Shah, E., Stagl, S., 2007. Agri-Food System Dynamics: pathways to sustainability in an era of uncertainty. (No. 4), STEPS Working Paper. STEPS Centre, Brighton.
- Unwin, T., 1989. Urban-rural Interaction in Developing Countries: A Theoretical Perspective., in: Potter, R., Unwin, T. (Eds.), *The Geography of Urban-Rural Integration in Developing Countries*. Routledge, London, pp. 11–33.
- VA Director, 2012. Interview with Director of a Vegetable Association.
- WAB, 2012. Wuhan Agriculture Bureau Report.
- WAB Director, 2012. Interview with a director at Wuhan Agriculture Bureau Markets Department (武汉市农业局市场处).
- WAB LXB, 2011. 金水农场有机蔬菜将直销省直机关.
- WAB Official, 2010. Interview with an official at Wuhan Agriculture Bureau.
- Walker, B., Holling, C.S., Carpenter, S.R., Kinzig, A., 2004. Resilience, adaptability and transformability in social-ecological systems. *Ecol. Soc.* 9.
- Walker, B.H., Gunderson, L.H., Kinzig, A.P., Folke, C., Carpenter, S.R., Schultz, L., 2006. A handful of heuristics and some propositions for understanding resilience in social-ecological systems. *Ecol. Soc.* 11, 13.

- Wang, S., 2014. Cabinet Said to Mull Reforms to Country's Nearly 1,800 State-Owned Farms. Caixin.
- WATSC Director, 2012. Interview with a director at Wuhan Vegetable Technology Service Centre (武汉蔬菜技术服务总站).
- W-DXH, 2011. Dongxihu district economic and social development 12th five year plan. 东西湖区国民经济与社会发展第十二个五年规划纲要.
- Webster, D., 2002. On the Edge: Shaping the Future of Peri-urban East Asia., Stanford University Discussion Paper. Stanford University, Stanford, CA.
- Webster, D., Muller, L., 2002. Challenges of peri-urbanization in the lower Yangtze region: the case of Hangzhou-Nimbo corridor. (Discussion Paper). Asia Pacific Research Centre, Stanford University, Stanford, CA.
- Webster, D.R., Cai, J., Muller, L., Luo, B., 2003. Emerging Third Stage Peri-Urbanization: Functional Specialization in the Hangzhou Peri-Urban Region. (Stanford University Discussion Paper). Stanford University, Stanford, CA.
- Wen, J., 2002. Speech to the National Working Meeting on the Vegetable Basket Project, 23 July 2002.
- WH, 2011. Wuhan Almanac 2011. 武汉综述.2011 年.
- Wiskerke, J.S.C., 2015. Urban Food Systems, in: de Zeeuw, H., Drechsel, P. (Eds.), Cities and Agriculture: Developing Resilient Urban Food Systems, Earthscan Food and Agriculture. Routledge, London and New York, pp. 1–25.
- WJS-Manager, 2012. Interview with state farm official WJS-Manager.
- World Bank, 2014. The World Bank - Data - Population.
- WS Purchaser, 2012. Interview with purchaser for a supermarket chain.
- WSB, 2012. Wuhan Statistical Yearbook 2012. 武汉统计年鉴 2012.
- WSB, 2011. Wuhan Statistical Yearbook 2011. 武汉统计年鉴 2011.
- XZ-01, 2012. Interview with peasant farmer XZ-01.
- XZ-02, 2012. Interview with peasant farmer XZ-02.
- XZ-03, 2012. Interview with peasant farmer XZ-03.
- XZ-04, 2012. Interview with peasant farmer XZ-04.
- XZ-05, 2012. Interview with peasant farmer XZ-05.
- Young, J., 2013. China's Hukou System: Markets, Migrants and Institutional Change. Palgrave Macmillan.

## **Appendices**

Appendix 1 – Fieldwork information sheets

Appendix 2 – Interview questions and tools

Appendix 3 – Example of interview write ups in Chinese

Appendix 4 – Example of translated interview

***Appendix 1 – Fieldwork information sheets***

**参与者信息单 PARTICIPANT INFORMATION SHEET**

**研究题目 STUDY TITLE:**

**武汉蔬菜生产供应体系是怎么应付这五年来的异常天气。**

**HOW DID THE WUHAN VEGETABLE PRODUCTION AND SUPPLY SYSTEM RESPOND TO THE PAST 5 YEARS' EXTREME WEATHER**

请您参与该调查。我们希望在您同意参与之前，您能明白我们调查的目的和内容。请您仔细阅读下面的信息。

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully.

**研究介绍 INTRODUCTION TO THE RESEARCH**

我是由英国经济与社会研究理事会资助的苏塞克斯大学博士生，现于武汉中南财经政法大学进修。

我是研究食品农业中关于环境适应变化政策方面的。我主要是研究武汉蔬菜生产供应体系是怎么应付这五年来的异常天气，比如 2008 年冰冻雨雪灾害，2010 年暴雨或 2011 年干旱。

我的研究目的是，在现有武汉蔬菜生产供应体系之下，过去五年的异常天气对该体系的影响。

我从两个方面来分析这个问题。第一个是生产者是从这些灾害受什么影响，并怎样适应气候变化。第二个是整个蔬菜生产供应体系，比如包括龙头企业，配送公司，销售者，他们是怎样应付这些灾害。

最后得出提议。在环境恶劣条件下，怎样改进武汉蔬菜生产供应体系的应对政策和措施。

该调查是到 2012 年底进行的。

I am a University of Sussex DPhil student funded by the Economic and Social Research Council. Currently I am registered as a student at Zhong Nan University of Economics and Law doing advanced study.

My research field is government policy around food and agriculture in response to environmental change. Specifically I am researching the vegetable production and supply system in Wuhan and how it has responded to the extreme weather since 2008. For example, the 2008 heavy snows, 2010 rain storms and the 2011 drought.

The purpose of my research is, in the context of Wuhan's vegetable production and supply system and its response to the past 5 years extreme weather, to compare two different approaches to adaptation policy. One approach emphasises the most vulnerable producers, what impacts they suffered and how they coped with these events. The second approach takes the whole system and looks at production and supply, including leading enterprises in the system, distribution companies, retailers etc. and how they responded to these events.



Finally I will explore how these two approaches complement or conflict with each other, how Wuhan government's policy compares and what lessons can be learned for improving policy for development of Wuhan's vegetable production system as well as lessons for how these two approaches might be combined to improve policy making in other situations.

## **您参与该调查的情况 YOUR PARTICIPATION IN THIS RESEARCH**

我们选择邀请您参与调查，因为您代表了武汉蔬菜生产供应体系的一部分。

We have chosen to invite you to participate because you represent one part of the vegetable production and supply system in Wuhan.

您的参与是自愿的，您可以选择不参与某部分或整个项目。如果您决定参与，请您保留这份调查资料并签署一份同意书。参与后您的随时撤回，都无需任何理由。

'It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason'.

如果您参与该项调查，您将接受我（负责这个项目的英国苏塞克斯大学的哲学博士研究员）和/或协助本项目的中南财经政法大学的学生的访问。

If you take part in this research you will be interviewed by me, the Sussex University DPhil researcher responsible for this project and/or students from Zhong Nan University of Economics and Law who are helping with the project.

您参与该调查不会遇到风险，因为该调查没有任何敏感的话题。

There are no risks involved in participating in this research because the topic is not a sensitive one.

您的个人信息将会根据英国的 Data Protection Act 1998 予以保护。未经您的允许您的名字不会与其他人共享。您的名字不会以全称的形式写入该论文或将来任何的其他文章中，而是被写做“××先生/女士”或者“某农民/经理/官员”。您的住所和工作地点，将根据您的同意，在本论文及将来的其他文章中以如下形式出现：××区××镇××村，××单位。

Your personal information will be kept confidential according to the UK's Data Protection Act 1998. Your name will not be shared with other people without your agreement. Your name will not be written in full in the thesis or any future publications but will be written as Mr/Mrs× or as 'a certain farmer/manager/official'. Your working and living places will be referred to as follows in this thesis and future publications according to what you agree: ××district, ××town, ××village, ××unit.

## **该调查的资料 THE RESEARCH DATA**

这项研究的结果将被用于我的哲学博士论文，也可能在将来的其他文章中被苏塞克斯大学和中南财经政法大学的科研人员使用。

The results of the research will be used in my DPhil thesis and may also be used in future publications by University of Sussex and Zhong Nan University of Economics and Law researchers. A copy of the DPhil thesis will be available through contacting the University of Sussex.

#### **许可情况 APPROVAL OF THIS RESEARCH**

这项研究已通过学校工商管理学院的批准以及经济职业道德的审查程序。

This research has been approved through the School of Business, Management & Economics ethical review process.

#### **找信息的联系人 CONTACT FOR MORE INFORMATION**

您可以直接联系我或者和我一起工作的同学来获取更加详细的信息。如果您对我们已完成的研究有任何疑问，您可以联系中南财经政法大学的丁教授或者苏塞克斯大学的我的导师吉姆·沃森教授以及菲奥娜·马歇尔博士。

For more information you can contact me directly or one of the students working with me. If you have any concerns about the way the study has been done, you should contact my host Prof Ding at Zhong Nan University of Economics and Law or my supervisors Prof Jim Watson and Dr Fiona Marshall at the University of Sussex.

#### **感谢您 THANK YOU**

感谢您阅读以上信息。

Thank you for reading this information sheet.

#### **日期 DATE**

2012 年 5 月

May 2012

***Appendix 2 – Interview questions and tools***

# 研究介绍 Research Summary

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## 问题 Questions

### 运销 Distribution & Sales

- 1) 你们公司是通过何种渠道进蔬菜的？你们是从批发市场买进还是管理生产基地等等？为什么？  
What kinds of vegetable supply channels do you use and why?
- 2) 过去五年来你们的进货渠道有什么变化，是如何变化的？  
How have these supply channels changed over the last 5 years?
- 3) 能否为我提供有关的蔬菜供应和价格的数据表？  
Is there price data and sales data I can access? >get contact<
- 4) 对于蔬菜运销，主要挑战是哪些？  
What are the main problems with vegetable supply?
- 5) 2008 年冰冻雨雪灾害如何影响到蔬菜运销？  
What was the impact of 2008 freezing rain and snow disaster on the supply of vegetables?
- 6) 对 2008 年的冰冻灾害，其他销售和配送公司采取了怎样的措施？他们的措施是怎样影响你的公司的？  
How did other retailers and distributors react to this event? How did that affect your business?
- 7) 对 2008 年的冰冻灾害，政府的相关部门采取了怎样的措施？他们的措施是怎样影响你的公司的？  
How did the government react to this event and how did that affect your business?

## 政策 Policy

- 8) 政府有哪些关键的政策影响到你们的生意？有什么好的影响或不好的影响？  
What are the key government policies that impact your business? Do they have a -ve or +ve effect?
- 9) 最近最大的政策变化是什么？它是怎么影响你们的生意？  
What is the most recent change in policy and how has it affected your business?
- 10) ‘菜篮子’政策是如何影响你们的？  
How does the 'Veg Basket' policy affect you?

## 相关的公司联系方式 Relevant Contacts

- 11) 您能否帮我介绍相关的生产、配送公司，并提供联系方式？  
Can you help me contact distributors and producers who I can interview?

非常感谢您。

Sincerely,

Jonathan

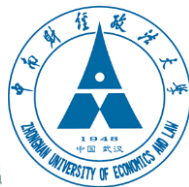
杜礼天 | Jonathan Dolley

博士生 | PhD Researcher

英国经济与社会研究理事会资助，苏塞克斯大学科学技术政策研究所在读博士；武汉中南财经政法大学进修生

A UK Economic and Social Research Council (ESRC) funded University of Sussex Science & Technology Policy Research Unit DPhil. hosted by Zhong Nan University of Economics and Law, Wuhan.

[www.esrc.ac.uk](http://www.esrc.ac.uk) | [www.sussex.ac.uk](http://www.sussex.ac.uk) | [www.znuel.cn](http://www.znuel.cn)



网页: [www.sussex.ac.uk/profiles/133363](http://www.sussex.ac.uk/profiles/133363)

邮件: [dltjnd@gmail.com](mailto:dltjnd@gmail.com)

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# 研究介绍 Research Summary

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最后得出提议。在环境恶劣条件下，怎样改进武汉蔬菜生产供应体系的应对政策和措施。

## 介绍 Introduction

- 1) 请介绍您的公司。是什么时候并如何建立的？从建立时到现在是如何发展的？现在带动多少工人？  
Please introduce your company.  
When and how was it established?  
How has it developed since it was established? How many people are involved?
- 2) 您可以给我们谈谈蔬菜方面的销售渠道信息吗？Describe details of distribution channels.
- 3) 您公司是种植什么品种？为什么？  
Types of vegetable grown.
- 4) 请问这些种植技术是您本就具备，还是在马站长等的指导下开展的呢？Production technology from Ma zhan zhang etc.?
- 5) 武汉市政府和农业局等给了您哪些优惠的待遇？What benefits have you received from Wuhan government and Agricultural Bureau?
- 6) 听说您的公司是一家龙头企业。对于这个评价是如何得来的？和其他生产者或配送公司比较起来有哪些优势？Dragon head enterprise.  
Significance. How achieved?  
Advantages compared to other producers and distributors.

7) 现在公司的主要业务内容和发展重点在哪里呢? Currently, what are the main operations of your Committee and what are the main points for development?

8) 对于蔬菜生产和运销, 主要挑战是哪些?

What are the main problems with vegetable production and supply?

## 2008 年冰冻雨雪灾害

9) 当 2008 年冰冻雨雪灾害的时候, 你们的公司遇到什么问题, 受什么影响? 你们是如何应对这些问题?

During the 2008 freezing rain and snow disaster what problems did your company face? How did you cope with these problems?

10) 有哪些因素阻碍你们应对这个灾害?

What factors hindered you from coping with that disaster?

11) 对 2008 年的冰冻灾害, 政府的相关部门采取了怎样的措施? 他们的措施是怎样影响你们的公司?

How did the government react to this event and how did that affect your business?



- 12) 对 2008 年的冰冻灾害，其他蔬菜生产者、供销农资公司、和运销公司，他们采取了怎样的措施？他们的措施是怎样影响你们的公司？

How did other producers, agricultural suppliers and distribution and sales companies that deal with you respond to this disaster? How did their actions affect your business?

- 13) 您以及公司的农民从 2008 年的抗灾经历中，学到了什么？这些是否有利于更好的应对未来的各种灾害？请描述一下。

Do you think that, because of your experience of the 2008 disaster, you and your workers have learnt how to better cope with future disasters? Please explain.

## 2008 年之后的灾害

- 14) 2008 年之后遇到了哪些严重灾害？比如 2010 年暴雨或 2011 年干旱。哪一个是最严重的？你们是如何应对那个灾害的？跟 2008 年的灾害有什么不同的影响？

Since the 2008 freezing rain and snow disaster what other serious disasters have there been? E.g. 2010 heavy rains, 2011 drought? What was the most serious? How was its impact different from the 2008 one?

## 相关的公司联系方式 Relevant Contacts

- 15) 您能否帮我介绍相关的生产、供销农资、配送公司，并提供联系方式？

Can you help me contact distributors, suppliers and producers who I can interview?

# 研究介绍

## 中文研究介绍

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## 问题

### 介绍

- 1) 请介绍你们的公司。是什么时候并如何建立的？从建立时到现在是如何发展的？现在带动多少工人？
- 2) 您可以给我们谈谈蔬菜方面的销售渠道信息吗？
- 3) 您公司是种植什么品种？为什么？
- 4) 请问这些种植技术是您本就具备，还是在马站长等的指导下开展的呢？
- 5) 武汉市政府和农业局等给了您哪些优惠的待遇？
- 6) 听说您的公司是一家龙头企业。对于这个评价是如何得来的？和其他生产者或配送公司比较起来有哪些优势？
- 7) 现在公司的主要业务内容和发展重点在哪里呢？
- 8) 对于蔬菜生产和运销，主要挑战是哪些？

### 2008 年冰冻雨雪灾害

- 9) 当 2008 年冰冻雨雪灾害的时候，你们的公司遇到什么问题，受什么影响？你们是如何应对这些问题？
- 10) 有哪些因素阻碍你们应对这个灾害？
- 11) 对 2008 年的冰冻灾害，政府的相关部门采取了怎样的措施？他们的措施是怎样影响你们的公司？

- 12) 对 2008 年的冰冻灾害，其他蔬菜生产者、供销农资公司、和运销公司，他们采取了怎样的措施？他们的措施是怎样影响你们的公司？
- 13) 您以及公司的农民从 2008 年的抗灾经历中，学到了什么？这些是否有利于更好的应对未来的各种灾害？请描述一下。

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- 14) 2008 年之后遇到了哪些严重灾害？比如 2010 年暴雨或 2011 年干旱。哪一个是最严重的？你们是如何应对那个灾害的？跟 2008 年的灾害有什么不同的影响？

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- 15) 您能否帮我介绍相关的生产、供销农资、配送公司，并提供联系方式？

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Sincerely,

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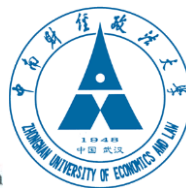
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# 调查

杜礼天 | Jonathan Dolley

博士生 | PhD Researcher

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University of Sussex

SPRU –

Science & Technology Policy Research



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1) 请介绍当地农民大多是种什么的？若没有附近哪里有种蔬菜的？

## 2) 基本信息

受访人: \_\_\_\_\_ 性别: \_\_\_\_\_ 年龄: \_\_\_\_\_ 是否为农工: \_\_\_\_\_ 手机号码: \_\_\_\_\_

采访人: \_\_\_\_\_ 采访时间: \_\_\_\_\_ 地址: \_\_\_\_\_

村大概人口: \_\_\_\_\_ (当地人占 \_\_\_\_\_ % 外地人占 \_\_\_\_\_ % 哪里的 \_\_\_\_\_)

## 3) 家庭情况

几口人，年龄，工作，住所，谁种菜: .....

户口: ☐ 当地 ☐ 外地



家乡 \_\_\_\_\_

来到武汉的时间是 \_\_\_\_\_

搬家的原因是 \_\_\_\_\_

选择来这里的原因是 \_\_\_\_\_

种蔬菜的经验（开始了几年？当时种什么的？为什么？到现在怎样发展的？）: .....

## 4) 您农业生产的组织方式？

1 自家小规模经营；2 参加合作组织；3 企业+农户；4 较大规模经营（承包他人）；5 企业化经营；

6 其他 \_\_\_\_\_

现在

5 年前

10 年前

## 生产和销售 Production and Sales

### 5) 土地面积和用途 Land area and usage

自有土地 _____ 亩。 年成本 = _____ 元/亩 _____ (描述)。	租用的土地 _____ 亩。 年成本 = _____ 元/亩 _____ (描述)。 从哪里租的土地？租赁的方法？：	因别人闲置而转让而得的土地 _____ 亩。 年成本 = _____ 元/亩 _____ (描述)。 从谁并如何转让的？有什么原因？：	其他： _____ 亩。 年成本 = _____ 元/亩。
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土地的优点和缺点。（肥沃程度，灌溉设施，排水系统，海拔低高，交通）

主要种植什么菜？

### 6) 您为什么种植这些菜，不种植其它的菜，比如快生菜？(先自然地说，然后用选择建议有可能的原因)

现在种这些菜是因为...	指的什么菜？	不要/不能种的菜是因为...	指的什么菜？
<input type="checkbox"/> 就跟这些品种很熟悉		<input type="checkbox"/> 对于别的品种缺乏知识	
<input type="checkbox"/> 品种技术含量低		<input type="checkbox"/> 品种技术含量对我 <b>太高</b>	
<input type="checkbox"/> 品种产量稳定		<input type="checkbox"/> 品种产量不稳定	
<input type="checkbox"/> 品种价格稳定		<input type="checkbox"/> 品种价格不稳定	
<input type="checkbox"/> 品种价格比较高		<input type="checkbox"/> 品种价格比较低	
<input type="checkbox"/> 品种抗灾害能力强		<input type="checkbox"/> 品种抗灾害能力不强	
<input type="checkbox"/> 品种能够长期储存		<input type="checkbox"/> 品种不能够长期储存	
<input type="checkbox"/> 没有储存设备			
<input type="checkbox"/> 品种的投入没有其它高		<input type="checkbox"/> 品种的投入太高	
<input type="checkbox"/> 品种病虫害很少		<input type="checkbox"/> 品种病虫害多，难以防治	
<input type="checkbox"/> 劳动强度比较低，忙得过来		<input type="checkbox"/> 劳动强度太高，忙不过来种植	
<input type="checkbox"/> 需求的资金不太高		<input type="checkbox"/> 资金不够修大棚等等	
<input type="checkbox"/> 市场质量要求不太高		<input type="checkbox"/> 现有的技术不能达到市场质量要求	

### 7) 您希望未来能种什么菜？为什么？能不能种？若不能种，那为什么呢？

## 8) 种植情况

品种和面积 (亩)	种类 1 大路菜； 2 快生菜； 3 粮食； 4 反季节； 4 其它。	质量 1 有机；2 绿色； 3 无公害；4 不必 要打农药；5 非 要打农药；6 施 有机肥料；7 施 化肥料	用不用大棚？若 1， 那有什么原因？[0 大 棚不适合这个品种；1 虽然大棚适合但没 用；2 竹架大棚；3 钢架大棚。（多少 亩？）]	播种和收获时间和 频率	每年大概的毛 收入 a) 情况差 b) 情况一般 c) 情况最好	每年大概的生 产资料的费用 a) 情况差 b) 情况一般 c) 情况最好	怎么销售的？原因？到哪里 卖的？用什么车辆？[1 上 门收购；2 自己到市场上销 售；3 村里统一销售；4 合 作社销售；5 其他。描述方 式和原因。]	是怎样决定价格的？ 价格有什么变化？为什 么？
亩				播种时间	A			
				收获时间	B			
				频率	C			
				播种时间	A			
				收获时间	B			
				频率	C			
				播种时间	A			
				收获时间	B			
				频率	C			
				播种时间	A			
				收获时间	B			
				频率	C			

## 生活 Livelihood

9) 近几年家庭的总共收入和纯利。


	2011	2010	2009	2008	2007
<b>大概的总共收入</b> <input type="checkbox"/> 收入能够让家人过得越来越好 <input type="checkbox"/> 收入能够满足基本需要 <input type="checkbox"/> 收入差一点不够满足基本需要					
<b>蔬菜销售纯利</b> (总收入 - 总费用 - 土地费用 =)					
<b>其他农业纯利</b> (如玉米, 水稻等粮食收入) 描述:					
<b>其它经济来源和产物:</b> a) 本人临时打工: _____ b) 家人打工: _____ c) 做生意: _____ d) 其他: _____ e) 自己拥有房子 <input type="checkbox"/> 。					

<b>有没有存钱?</b> <input type="checkbox"/> 有 <input type="checkbox"/> 没有	<b>若没有, 为什么?</b>
<b>有没有贷款?</b> <input type="checkbox"/> 有 <input type="checkbox"/> 没有	<b>若有, 是什么原因?</b>

困难和灾害 Difficulties and Disasters

10) 在以下那些方面当中近五年是什么原因导致了您的收入降低或劳动强度变大？

困难	怎样影响您的收入和劳动强度的？ 先描述然后写数字：1 收入降低，劳动强度没变多少；2 劳动强度变大，收入变不多；3 收入又降低，劳动强度又变大；4 还有其它影响（描述）。	自己管理风险的方法	得到了什么帮助？是否真正有利的？为什么？ 1 镇/区/市政府；2 亲戚朋友；3 村干部；4 农技站；5 合作组织；6 相关企业；7 科研院所；8 其他（描述）	为了更好地面对该困难最需要的是什么？得到这些有什么困难？为什么？ 比如：缺乏市场信息；缺乏资金；
经济（让农民先随口说在这方面中的一个最大困难，然后跟他查一下下面的困难有没有影响）				
蔬菜价格的变动。 蔬菜供应过多。 农资投入价格升涨。 蔬菜质量要求太高。 运送费用升涨。 其它。				
正常每个季节发生的自然困难（强风，下大雨，害虫，下雪，冰冻，干旱，酷暑期）				
写自然困难和季节				
环境变化及污染				
长期温度上升。 土壤退化。 灌溉水的污染（因农业而引起的）。 工业引起的污染。 其它。				

11) 在这几个最大的困难当中您认为它们分别占多大的比重？（%）  （哪些困难给你造成的损失最大？）



12) 近五年的灾害是如何影响您的收入和劳动强度？

灾害	怎样影响您的收入和劳动强度的？ 先描述然后写数字：1 收入降低，劳动强度没变多少；2 劳动强度变大，收入变不多；3 收入又降低，劳动强度又变大；4 还有其它影响（描述）。	自己管理风险的方法	得到了什么帮助？是否真正有利的？为什么？ 1 镇/区/市政府；2 亲戚朋友；3 村干部；4 农技站；5 合作组织；6 相关企业；7 科研院所；8 其他[描述]	为了更好地面对该困难最需要的是什么？得到这些难不难？为什么？ 市场信息；资金；组织销售；组织购买；
<b>极端的环境</b>				
2008 冰雪 2010 暴雨 2011 干旱 2012 暴雨				
其它				

13) 未来，对于种植蔬菜，您最担心什么？为什么？

14) 未来，对于种蔬菜，您最需要的是什么？希望政府能够提供什么样的帮助？

**支持与机会 Support and Opportunities**

15) 您是怎样学到种植技术的？为了提高您的种植技术您做了什么？

1.父辈传承；2 邻居或亲戚；3 农技员面授或培训；4 生产资料销售部门；5 示范户；6 看电视或广播；7 手机或电脑网络；8 书籍或报纸；9 村政府。（若得到了培训是什么内容？有没有效果？若没有的话是为什么？）

16) 您认为该如何提高你们的生活水平？为此，农民们可以做什么，政府可以做什么？

***Appendix 3 – Example of interview write ups in Chinese***

1) 请介绍当地农民大多是种什么的？若没有附近哪里有种蔬菜的？

主要以大路菜和快生菜为主。大路菜包括番茄、花菜、西兰花、莴苣、豆角等。快生菜以叶子菜为主，包括小白菜、大白菜、竹叶菜、苋菜等。

2) 基本信息

受访人： 性别： 年龄： 是否为农工： 否 手机号码：  
采访人： 采访时间： 2012-07-25 地址： 东西湖区  
村大概人口： (当地人占 20 % 外地人占 80 % 哪里的 以洪湖、嘉鱼、湖南等外来人员为主 )

3) 家庭情况

几口人，年龄，工作，住所，谁种菜： .....  
目前家中有 6 口人。包括户主、妻子、两个儿子，一个孙子和一个孙女。户主和妻子在家中务农，两个儿子现在在外打工，均不参与农业劳动。住所为自建的砖房。两个儿子目前经济相对独立，没有余力供养父母，且大儿子的两个孩子留在家中让父母照养。

户口： [ ] 本地 [ ☒ ] 外地  
家乡 洪湖  
来到武汉的时间是 1988 年  
搬家的原因是 原来在洪湖主要以种植水稻玉米等粮食为主，种粮食基本没有收入，听同村人介绍说武汉可以种蔬菜，相对收入较高，所以来武汉租地种蔬菜。  
选择来这里的原因是 原来种蔬菜的地被政府征用了

种蔬菜的经验（开始了几年？当时种什么的？为什么？到现在怎样发展的？）： .....  
从 1991 年开始学习种植蔬菜。主要是大路菜，包括番茄、花菜、西兰花、莴苣、豆角等。因为叶子菜种植劳动强度较大路菜大，虽然技术上相对容易，但是不愿意再付出更多的劳动强度一直到现在也没有种过其他的蔬菜，未来几年也不考虑更换品种。

4) 您农业生产的组织方式？

1 自家小规模经营；2 参加合作组织；3 企业+农户；4 较大规模经营（承包他人）；5 企业化经营；  
6 其他

现在	1	5 年前	1	10 年前	1
----	---	------	---	-------	---

## 生产和销售 Production and Sales

### 5) 土地面积和用途 Land area and usage

自有土地 _____ 亩。 年成本 = _____ 元/亩 _____ (描述)。	租用的土地 <b>5</b> 亩。 年成本 = <b>400</b> 元/亩 此数字仅指租金，不包括生产资料的投入等。(描述)。 从哪里租的土地？租赁的方法？： 土地是从当地农场租赁而来。 目前租赁合同一年签一次。	因别人闲置而转让而得的土地 _____ 亩。 年成本 = _____ 元/亩 _____ (描述)。 从谁并如何转让的？有什么原因？：	其他： _____ 亩。 年成本 = _____ 元/亩。
---	--	--	----------------------------------

土地的优缺点。(肥沃程度，灌溉设施，排水系统，海拔低高，交通)  
 土地肥力原先状况不错，但是近几年变差了，因为一直在耕种没有让土地休息过，目前只能靠施用肥料来保持作物生长。  
 灌溉设施情况良好，地旁边有沟渠，方便取水。  
 排水主要靠水泵，将水引入排水渠，但是水渠容量有限，在雨水量大时难以阻止土地被淹。  
 海拔相对较低，淹水情况严重。  
 交通相对方便，有质量良好的公路，离最近的蔬菜批发市场的路程大约是 30 分钟（三轮摩托）。  
 主要种植什么菜？  
 主要是大路菜，包括番茄、西兰花、莴苣、花菜。

### 6) 您为什么种植这些菜，不种植其它的菜，比如快生菜？(先自然地说，然后用选择建议有可能的原因)

现在种这些菜是因为...	指的什么菜？	不要/不能种的菜是因为...	指的什么菜？
[ <input checked="" type="checkbox"/> ] 就跟这些品种很熟悉	大路	[ <input checked="" type="checkbox"/> ] 对于别的品种缺乏知识	快生
[ <input type="checkbox"/> ] 品种技术含量低	大路	[ <input type="checkbox"/> ] 品种技术含量对我太高	快生
[ <input checked="" type="checkbox"/> ] 品种产量稳定	大路	[ <input type="checkbox"/> ] 品种产量不稳定	
[ <input type="checkbox"/> ] 品种价格稳定		[ <input checked="" type="checkbox"/> ] 品种价格不稳定	
[ <input type="checkbox"/> ] 品种价格比较高		[ <input type="checkbox"/> ] 品种价格比较低	
[ <input type="checkbox"/> ] 品种抗灾害能力强		[ <input type="checkbox"/> ] 品种抗灾害能力不强	
[ <input type="checkbox"/> ] 品种能够长期储存		[ <input type="checkbox"/> ] 品种不能够长期储存	
[ <input type="checkbox"/> ] 没有储存设备			
[ <input type="checkbox"/> ] 品种的投入没有其它高		[ <input type="checkbox"/> ] 品种的投入太高	
[ <input type="checkbox"/> ] 品种病虫害很少		[ <input type="checkbox"/> ] 品种病虫害多，难以防治	
[ <input checked="" type="checkbox"/> ] 劳动强度比较低，忙得过来		[ <input checked="" type="checkbox"/> ] 劳动强度太高，忙不过来种植	
[ <input type="checkbox"/> ] 需求的资金不太高	大路	[ <input type="checkbox"/> ] 资金不够修大棚等等	
[ <input checked="" type="checkbox"/> ] 市场质量要求不太高	大路	[ <input checked="" type="checkbox"/> ] 现有的技术不能达到市场质量要求	快生

### 7) 您希望未来能种什么菜？为什么？能不能种？若不能种，那为什么呢？

以后都只考虑种植大路菜，快生菜采摘需要一定经验，不能破坏菜的美观，否则会影响销售。自己不愿意学习采摘快生菜方面的经验，所以就种大路菜就可以了。

## 8) 种植情况

品种和面积 (亩)	种类 1 大路菜; 2 快生菜; 3 粮食; 4 反季节; 4 其它。	质量 1 有机; 2 绿色; 3 无公害; 4 不必 要打农药; 5 非 要打农药; 6 施 有机肥料; 7 施 化肥料	用不用大棚? 若 1, 那有什么原因? [0 大 棚不适合这个品种; 1 虽然大棚适合但没 用; 2 竹架大棚; 3 钢架大棚。(多少 亩?) ]	播种和收获时间和 频率	每年大概的毛 收入 a) 情况差 b) 情况一般 c) 情况最好	每年大概的生 产资料的费用 a) 情况差 b) 情况一般 c) 情况最好	怎么销售的? 原因? 到哪里 卖的? 用什么车辆? [1 上 门收购; 2 自己到市场上销 售; 3 村里统一销售; 4 合 作社销售; 5 其他。描述方 式和原因。]	是怎样决定价格的? 价格有什么变化? 为什 么?
番茄	1  5  亩	5,7	3	播种时间 11 月左右 收获时间 5 月左右 频率 1 次/年	A 20000  B 35000  C 50000	A 5000  B 6000  C 7000	2 卖到皇金塘批发市场, 使用 三轮摩托。多年习惯将菜卖 到批发市场。	与市场中的批发商(贩 子)进行讨价还价后决 定。因为市场价格只能遵 从供求规律。供应量大 的时候价格就低, 供应 量小的时候价格就高。 价格变化波动较大
花菜					A 3000  B 5000  C 7000	同上, 略少		
莴苣	1  3  亩	5,7	3	播种时间 9 月 收获时间 12 月 频率 1 次/年	A 4000  B 6000  C 10000	同上, 略少	2 卖到皇金塘批发市场, 使用 三轮摩托。多年习惯将菜卖 到批发市场。	与市场中的批发商(贩 子)进行讨价还价后决 定。因为市场价格只能遵 从供求规律。供应量大 的时候价格就低, 供应 量小的时候价格就高。 价格变化波动较大
西兰花					A 1200  B 1500  C 2000	大概为莴苣的 一半		

## 生活 Livelihood

9) 近几年家庭的总共收入和纯利。

	2011	2010	2009	2008	2007
<b>大概的总共收入</b> <input type="checkbox"/> 收入能够让家人过得越来越好 <input type="checkbox"/> 收入能够满足基本需要 <input type="checkbox"/> 收入差一点不够满足基本需要	差一点 （继续有番茄死亡的现象，与此同时孙子孙女同时上幼儿园，学费开支很大）	差一点 （番茄开始出现不明原因的死亡，产量受损）	基本满足略有盈余	基本满足略有盈余	基本满足略有盈余
<b>蔬菜销售纯利</b> (总收入 – 总费用 – 土地费用 =)	23000	26000	30000	30000	30000
<b>其他农业纯利</b> (如玉米，水稻等粮食收入) 描述：	0	0	0	0	0

### 其它经济来源和产物：


- a) 本人临时打工：\_\_\_\_\_
- b) 家人打工： 去年开始子女参加工作，他们各自的生活不再需要父母通过种植蔬菜的收入供给。4000/月
- c) 做生意：\_\_\_\_\_
- d) 其他：\_\_\_\_\_
- e) 自己拥有房子 [ 有 ]。

<b>有没有存钱？</b> <input type="checkbox"/> 有 <input checked="" type="checkbox"/> 没有	<b>若没有，为什么？</b> 有番茄死亡的现象，与此同时孙子孙女同时上幼儿园，学费开支很大
<b>有没有贷款？</b> <input type="checkbox"/> 有 <input type="checkbox"/> 没有	<b>若有，是什么原因？</b>

困难和灾害 Difficulties and Disasters

10) 在以下那些方面当中近五年是什么原因导致了您的收入降低或劳动强度变大？

困难	怎样影响您的收入和劳动强度的？ 先描述然后写数字：1 收入降低，劳动强度没变多少；2 劳动强度变大，收入变不多；3 收入又降低，劳动强度又变大；4 还有其它影响（描述）。	自己管理风险的方法	得到了什么帮助？是否真正有利的？为什么？ 1 镇/区/市政府；2 亲戚朋友；3 村干部；4 农技站；5 合作组织；6 相关企业；7 科研院所；8 其他（描述）	为了更好地面对该困难最需要的是什么？得到这些有什么困难？为什么？ 比如：缺乏市场信息；缺乏资金；
经济（让农民先随口说在这方面中的一个最大困难，然后跟他查一下下面的困难有没有影响）				
蔬菜价格的变动。 蔬菜供应过多。 农资投入价格升涨。 蔬菜质量要求太高。 运送费用升涨。 其它。	主要来自于： 1. 农药化肥投入显著增加。化肥和农药的价格比起 5 年前已经涨了 2 倍。 导致成本的增加，在收菜之前手中没有现金，农资只能靠赊账购买。	目前没有什么特殊的办法。只能考虑买稍微便宜但是效果差一些的农药化肥	没有	希望政府有补贴
正常每个季节发生的自然困难（强风，下大雨，害虫，下雪，冰冻，干旱，酷暑期）				
写自然困难和季节	夏天：害虫（增加成本），淹水（常见且严重，只要下一天暴雨，土地就会被淹，产量损失很大，严重影响收入），干旱（由于灌溉设施良好，影响不大） 冬天：下雪（压倒棚子，冻死蔬菜，减产，减收）	应对自然灾害没有什么特别的方法。只面对病虫害的问题，只能多打农药，增加成本投入。目前农药的效果还不错，基本能控制病虫害的蔓延。干旱的问题有生产队提供集中供水，不是特别担心。而淹水和下雪一旦发生，就只能任由蔬菜淹死冻死，没有任何办法。	没有	希望能有准确的气候信息。
环境变化及污染				
长期温度上升。 土壤退化。 灌溉水的污染（因农业而引起的）。 工业引起的污染。 其它。	土壤退化 番茄出现不明原因的死亡，专家说是土壤退化的原因。	自己没有办法	专家验过土地质量以后有说大概应该怎么施肥，但是毫无效果。	希望能来别的专家提供有用的办法

11) 在这几个最大的困难当中您认为它们分别占多大的比重？ (%)  （哪些困难给你造成的损失最大？）

主要是农药化肥的成本增加，使得手上没有余钱，只能靠赊账来购买生产资料。现在甚至开始考虑买质量相对较差的农药化肥了，影响产量。再一个就是番茄意外死亡的现象可能得不到解决，估计后面几年番茄的收入会降低很多。

12) 近五年的灾害是如何影响您的收入和劳动强度？

灾害	怎样影响您的收入和劳动强度的？ 先描述然后写数字：1 收入降低，劳动强度没变多少；2 劳动强度变大，收入变不多；3 收入又降低，劳动强度又变大；4 还有其它影响（描述）。	自己管理风险的方法	得到了什么帮助？是否真正有利的？为什么？1 镇/区/市政府；2 亲戚朋友；3 村干部；4 农技站；5 合作组织；6 相关企业；7 科研院所；8 其他[描述]	为了更好地面对该困难最需要的是什么？得到这些难不难？为什么？ 市场信息；资金；组织销售；组织购买；
<b>极端的环境</b>				
2008 冰雪 2010 暴雨 2011 干旱 2012 暴雨				
其它				

13) 未来，对于种植蔬菜，您最担心什么？为什么？

第一是生产资料的价格继续上涨的同时蔬菜价格更剧烈的变化，这样会造成收入更加不稳定。第二是番茄的死亡，不知道还会不会继续，减产太严重了。最后是天气，希望淹水和下雪压倒棚子事情少一点。

14) 未来，对于种蔬菜，您最需要的是什么？希望政府能够提供什么样的帮助？

希望政府能安排技术人员教大家生产技术，而且要到每家每户来实地考察，根据不同情况提出不同的方法，要保证有效。

**支持与机会 Support and Opportunities**

15) 您是怎样学到种植技术的？为了提高您的种植技术您做了什么？

1.父辈传承；2 邻居或亲戚；3 农技员面授或培训；4 生产资料销售部门；5 示范户；6 看电视或广播；7 手机或电脑网络；8 书籍或报纸；9 村政府。(若得到了培训是什么内容？有没有效果？若没有的话是为什么？)

一直都是跟邻居种植蔬菜的人学习的，从来没有过任何其他渠道的技术来源。

16) 您认为该如何提高你们的生活水平？为此，农民们可以做什么，政府可以做什么？

农民自己种地上还是应该学习一些合适的技术稳定产量，提高蔬菜的质量。在生产资料上希望政府能提供可靠的渠道进行购买适当控制农资的价格，或者给农民提供补贴。



***Appendix 4 – Example of translated interview***

<b>Area</b>	<p>东西湖区</p> <p>20% local, 80% migrant from Hubei (Honghu, Jiayu) and Hunan.</p> <p>Staple Veg: tomatoes, cauliflower, broccoli, lettuce/莴苣, bean/豆角, etc.</p> <p>Fast Growing Veg: small chinese leaf/小白菜, large chinese leaf/大白菜, bamboo leaf/竹叶菜, chinese spinach/苋菜 etc.</p>
<b>Personal</b>	<p> from Honghu. 非农工. Family of 6: husband, wife, two sons, grandson and granddaughter. Husband and wife grow veg. Two sons work elsewhere and do not help with the farming, they are independent of parents but neither do they help support their parents. Husband and wife live in their self built single story dwelling with their two grandchildren who they look after for their eldest son.</p>
<b>Income</b>	<p>30,000 declining to 23,000 元 from 2007 to 2011.</p> <p>Income just enough to meet needs with some surplus but declining recently as tomato yields started to die for unknown reasons and grandchildren started kindergarten.</p>
<b>Savings / Debt</b>	<p>No savings. Tomato crop failed and grandchildren started kindergarten. They pay the school fees from veg production income. So no savings left.</p>
<b>Story</b>	<p>Came to Wuhan in 1988. Grew rice and maize in Honghu but income was very low. Heard about growing veg in Wuhan from others from their village who said income from veg farming was better so they came to grow veg in Wuhan. The land they previously grew veg on in Wuhan was taken for development so they moved here.</p>
<b>Veg-experience</b>	<p>Started learning how to grow veg in 1991. Learnt how to grow staple veg (tomatoes, cauliflower, broccoli, lettuce/莴苣, beans/豆角 etc) and have grown these varieties ever since.</p> <p>Learnt from neighbors who grew veg.</p>
<b>Land</b>	<p>5 mu; 400 元 per mu per year leased from farm on a yearly contract resigned each year.</p> <p><b>Advantages:</b> irrigation is good with channels alongside fields allowing easy access to water, good transport links and good roads, 30 minutes by motorized tricycle from nearest wholesale veg market.</p> <p><b>Disadvantages:</b> fertility used to be not bad but has got worse in recent years as land has not been allowed to rest, dependent on fertilizer, drainage is aided by having water pumps but capacity is limited so that when it rains heavily it is difficult to avoid waterlogging, land is low lying so flooding is serious.</p>
<b>Crop choice</b>	<p>Staple veg: tomatoes, broccoli, lettuce/莴苣, cauliflower.</p> <p>Leaf vegetables require a lot more work than staple veg although skills required are easier than staple veg. However, because they are unwilling to do the harder work for leaf veg they decided to stick with staple veg and do not intend to change.</p> <p>Staple veg: familiar, stable yields, less hard work, market quality requirements</p>

	<p>not to high.</p> <p>Fast growing veg: unfamiliar, unstable prices, too much work to do with resources available. difficult to meet market quality requirements. Need experience to know how to keep leaf veg looking fresh (otherwise sales income is affected), not willing to learn this experience.</p>
<b>Tomatoes</b>	<p>5 mu, SV, MPT, plant Nov - harvest May, once per year.</p> <p><b>Income:</b> (A) 20,000 (B) 35,000 (C) 50,000 total gross income per year.</p> <p><b>Costs:</b> (A) 5,000 (B) 6,000 (C) 7,000 total costs of inputs per year.</p>
<b>Cauliflower</b>	<p>3 mu, SV, MPT, plant Jun - harvest Aug, once per year.</p> <p><b>Income:</b> (A) 3,000 (B) 5,000 (C) 7,000 total gross income per year.</p> <p><b>Costs:</b> 3,000 - 4,200 total costs of inputs per year.</p>
莴苣	<p>3 mu, SV, MPT, plant Sep - harvest Dec, once per year.</p> <p><b>Income:</b> (A) 4,000 (B) 6,000 (C) 10,000 total gross income per year.</p> <p><b>Costs:</b> 3,000 - 5,000 total cost of inputs per year.</p>
<b>Broccoli</b>	<p>1 mu, SV, MPT, plant Jul - harvest Oct, once per year.</p> <p><b>Income:</b> (A) 1,200 (B) 1,500 (C) 2,000 total gross income per year.</p> <p><b>Costs:</b> 1,000 - 1,500 total cost of inputs per year.</p>
<b>Future</b>	
<b>Inputs</b>	Pesticides and chemical fertilizers necessary.
<b>PTs</b>	Use metal frame PTs.
<b>Sales</b>	Take by electric tricycle to Huangjingtang wholesale market to sell. Prices fluctuate a lot, when supply is high prices fall and when supply is low prices rise.
<b>Market Issues</b>	<p>Pesticides &amp; fertilizer prices rising, 1 or 2 times higher than 5 years ago.</p> <p>Before harvest, usually don't have enough cash to buy inputs so have to buy on credit with the agri inputs shop. In response they buy cheaper, less effective inputs.</p> <p>Veg prices too volatile.</p>
<b>Environmental Issues</b>	<p>Summer - pests and diseases increase production costs, flooding is common and serious (just one day's torrential rain and land floods, destroying crops and seriously reducing income), drought has little effect because irrigation facilities are good.</p> <p>Winter - snow (weighs down and damages PTs, ice kills vegetables reduces yields and income).</p> <p>Soil fertility declining. Tomatoes started dying for unknown reason. Expert came and said it's because soil fertility has declined. The expert advised how to use fertilizer but have seen no improvement.</p>
<b>Government Assistance</b>	None.
<b>Needs</b>	<p>Technical officers to provide production training and guidance. They should also visit every household to assess needs and provide guidance for each individual situation.</p> <p>Farmers need to learn new techniques to stabilize yields and improve quality.</p> <p>Government should safeguard ways of buying quality inputs at affordable</p>

	prices or provide subsidies.
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