Red Lines for a Green China:
Adaptation, Negotiation and Experimentation in China's Efforts to Transform Sustainably

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ABSTRACT

After years of rapid economic growth and unbridled urbanization, China is now attempting to transition to an "ecological civilization," the nation's term for sustainable development. A foundational element of China's approach is the development and enforcement of "ecological conservation red lines" (ERLs). As the most comprehensive conservation plan in China's history, for up to 35% of its territory, ERLs define strictly controlled boundaries for ecosystem services and ecologically sensitive areas in order to safeguard natural resources and human health and to address climate risks. Globally, this is the largest effort ever undertaken to plan land uses across geographic scales based on the optimization of ecosystem services.

Based on extensive fieldwork and the application of multiple qualitative research and analysis methods, this dissertation is the first comprehensive study of the politics of the ERL. It examines the development of the ERL at the national level and within two localities to address two puzzles: (1) How and why did China create the world's most comprehensive ecosystem-based land planning strategy? (2) How and why would China which is applying top-down command and control environmental regulation, and is increasingly politically centralized, be able to support local variation?

The ERL is an integrated science and practice policy model that produced a paradigmatic idea which changes the conceptualization of land use planning in China. The ERL process combines a historical adaptive "guerilla policy style," with a more recent command and control environmental regulation in which targets are set by the central government for local implementation. This apparent contradiction in the ERL's design as dynamic with binding targets has produced an ERL process that was more adaptive, negotiated and flexible than expected. The main determinants of the shape and size of the ERL in each locality were political economy, existing levels of environmental quality, ongoing planning processes, and long-standing institutional dynamics. The ERL outcome has been shaped primarily by interactions among existing institutions in the face of political, economic and moral incentives as understood by local officials. This analysis suggests advances in future studies of institutional change, especially in regards to sustainable transitions.

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I dedicate this to my parents and to everyone working for a more sustainable and equitable planet.

Acronyms

CAS: Chinese Academy of Science
CLPSI: China Land Planning and Survey Institute
DRC: Development and Reform Commission (with municipal and county levels under NDRC)
EEB: Ecology and Environment Bureau (with provincial, municipal and county levels under MEE)
ERL: Ecological Conservation Red Lines
EFZ: Ecological Function Zone
MEA: Millennium Ecosystem Assessment
MEE: Ministry of Ecology and Environment (formerly Ministry of Environmental Protection (MEP))
MEP: Ministry of Environmental Protection (formerly State Environmental Protection Authority and now Ministry of Ecology and Environment (MEE))
MLR: Ministry of Land and Resources (now Ministry of Natural Resources (MLR))
MNR: Ministry of Natural Resources (formerly Ministry of Land and Resources (MLR))
MOF: Ministry of Finance
NRB: Natural Resource Bureau (with provincial, municipal and county under MNR)
NDRC: National Development and Reform Commission
PDRC: Provincial Development and Reform Commission (provincial level under NDRC)
RFFP: Returning Farmland to Forests Program
WRB: Water Resource Bureau (with provincial, municipal and county levels under Ministry of Water Resources)

Chapter 1

Introduction

Building an ecological civilization is vital to sustain the Chinese nation's development. We must realize that clear waters and lush mountains are invaluable assets and act on this understanding, implement our fundamental national policy of conserving resources and protecting the environment, and cherish the environment as we cherish our own lives. We will adopt a holistic approach to conserving our mountains, rivers, forests, farmlands, lakes, and grasslands, implement the strictest possible systems for environmental protection, and develop eco-friendly growth models and ways of life.

– President Xi Jinping, 19th National Party Congress Speech, October 2017

I. Introduction

"In a house, there is a kitchen, a bedroom, a living room and a bathroom. Each area in the house has a specific purpose and is governed by different rules," a patient government official explained to me. China is dividing its land like parts of a house, she continued, in attempt to make what seems like an outrageous idea seem normal. You would not cook in a bedroom. Why would you have a factory next to a drinking water source? But how should an entire country be divided, especially one as large and diverse as China, into areas for development, agriculture and conservation?

A centerpiece of this remodeling in China is the Ecological Conservation Red Line (ERL)[1]. The ERL physically demarcates ecologically important, sensitive and vulnerable areas that will be off limits to development. By 2020, the central government has targeted up to 35% of China's territory to be protected by ERLs. ERL areas include areas for water source conservation, biodiversity conservation, and soil and water conservation and areas that provide wind and sand fixation, coastal ecological stability, or address other ecologically sensitive and vulnerable concerns such as soil erosion, land desertification, rocky desertification, and salinization (MEP and NDRC 2017).

This ambitious effort is an attempt to reorganize land use around environmental principles and, in the process, shift China's resource-driven development to a sustainable path. It is a central component to China's plans for achieving an "ecological civilization," its term for sustainable development. The ERL applies ecosystem services, a method to measure the value of natural resources in economic terms, as a means to allocate land in order to safeguard ecosystems, human health and address climate risks. This immense undertaking is impacting billions through its potential influence on greenhouse gas emissions, air and water pollution and supply chains. In 2018, 15 provinces and provincial-level cities completed their red line maps designating areas for protection and the rest of the country's ERLs are on the way.

China is not a country that most people tend to examine for advances in environmental governance. It is rated 120 out of 180 on the Yale Environmental Performance Index, which ranks countries on 24 indicators (Wendling et al. 2018). Many have said that cooking in the bedroom has set the house on fire (Economy 2010; H. Zhang and Xu 2017; J. Liu et al. 2018; Shapiro 2016). Air, soil and water pollution are pervasive, together with widespread ecosystem degradation and loss of biodiversity. The estimated economic costs

[1] I use the acronym ERL rather than ECRL since this is how it is commonly referred to in Chinese and its former name, ERL or *shengtai hongxian* (生态红线)

of the interrelated problems associated with environmental degradation (e.g., resource depletion, environmental pollution, and ecological degradation) are estimated to exceed 13% of the national gross domestic product (M. Shi, Ma, and Shi 2011). Additionally, climate change is exacerbating land degradation through increases in rainfall intensity, flooding, drought frequency and severity, heat stress, dry spells, wind, sea-level rise and wave action and permafrost thaw (IPCC 2019).

Yet in this unlikely corner, China is grappling with questions that countries around the globe are facing as they have indicated their intentions to transition to a low-carbon sustainable future. The recent signing of the Paris Agreement and adoption of the UN Sustainable Development Goals call for a green transformation on a planetary basis. Although there is consensus on the terms of these agreements regarding the desired results, there is no agreement on how to get there and how to address the social, cultural, institutional, and political challenges that are sure to arise (Scoones, Leach, and Newell 2015).

According to a recent IPCC report, land management is key to achieving many of these international commitments and is a critical and scarce resource (IPCC 2019). Land provides the primary basis for human livelihoods and well-being including the supply of food, freshwater and multiple other ecosystem services, as well as biodiversity. Human use directly affects more than 70% of the global, ice free land surface leaving minimal space for continuous expansion or for the rest of the species on the planet. Land is significant to address climate change as it has an important role in the climate system and is simultaneously a source and a sink of CO_2. Sustainable land management can also reduce the negative impacts of multiple stressors, including climate change, on ecosystems and societies (IPCC 2019). China, with limited land resources per capita and with much of its land already used for development and agriculture (Y. Liu, Fang, and Li 2014), is testing a new sustainable land use strategy to address these issues, the ERL.

Developing the ERL for an entire country is no simple task and it has no precedent. It comes with numerous scientific and governance challenges. So, where did this idea come from? How does it work in practice? No one has asked these questions thus far. The academic literature on the ERL has been primarily focused on technical and scientific considerations. It has emphasized the need for better maps and improving the technical analysis used to achieve ecological goals. To my knowledge, there has been no study that has examined the local ERL process from an institutional vantage point. This dissertation aims to begin to fill this gap at a critical juncture in the development of ERLs and China's attempt to transition to an ecological civilization.

The Chinese government has been praised for its effort to use spatial planning to manage the balance between conservation and development (Johnson et al. 2017; UNEP 2016). Drawing on multi-method and multi-scale qualitative research, I argue that the process and outcome of the ERL are not what we would expect from the theory on China's top down command and control environmental regulations, especially in this current round of centralization.

The ERL-setting process was nuanced, contingent and complex and not nearly so top down. The national history of the ERL reveals a unique policy style, one that borrows and builds on previous policies. The ERL process began with a local experiment combined with years of scientific study led by national ecologists on ecosystem services. This bottom-up scientifically informed process is an integrated science and practice model. It produced a paradigmatic idea, which has changed the conceptualization of land use planning. Over time, the ERL concept has adjusted and changed. Its form combines a historical adaptive "guerilla policy style" (Heilmann and Perry 2011), with a more recent policy mechanism, of top-down binding environmental regulations. This apparent contradiction in the ERL's design as both dynamic combined with binding targets has produced an ERL process that is more adaptive, negotiated and

flexible than expected.

The shape and size of the ERL in both case study localities has been shaped by roughly similar dynamics. The political economy, existing levels of environmental quality, ongoing planning processes, and long-standing institutional dynamics were the main determinants of the shape and size of the ERL in each locality. I argue that the ERL outcome has been shaped primarily by interactions among existing institutions in the face of political, economic and moral incentives as understood by local officials.

This chapter proceeds as follows. First, I provide background on China's environmental problems, ecosystem based spatial planning and the ERL. Second, I provide the theoretical grounding for this dissertation. Third, I describe my research questions and methodology. Finally, I include a short introduction of the case study localities.

II. The Problem: Environmental Degradation, Climate Change, and Urbanization

China's ambitious efforts emerge from a serious environmental crisis. In 2017, 71% of cities did not meet international or national air quality standards (MEE 2017). Based on data from 2014, pollution levels contributed to 1.6 million deaths per year (Rohde and Muller 2015). Heavy metal soil pollution in industrial and agricultural regions across China impacts soil and groundwater quality, the quality of agricultural products, food security and public and environmental health (Yang et al. 2018; Lora-Wainwright 2013). Average per capita freshwater availability in China is only one-quarter of the world's average, and resources are further stressed by pollution, climate change and overuse as five of the seven major river basins are polluted (J. Liu et al. 2018). Over 60% of people living in cities experience water shortages and 300 million rural citizens lack access to safe drinking water (J. Liu and Yang 2012).

Development has led to the loss and fragmentation of ecosystems, especially along the coast (Güneralp, Perlstein, and Seto 2015). Between 2000 and 2010, China's total length of natural coastlines decreased by 14.1%, while the total length of constructed coastlines increased by 30% (Ouyang et al. 2016). Drainage and reclamation have left 79% of wetlands in poor condition (Zheng et al. 2012). Further inland, development continues to impact ecologically sensitive areas even with the increase in protected areas (Li 2012).

This has led to biodiversity loss. Many globally important ecosystems exist in China, including boreal and tropical forests, wetlands, grasslands, riparian zones, and marine ecosystems. The latest IUCN red list of China's biodiversity indicates that more than 10% of higher plants and more than 20% of vertebrates are threatened or have gone extinct (J. Liu et al. 2018). One reliable estimate is that 45% of China's ecosystems are at high or medium ecological risk (Xuegong Xu et al. 2015).

Drivers

China's ecosystems remain subject to ongoing degradation and loss of biodiversity (Zhao et al. 2015) due to land use/cover change (Song and Deng 2017), pollution (Liu 2018), mining (Jian Peng et al. 2015), infrastructure, wetland drainage (Zou et al. 2018), climate change and institutional failures (W. Xu et al. 2017). Existing efforts to protect ecosystems have received substantial financing, but have been largely ineffective (CCICED 2014).

Ecological degradation has been driven by industrialization and urbanization and its accompanying unbalanced and unregulated land use. In the past several decades, China has experienced rapid and drastic land use and cover change (Zhao et al. 2015). A substantial amount of natural land cover has been converted for residential and industrial development, roads, agricultural land, highways, railroads, and

airports. This is likely to continue as the latest plan calls for an urbanization rate (the percentage of persons living in urban areas) of 60% by 2020, leading to an increase of 100 million people living in cities in less than ten years (National New-type Urbanization Plan 2014-2020). To accomplish this, the urban land area in China is expected to increase by almost 400% between 2000 and 2030 (Güneralp and Seto 2013). The nearly 340,000 km^2 increase in urban land during this period will be the largest in the world (Güneralp, Perlstein, and Seto 2015). Unless planned appropriately, this could dramatically impact existing protected areas (Güneralp, Perlstein, and Seto 2015), influence ecosystem services and lead to increasing greenhouse gas emissions.

This rapid land conversion has been supported by institutional incentives which encourage local governments to lease land for development and promote land and resource-based development strategies. Land alters the revenue structure of local governments and also provides local officials an important instrument to intervene in the local economy. The institutional structure of the land transfer process also enables local governments to make significant profits. Rural land must be first converted to urban land in order to fully realize its market value. Such rural-to-urban land conversion is monopolized by the state. The compensation paid to rural residents for their land can be hundreds of times less than what is paid by private developers (Lichtenberg and Ding 2008).

Fiscal re-centralization also provides economic incentives for land-based growth. Under the tax sharing system introduced in 1994, subnational governments receive approximately half of all collected taxes but they account for approximately 80% of total budgetary government expenditures (Wong 2013). Local governments have significant economic incentives to sell land use rights and initiate urban construction projects. The revenues received from the sale of land use rights have become the most important source of extra-budgetary income for local governments (Man 2011). The result has been continuous pressure

on local governments to convert new land to high-intensity urban uses, especially housing units that can be sold for profit in China's new real estate market (Huang 2012).

Fragmented environmental management system with various types of protected areas and zoning rules have also contributed to continuing degradation. This system is characterized by a lack of coordination between ministries over land use and development planning and weak enforcement (He et al. 2018). China has various types of protected areas including national parks, nature reserves, forest parks, scenic spots, geological parks, wetland parks and drinking water conservation areas. These were managed by different ministries with different regulations and interests in conservation until 2017.

Issues that plague the different protected area systems are evident in the nature reserve system, which has jurisdiction over the largest protected area. As of 2014, there were 2,729 nature reserves which covered 15% of China's land surface (W. Xu et al. 2017). Nature reserves have been widely criticized for their placement, small size and management practices. Most reserves were chosen without consideration of broader conservation targets (H. Xu et al. 2018). Recent analysis suggests that nature reserves only contribute to 4.3–7.8% of the four primary ecosystem services (i.e., water retention, soil retention, sandstorm prevention, and carbon sequestration) (W. Xu et al. 2017). Additionally, reserve boundaries are frequently adjusted to permit continued construction (Y. Bai et al. 2016).

III. Solution: Ecosystem-Service Based Spatial Planning

China's new long-term national development strategy aspires to address many of these issues as the country aims to be an "ecological civilization" (The 18th National Congress of the Communist Party of China 2012). This is China's vision for its future and it comes with a plan and the finances to implement it. Ecological civilization goals include optimizing spatial development, using resources efficiently, improving

environmental quality and establishing regulatory systems (State Council 2015). This comprehensive view of environmental governance demonstrates how China is taking a multi-pronged approach to address the various drivers of environmental problems. For example, the plan tackles water issues through improving industrial and agricultural water efficiency, overall water quality, reduction of specific pollutants and maintaining forests and soil quality. The table below lists all the targets included in the plan. It also demonstrates the reliance on top-down quantifiable environmental regulations as the primary policy tool. To achieve this these targets by 2020, China is pursuing ambitious changes outlined in the 13th Five-Year Plan (2016–2020). These will involve an estimated investment of 10 trillion RMB (US$1.5 trillion) in environmental conservation (US-China Economic and Security Review Commission 2017).

A primary component in the ecological civilization targets is improving spatial development. International and more recently Chinese scholars have suggested that spatial planning should be used to spur climate change mitigation (Lü et al. 2011), encourage ecosystem-based adaptation (Scarano 2017), direct development away from biodiversity hot spots (Güneralp, Perlstein, and Seto 2015), reduce water pollution (Mitchell 2005), and promote more sustainable development (Silberstein and Maser 2013).

China has created new zoning systems to address uneven development and conservation in land use planning. Ecological Civilization targets in this area focus on three aspects: implementing major area function zones, enforcing the agricultural red line and creating the ERL. This is the first section in the table below and the focus of the dissertation. The agricultural red line sets an overall limit for agricultural land for the country at 120 ha or 463,322 square miles across the country. It was created as a food security measure. The Major Area Function Zones and the ERL are described in the next section.

Ecological Civilization Targets by 2020	
Targets	**Contents**
Further optimize spatial development	• Major Area Function Zones effectively implemented • ERLs delineated and enforced • Agricultural red line enforced
Utilize resources more efficiently	• CO_2/GDP down by 40-45% over 2005 level • Energy intensity further reduced • Resource productivity greatly increased • Total water consumption under 670 billion cubic meters • Water consumption/10,000 RMB of industrial added value under 65 cubic meters • Irrigation efficiency above 0.55 • Non-fossil energy reaching approximately 15% of primary energy consumption
Improve the overall quality of the ecological environment	• Total discharge of SO_2, NO_x, chemical oxygen demand and ammonia nitrogen further decline • Improve air and water quality in key watersheds and offshore areas • More than 80% of the key rivers/lakes/water function areas meet water quality standards • Safety and security of drinking water continuously improved • Overall soil quality stable • Environmental risks effectively controlled • Forest coverage rate over 23% • Grassland vegetation coverage 56% • Minimum wetland areas at 533,333 sq. kilometers • More than 50% of the reclaimable desert reclaimed • At least 35% of the natural shorelines preserved • Speed of biodiversity loss under control and stability of nation-wide ecosystems clearly enhanced
Establish major regulatory systems	• Develop an ecological civilization system characterized by "prevention at source, control over pollution process, compensation for damages, and holding those responsible to account" • Definitive achievements in development critical systems such as the ownership and use of natural assets, ERLs, compensation for ecological protection, and ecological and environmental protection management

Source: (State Council 2015)

Major Area Function Zones

The State Council approved the "National Plan for Major Area Function Zones" in 2010. The plan, which aims to support sustainable development, divides China's land area into four categories: optimized,

major, restricted and prohibited areas. These categories are based on regional resources and environmental carrying capacity, existing development density and development potential (State Council of China 2010). Optimized development areas are the areas where land development density is already high and the carrying capacity of resources and environment has begun to weaken. Major development areas are areas with strong resource and environmental carrying capacity and good economic and population agglomeration conditions. Restricted development areas are areas with weak resource carrying capacity, large-scale agglomeration economies and poor population conditions and related to national or larger regional ecological security. Prohibited development areas are various nature reserve areas established according to the law (State Council 2015).

Optimized and major development area are urbanized areas. Restricted and prohibited areas are agricultural and ecological areas. Prohibited areas, which encompass 12.5% of China's land include national nature reserves, world cultural heritage reserves, national scenic areas, national forest parks and national geoparks. ERLs encompass all the development prohibited zones. Development restricted areas cover 40.2% of China's land and only allow limited large-scale and intensive resource extraction, urbanization, and industrial development. It includes 25 regions with high potential for ecosystem services, including biodiversity conservation, fresh water sources, soil and nutrient conservation, and carbon sequestration.

An analysis has found that there are significant overlaps between these various land categories (Lü et al. 2013). The total percentage of land declared for protection either as development prohibited areas, development restricted areas, agriculture and forest protection areas, and ecological function zones combined, reaches 122% of China's land (Lü et al. 2013). This does not include land for construction and other uses. This impossible figure brings forward many questions around how land use planning works in

practice. It also demonstrates how land has been classified in multiple ways over time by different ministries and across different policies. This overlapping of classifications is one issue that the ERL seeks to address and will be discussed in the next section. Additionally, the existence of multiple types of protected areas and uneven implementation motivates my case study approach in order to understand how national policies are translated at the local level.

Ecological Conservation Red Lines

Ecological conservation and restoration are the two main approaches used throughout the world to combat ecological degradation by reducing human use pressures on natural ecosystems or by facilitating ecosystem recovery from degradation (Benayas et al. 2009). Recently, these efforts have also been widely promoted as forms of climate planning, encompassing both ecosystem-based adaptation planning to address the impacts of climate change and the building of resilience of societies and ecosystems while also mitigating climate change (Scarano 2017).

The ERL is an attempt to define protected areas in a more systematic way with a cohesive management system. The central objective of the ERL is similar to earlier efforts to protect important areas. Although the definition of protected areas by the International Union for Conservation of Nature includes explicit reference to conserving "nature with associated ecosystem services" (2008), biodiversity has historically been the dominant goal for protected area design, implementation, and management (Durán et al. 2013). In China, the ERL policy appears to take a wider variety of ecosystem services into consideration. It is characterized not only by its sheer scale but also by its complexity and cohesion (Xibao Xu et al. 2018). For example, in Sichuan, the ERL covers 30.45% of the province's total area, encompassing various ecosystem services and is integrated with the main functional area planning, ecological function zoning, national land planning, urban and rural planning, and the farmland protection policy (Government of

Sichuan Province 2018). This has placed the ERL within the province's broader land and development planning.

ERLs "refer to the areas with special important ecological functions…that must be strictly protected. It is the bottom line and lifeline for safeguarding and maintaining national ecological security, ecosystem services and other ecologically sensitive and vulnerable areas" (MEP and NDRC 2017). Protecting ERL areas has been incorporated into China's newly revised Environmental Protection Law (MEP 2014), and National Security Law (Standing Committee NPC 2015b). It is one part of the "three lines" program – ecological red lines, minimum environmental quality baselines, and upper resource usage limits - which are being used to move China towards comprehensive environment management. This combined system is an attempt to address to optimize land use, improve environmental quality and reduce overall resource in an integrated way.

Additionally, the central government is raising the level of importance of the ERL by integrating red line targets into the cadre evaluation system, which the Chinese government uses to assess officials' performance and promotion opportunities. In order to assess the ERL areas and local officials implementation efforts, China is investing 286 million RMB (US$42.2 million) to build a national monitoring platform that combines satellite remote sensing and local ecosystem monitoring stations (Qianlong 2018). It is slated to be completed by 2020 (B. Jiang et al. 2019). These are strong policy signals and enforcement mechanisms that have not been applied to any previous efforts to support conservation planning.

Technical guidelines, released by the Ministry of Environmental Protection (2015) and then subsequently released along with the National Development and Reform Commission (2017), provide principles, technical processes and methodology for delineating ERLs. These guidelines translate the more general

State Council policy (2017) into an actionable policy. Key criteria include maintaining ecological functions like water conservation, biodiversity conservation, soil conservation; ecologically and environmentally sensitive and fragile areas such as areas of water and soil loss, rocky desertification and existing protected areas (MEP and NDRC 2017). The process to develop the map is required to include a scientific assessment of ecosystem services, ecological sensitivity and vulnerability. This assessment is then overlaid on top of existing protected areas. Thus, ERLs should encompass both national and provincial protected areas and other areas that require strict protection (MEP and NDRC 2017).

It has become apparent, however, that the ERL process faces challenges. Chinese ecologists have criticized the ERL mapping process as it has evolved thus far (Xibao Xu et al. 2018; Y. Bai et al. 2016; 2018; B. Jiang et al. 2019). A recent article by Xu et al. (2018) which included an alternative version of the Yangtze River Belt ERL, points to the challenges facing ERL implementation: the lack of science-informed criteria for selecting key indicators, unclear methods for classification of various ERL areas, spatial mismatch of ERLs in cross-border regions, and ineffective coordination between the ERL policy and existing ecological conservation policies (Xibao Xu et al. 2018). Others have critiqued ERLs for not taking a regional approach, and therefore skirting long standing interjurisdictional issues that limit the ability of compromised ecosystems to rebound (Eaton and Kostka 2018). Ultimately, there is concern that current approaches may lead to ecological zones based on management convenience rather than ecological need. Additionally, there are significant questions being raised about long-term commitments to protecting ERL areas in the future given China's past conservation history. These critiques all have significant implications for the implementation of red lines and their ability to address their overall goals while also providing indications of the gaps between theory and practice.

IV. Theoretical Framework

This dissertation project lies at the intersection of environmental politics, China and comparative political science and science and technology studies. It locates China's efforts to implement ecological red lines within three wider analytical questions addressed within these bodies of literature: (1) how does institutional change happen? (2) how does scale and multi-scalar interaction affect environmental decision-making? and (3) what is the role of knowledge in policy-making? Much of the literature on these questions has focused on Western democracies. The China environmental politics literature has been dominated by political scientists who have neglected the role of science and knowledge in environmental policy. This project attempts to bridge these gaps and use Chinese cases as a way to begin to build theory on institutional change that can be applied beyond its borders.

Green Transformations and Institutional Change in China

A common focus of improved governance for sustainability is institutional reform, understood as modifications in the rules, strategies and norms that guide individual and organizational behavior (Ostrom 2005). These changes can be addressed formally (e.g. laws, policies, regulations) or informally (e.g. norms, incentives, strategies, codes of conduct). Institutional reform is an important driver for promoting more sustainable pathways for development (Scoones 2016).

China is currently attempting to remake its political economy as it seeks to become an "ecological civilization." While enormous change has occurred in China, the mechanisms for promoting change in post-Mao China are still not well understood given the lack of transparency in the Chinese political sphere (Lieberthal and Lampton 1992). The literature on sustainable transitions, social-environmental change and shifts in the Chinese political economy point to some ways in which the implementation of ERLs could

succeed and the key actors who would need to involved. What is learned from China's effort to implement ERLs could have implications for even wider transitions.

The importance of political economic approaches has been largely ignored in debates about sustainability and development. Instead, the focus in many parts of the world has been on technical and economic tools (Scoones 2016). Political ecologists, Michael Watts and Nancy Peluso (2013) suggest that understanding social and environmental change requires examining three overlapping "regimes." Each theorizes power differently, and each suggests the operation of different political dynamics. These regimes are truth (knowledge, framing, risk), rule (who controls what and through what forms of governance) and accumulation (who gets what, how it is distributed, i.e. political economy). The politics of knowledge, interests, and the wider political economy context should be central to sustainability thinking (Scoones 2016) and are at the heart of my approach to the study of ERLs in China.

Building on typologies of political and environmental change developed by political scientists (e.g. Clapp and Dauvergne 2005), as well as the politics of green transformations from social anthropologists and development scholars, (Scoones, Leach, and Newell 2015), leads to the creation of various narratives of transformation based on the roles of the state, citizens, technology and markets. These narratives suggest that there are diverse pathways China could be pursuing in its effort to become a more ecological civilization. Additionally, they suggest that how sustainable development is pursued involves a normative struggle in which political and moral choices are central. This drives some of the central questions explored in this dissertation. Why has China pursued this path? What are the implications for the processes, institutions, instruments deployed? Who is involved and on what terms? What are the political and moral choices embedded in the ERL as policy tools?

Institutional Change in China

While much work on institutional change in Western countries by political scientists has focused on what is called punctuated equilibrium (Baumgartner and Jones 2010), where long periods of institutional stasis are interrupted by exogenous shocks, China appears to be following a somewhat different model of gradual endogenous change (Naughton 1996; Lieberthal and Lampton 1992). Streeck and Thelen (2005), referencing liberal capitalist societies, point to four forms of institutional change that follow this gradual and incremental path: (1) **displacement** - the removal of existing rules and the introduction of new ones; (2) **layering** - the introduction of new rules on top of or along existing ones; (3) **drift** - the changed impact of existing rules due to shifts in the environment and (4) **conversion** - the changed enactment of existing rules due to their strategic development. This framework provides a lens through which to examine the process through which the ERL is evolving. I argue that the ERL is a form of layering as it is competing with existing land use rules.

The China political science literature theorizes different trajectories and processes of change (and stability). This literature is predominately state-centered, especially around the role of the central government and the Chinese Communist Party. It points primarily to structural factors as explanatory variables. A dominant theory -- "fragmented authoritarianism" -- presents policymaking as a process of incremental change shaped by bureaucratic bargaining and consensus building as the vertical bureaucracy interacts with horizontal levels of state administration (Lieberthal and Lampton 1992). This model assumes that policy created by the central government is flexible enough to accommodate the organizational and political goals of vertical agencies and provinces, leaving space for inter-ministerial and central-local conflicts to work themselves out while subnational officials alter national priorities to fit local conditions. This dynamic is necessarily protracted (shaped over a long time), disjointed (uncoordinated as decisions involve different and loosely coordinated agencies) and incremental (change is mostly gradual). The ERL

process includes these characteristics.

A smaller body of literature has focused on the role of subnational governments in China as key to institutional change. For example, the emergence of new economic actors, such as local businesses and local government agencies is the result of institutional change (Nee and Lian 1994) that occurred without formal national legislation (Krug and Hendrischke 2008). Chung Jae Ho (2000) explains local variation around provincial responses to decollectivization of agriculture, demonstrating that while some provinces followed central policy, others were "pioneers" that acted before central policy mandates and some were characterized by active resistance. This challenges the official narrative regarding decollectivization as a local experiment explicitly supported by the national government and then uniformly spread. This literature demonstrates that there may be more agency at the local level than expected. In fact, Zhejiang appears to be an ERL pioneer.

Other scholars have pointed to the ways in which Chinese policymaking is uniquely characterized by continuous change, experimentation and adjustment (Heilmann 2011; Qian 2003). Heilmann and Perry (2011) term this a "guerilla policy style," which sources China's political resilience to its Maoist revolutionary roots. This runs counter to the narrative that China's rigid authoritarian-bureaucratic environment is incapable of innovation.

This model includes several characteristics apparent in the ERL policy process including that new methods are derived from practical experience in concrete settings. The adoption of ERLs provides support for this perspective as ERLs began as a solution to a water pollution in Zhejiang Province. The ERL, therefore, provides a means to examine the degree to which China's institutional system allows for a more bottom-up process than would normally be predicted as ideas emerge from outside the central government.

This practice-based approach, which is called "experimentation under hierarchy," is used to explain how the central government encourages local officials to innovate, and then selectively integrates local experience back into national policy formulation, providing a means for bottom-up change in a centralized system (Heilmann 2008). According to Heilmann (2008), it is through this system that China has been able to adapt its policies and institutions to address the challenges of economic change while maintaining stability. This work disrupts the official narrative of centralized policymaking which contends that change emerges only from the top.

While the debate between top-down and bottom-up reform continues, it seems most useful to consider the dynamic interaction between scales, and not allow either the local or the national level to lose agency. Post-Mao China has lived through cycles of centralization and decentralization. China is currently undergoing a new round of centralization under Xi Jinping (Kostka and Zhang 2018). By reducing local government power, sending thousands of local officials to prison for non-compliance and introducing new monitoring and sanctioning practices, Xi has strengthened central government power (Donaldson 2016). This has led to increased compliance of local directives.

This centralization occurred in the environmental sector as well. There has been an introduction of stricter national environmental laws and sanctions, the reliance on nationwide central enforcement campaigns, the introduction of a centralized verification program of local emission data and the use of binding environmental targets for local leaders (Kostka and Nahm 2017). This dissertation is focused on this last component, binding targets. This is a type of top-down command and control regulation and now a dominant environmental policy tool. The ERL is one of these targets.

What are these binding targets? While regulations in the United States are supported through law, and are often consistent across the country, in China this is not the case. Rather, mandatory regulations are enforced through the cadre evaluation system, which is how local official's promotion decisions are determined (A. L. Wang 2013). Targets are determined by the national government and then allocated to the provinces, who distribute targets to localities (Jin 2017). For example, the ERL target was set at 35% for the whole country and all provinces were expected to include 35% of their land into their ERL plans.

This target responsibility system was first started during the 11th Five Year Plan (2006-2010). Therefore, this is a relatively new environmental regulation tool and was created to address lagging enforcement at the local level. A recent analysis has found that local governments reinforced political discourses on environmental protection after 2006 when environmental targets were first incorporated into the cadre evaluation system (C. Shi, Shi, and Guo 2019). But, how targets function in practice and whether it is an effective method for improving implementation is still underexplored (Kostka 2016).

The use of a top-down binding environmental regulation in this cycle of centralization would lead us to expect little variation across provinces and localities. Yet, red line planning clearly exhibits substantial variation and the capacity to integrate local needs. How could this be happening within this form of top-down regulation, especially in a period of increasing centralization? This is one of the driving questions of this project.

Scale in Environmental Politics

The environmental governance literature emphasizes the importance of scale since the nature of both problems and solutions is spatially, socio-politically, and temporally multi-scalar (Lemos and Agrawal 2006). Climate change, biodiversity loss and pollution, droughts and floods all cross traditional

jurisdictions, stretching from local to global levels (Dietz, Ostrom, and Stern 2003). The complications that scale brings to environmental governance are well documented (eg. Ostrom 1990; Young 2002; Folke et al. 2007). Cash and Moser (2000) present three primary challenges of scale for social–ecological system governance: 1) matching scales of bio-geophysical systems with scales of management systems (an institutional fit problem), 2) avoiding scale discordance (matching the scale of ecological assessment with the scale of management), and 3) accounting for cross-scale dynamics (understanding the linkages between scales, and how they affect decision-making information flows, and the integration of information into the decision-making process). My research demonstrates how the ERL assessment and mapping process is faced with all these challenges.

Conversations about scale have been complicated by work concerned with the political and social construction of scales (Bulkeley 2005). This work shifts the focus away from ecological questions to how different actors and power relations define, contest, and reconstruct the scale by which a problem is understood and managed (Newig and Moss 2017). This calls for an analysis of the politics of scale and examining how the ERL is framed across and within the national, provincial and local level.

Centralization v. Decentralization

A fierce debate within the environmental governance literature in western democracies centers on the proper division of responsibility between central and local governments within democracies. Who should have final decision-making responsibility? Decentralization theorists assert that local governments are better environmental stewards because they have better access to information and local knowledge, are more representative and responsive to local needs and are more effective and innovative than the national government (e.g. (Ribot 2002). Practically, a local focus seems to have led to better outcomes across environmental problems including forestry, fisheries, and water and air pollution (Ostrom 1990; Agrawal

2010). Other scholars have advocated central control to stop problems of leakage and regulatory differences leading to a "race to the bottom" (Wilson 1996, Oates 2001).

The China environmental governance literature from both Western and Chinese scholars, however, has largely blamed local implementation for environmental degradation while claiming that the central government has produced well-structured environmental laws and regulations. Within these analyses is an implicit assumption that the environment is more effectively governed by the center. Some work has pointed to central-local dynamics such as lack of the right incentives (Economy 2010), perverse incentive structures for local officials (Ran 2013), as well as the general weakness in state capacity or political will (Eaton and Kostka 2017). This debate, however, has largely maintained a binary choice between the central government and everything below it (Shin 2017).

There is evidence that the central-local dichotomy simplifies a much more complicated story. The central government may prefer to shift the blame to the localities, encouraging its own legitimacy, even though it is complicit in the failure of local levels (Ran 2017). Recent work has shown that there are significant areas of overlapping interests and similar patterns of behavior at the central and local level calling for a rethinking of existing assumptions in the literature (Kostka and Nahm 2017). For example, both the central government and municipal governments selectively implement environmental regulations (Kostka and Nahm 2017). Yet, despite important advances in research on central–local relations, there is still a lack of empirical work explaining how the role, interests and interactions of agencies at different government levels shape environmental governance outcomes in China (Kostka and Nahm 2017). Drawing on this body of work, I present a multi-scale analysis of the dynamic interconnections among central, provincial and city/county scales.

Role of Scientific Knowledge

Although science is often considered an objective enterprise and is accepted as a simple input into policymaking, I draw on recent work in anthropology and science and technology studies to note the dynamic relationship between science and policy. Jasanoff coined the term co-production to demonstrate how science and society are embedded systems that form and inform each other (2004). These literatures investigate how knowledge about the environment is produced and deployed, along with its implications for governance (Beck et al. 2016). This literature is largely based on work from Western democracies and has rarely been applied in China (see (Greenhalgh and Zhang 2019) for a notable exception), especially within environmental policies.

Since the death of Mao, China has embraced science and technology as key to its development. Deng Xiaoping, who lead China toward market-based reforms famously coined the slogan, "Science and Technology are the First Productive Force" and placed science and technology at the heart of his modernization project (Simon 1989). Following in his footsteps, the former President and leader of the Chinese Communist Party, Hu Jintao developed the "Scientific Approach of Development," which was adopted as a theoretical guidance for the Chinese Communist Party (Xinhua 2012) and brought environmental protection into political discourses (C. Shi, Shi, and Guo 2019). These concepts have led to a unique vision of how science and technology ought to affect the formation of policy. Experts and expertise form essential parts of the policy process (C. Cao 2004). The ERL is no exception. The concept, methodology and monitoring included in the ERL process were developed by scientists. The national red line map that preceded the policy was conceived as a scientific project lead by the Chinese Academy of Science. This makes understanding the role of scientists within the policy process an essential component in my analysis.

Drawing on the concept of "policy problematizations," how science defines the "problem" to be addressed, its optimal solutions, and the costs and benefits attributed to it (Greenhalgh 2008), this project focuses on the process through which the ERL came to be, how ecologists and policymakers framed the ERL and what problems it seeks to address. Institutions are problem driven. Their perception of a problem therefore shapes their policy agenda and policy process from problem definitions to decisions about suitable solutions (Young 2002). Framings of problems and solutions, as well as the discourses and narratives they trigger, become important components of policy analysis (Dryzek 2013). Framing refers to the principles and assumptions underlying a political debate (Forsyth 2002) and is regarded as a social process, not altogether determined by the objective characteristics of a problem (Hajer 1995).

Scientific knowledge has played an important role in the development of ERLs. The first principle of a red line is the "scientific principle" which calls for red line areas to be defined according "to the importance of ecosystem service function and the sensitivity of the ecological environment" (Ministry of Environmental Protection and National Development and Reform Commission 2017). This requires understanding what Gieryn (1999) calls "epistemic authority," the legitimate power to define, describe and explain the bounded domains of reality, within environmental politics while also recognizing that this is negotiated terrain. Greenhalgh (2008) demonstrates how various forms of knowledge influence policy processes, as scientific evidence around China's One Child Policy is ultimately a political enterprise influenced by three groups of scientists. The researchers' epistemological grounding and background influenced the type of research they conducted and the policy prescriptions that followed. Understanding the actors who are creating policy-oriented knowledge is important. Blaikie and Muldavin (2004) have argued that in China "the state and 'its' science wield overwhelming authority in creating a singular environmental 'truth,' and excludes from legitimate discourse other types of knowledge about the environment."

Scott (1998) reveals the ways in which modern statecraft utilizes processes of simplification like maps and cadastral surveys to make complex issues legible. The red line is a governance tool which defines areas for development and conservation. Classifications have power as "the architecture of classification schemes is simultaneously a moral and an informatic one," privileging some and not others (2000). As Bowker and Star (2000) state, "whether or not a region is classified as ecologically important, whether another is zoned industrial or residential come to bear significantly on economic decisions" and have material effects. The delineation of land from one category to another will have impacts on social and environmental outcomes as there is evidence that this has already been the case in previous programs (e.g. Yeh 2009). The implications of ERL maps on humans and the environment motivate the political and normative questions within this project.

V. Research questions

Drawing on this literature, this dissertation examines the history, form and development of the ERL at the national level and within two localities in hopes of addressing two puzzles:

1. How and why did China, known in the past for its weak environmental performance and widespread environmental degradation, create the world's most comprehensive ecosystem-based land planning strategy?

2. How and why would China which is applying top-down command and control environmental regulation, and is increasingly politically centralized, be able to support local variation?

VI. Methodology

This study draws on the analytical perspectives discussed above to consider the development of the ERL at different scales and in different localities from the perspective of scientists and government officials. It is a multi-scale comparative case study drawing on multiple qualitative research and analysis methods (Singleton and Straits 2017; Yin 2009). The methods and data sources include semi-structured interviews, participant observation, workshop and conference presentations, policy and planning documents, maps, speeches, grey literature and academic and newspaper articles. The multiple sources of data allow me to triangulate analytical observations and strengthen reliability and internal validity. (I discuss the rationale for these choices below.)

Data was collected over 13 months in Summer 2016 and September 2017-August 2018. Interviews were conducted in Beijing, Haikou, Changsha, Anhua, Nanjing, Jiaxing, Yantai, Yinchuan, Hawaii and Paris. The data collected in Hunan and Shandong were collected with researchers from the China Land Planning and Survey Institute (CLPSI) under the Ministry of Natural Resources. In Jiaxing, interviews were conducted jointly with a former city government official. Most other interviews were conducted alone.

The selection of interviewees was a purposive sampling of the main government officials involved in the development of the ERL idea, government and academic researchers and international and national non-government actors. This was expanded through snowball sampling to include a wider variety of actors involved in environmental governance in China. Given my limited access to Chinese government officials, these interviews provided context to understand the other data collected. In total, 140 formal and informal interviews were conducted. The majority of government official interviews were conducted over two hours with multiple officials from the same bureau at one time. Other formal interviews averaged

one hour and informal interviews around 30 minutes, often as multiple short conversations. (For a list of interviews by institutional grouping and case, see the appendix.)

Due to the nature of China's political situation, taping interviews was not possible. In Hunan, in order to ensure accuracy, notes were taken by 2-4 members of the larger team and then discussed and combined the same day. In most other instances, interviews were conducted in English or Mandarin. In some instances, interviewees were contacted later and provided clarification and answers to further questions. All interviews were conducted anonymously and identifying data was not collected.

My coding of the interviews involved a hybrid modified grounded theory approach. I began with a set of codes derived from the literature, then modified the codes based on themes that emerged from the interviews (Charmaz 2006). I then developed broader analytical categories, drawing on the methodologies proposed by Charmaz (2006).

I engaged in participant observation of government science-making as a member of the China Land Planning and Survey Institute, a Chinese national government research group from November 2017-July 2018. The group was developing a technical platform for creating ERL maps and producing new experimental maps for two cities and one county in order to improve the technical red line mapping process. I did three field study trips with the team and attended group meetings and workshops in Beijing regarding their ERL technical research project. This gave me access to local officials and documents that otherwise would have been impossible to collect. This includes meals, site visits and car rides with local officials which provided an opportunity to triangulate information from more formal interviews. It also provided insight into the role of researchers within the national government, their perceptions and understandings of the data we collected, and an in-depth understanding of China's spatial planning

system from experts involved over a long period of time.

Additionally, I conduced participant observation and formal and informal interviews at various other meetings, workshops, conferences and lectures. (For a full list, see the appendix.) These sites provided access to a range of people in a casual setting where questions were welcomed. Many of these conferences included study trips to different regions in China allowing for a better understanding of Chinese environmental policy, the perspectives of various actors and implementation on the ground.

Finally, various types of written documents were collected and analyzed. The Chinese government is "ruled by documents" (Chan and Gao 2008) and official documents are a primary method to understand policy dynamics. Therefore, all available ERL policy and planning documents and maps were collected at the national, provincial and local level. Conference and workshop powerpoint presentations were also collected when possible for both meetings that I attended and other related meetings that occurred before I arrived or was unable to attend. Related policy documents were gathered from interviewees and on-line including development plans and environmental plans. In order to understand the perspective of red line researchers and national officials, I reviewed relevant speeches, grey literature, academic and newspaper articles from 2008-2018. This provided critical sources of information about their ideas beyond what could be collected or understood through an interview.

China, especially at this moment, presents a range of obstacles to conducting qualitative research. There are limited data available on-line, requiring interviewing officials who are directly involved in the policy process. There is no incentive for anyone to be forthcoming, especially with foreign strangers. The environment also limits the potential questions that can be asked and that will be answered. This is true for people across all sectors of society as the climate for research was particularly difficult given the

political situation during 2017-18.

These challenges made connections to various institutions and invitations to meetings necessary to collect any data. During the second round of fieldwork, I was hosted by three institutions, Peking University School of Environmental Science and Engineering, Tsinghua University School of Public Policy and the China Land Planning and Survey Institute. I also relied on my US academic networks and networks from previous education, work and fieldwork in China since 2004. These connections were essential to overcome challenges in building trust since interviewees were familiar with me or my hosts often from long standing relationships. These constraints influenced my research findings in shaping the focus of the research, case selection and interview protocol. I was unable to understand the entire ERL policy process across each scale over time. Given these restrictions, and the continually changing dynamics in China, this research represents a snapshot in time in a large and complex country.

Case Selection Rationale

The aim of case study research is to "expand and generalize theories" rather than provide explanations of causality (Yin 2009). A case study approach is appropriate for this project given the lack of available data and theory and given that my objective is theory building. Detailed case study analysis offers a way to weight the many factors that bear on the ERL process, and a way to be sensitive to the geographic, historical, social and institutional factors that frame the development of environmental policy in China.

Cases were chosen using purposive sampling methods that includes a representative sample along with variations on the dimensions of theoretical interest (Seawright and Gerring 2008). These selected cases represent embedded cases that allow for both within-case and between-case comparison (Yin 2009). The sampling frame was all provinces and provincial level cities with red line maps (n=15).

Local cases in two provinces, Anhua County, Hunan and Jiaxing City, Zhejiang were chosen as diverse cases. At the time of their selection in Fall 2017, no ERL maps were publicly available. This made it impossible to choose based on ERL criteria. Rather, cases were chosen to understand connections between scales and the role of the science in policymaking given that these were variables of interest. Additionally, these cases are representative of variables that have been shown to influence local environmental policy decision-making: level of urbanization, GDP and geographic location (Kitagawa 2017). Anhua is a poor, western, rural county and Jiaxing is a rich, coastal, urban center.

Case Comparison

	Population	Urbanization	GDP	Ecology	ERL	Technical Capacity
Anhua, Hunan	912,100	27.46%	22.16 million RMB	Mountains Forests	31.49%	Low
Jiaxing, Zhejiang	4,501,657	59.2% (2014)	435.524 billion RMB	Wetlands Rivers	3.95%	High

The county and city level are the appropriate scale for comparison if the goal is to understand the detailed process of developing the red line maps and implementation plans. For the in-case comparison, different departments within the local government were consulted in the process of developing the maps, allowing for a better understanding of the various interests within the bureaucracy and providing a means to triangulate information about the mapping process. Additionally, localities provided data on opportunities and constraints as the ERL policy moves forward. In the future, local governments will be responsible for monitoring and implementation, and for integrating their ERL into local economic and social development and land use planning.

In order to analyze the two cases, a case analysis framework was adapted from Watts and Peluso (2013) and Scoones (2016). This has focused my analysis on three areas, (1) the mapping process, (2) political economy and ecology and (3) knowledge and interests.

Case Analysis Framework

	Components
ERL Mapping Process	Who are the actors? What is their role? At what scale? What is the role of science?
Political Economy/Ecology	How does the red line interact with historical and existing institutions, policy priorities and ecology?
Knowledge/Interests	How are the ERL goals and science understood? What is the role of the ERL as understood by different parts of the government?

VII. Introduction to the Case Study Areas

Anhua County, Hunan

Anhua County is located in central Hunan Province under the administration of the city of Yiyang. Hunan province is marked in red on the map below and Anhua is marked in yellow. It is the third largest county in the province, larger than Rhode Island. It is composed of five townships and 18 towns. The population with a household registration in the county is 1.04 million. There is a resident population of 862,600 (Anhua County Government n.d.). It is a primarily rural county with an urbanization rate (calculated as the percentage of residents in urban areas) of 27.46% (Anhua County Government n.d.). The county is listed as a national poverty county with high levels of income inequality. Anhua's primary industries are tea, medicinal products, tourism, clean energy and lithium battery recycling.

Source: Wikimedia Foundation

The county is considered to be an area with plentiful resources. The forested area covers 5.36 million mu (1379 square miles) with forests covering 76.51% of the county land (Anhua County Government n.d.). One of the last South China tiger families was sited and captured in Anhua in 1984 (Tilson, Traylor-Holzer, and Jiang 1997). Three river systems cross the county. The main environmental issues are water and soil pollution due to small- and large-scale industry such as pig and poultry farming and mining. The town has also experienced earthquakes, landslides and in 2017 there were several rounds of severe floods (Government of Anhua 2017).

Jiaxing, Zhejiang

Jiaxing is a second-tier city located in northeast Zhejiang Province. It is highlighted in red on the map to the left. Jiaxing city is one of the cities in the southern wing of the Yangtze River Delta and the Taihu Lake basin areas. Jiaxing has jurisdiction over 2 municipal districts (Nanhu District, Xiuzhou District), 3 county-level cities (Haining, Pinghu and Tongxiang) and 2 counties (Jiashan County and Haiyan County). In 2015, the population was 4,585,000. According to

Source: Wikimedia Foundation

government statistics, GDP reached 435.524 billion RMB (US$63.564 billion) in 2018 with 7.8% growth. According to the Jiaxing Statistics Bureau, for the six months that ended 30 June 2017, Jiaxing City's GDP was 190.4 billion RMB (US$27.788 billion) and it was ranked the ninth in GDP growth rate among 16 cities in the Yangtze River Delta (Jiaxing Statistics Bureau 2017).

Jiaxing is famous for its waterways. It has 13,802 km of river channels and 145 lakes whose total surface water area is 46.29 km2 (Shao 2010). There has also been significant agricultural non-point pollution (Xie et al., 2007, Wang et al., 2007), rural industrial pollution (Tao and Jiang, 2005, Wang et al., 2008) and pollution transported into Jiaxing rivers from Jiangsu province and the municipalities of Huzhou and Hangzhou (He and Zhang 2006). Water pollution has been a focus of government efforts and has led to the subsequent closing of factories and pig farms.

Chapter 2

Combining Science and Practice: Origins and Institutionalization

Every aspect of environmental issues today mirrors an aspect of the Chinese society in general. And every solution to it is an experiment to reform China.

– Pan Yue, Former Deputy Minister, China's Ministry of Ecology and Environment

I. Introduction

The history of the ERL is an intertwined story of science and policy that emerges at a time of renewed attention to China's environmental crisis. The ERL is grounded in international and national scientific ideas that interact within China's governance system. The combination places ecologists and ecology at the intersection of policymaking, rounds of local experimentation and a central government that relies on target-based policy instruments to ensure local compliance with national directives. It is in this unique interaction between science, policy and practice that the ERL was born. This chapter traces the evolution of the ERL from 2000-2018, emphasizing how the concept has evolved and become institutionalized over time. In doing so, it asks: Why did China decide to use ecosystem services as a basis for land use planning? How did this objective ultimately take the form of the ERL? And, finally, what was gained and lost along the way?

Drawing on Greenhalgh's (2008) approach, this analysis understands policies as products of particular

histories and centers on the interaction of science and policy as a process of "co-production" (Jasanoff 2004): science informs policy and policy informs science. In China, this is more the case than in democracies where the idea of co-production emerged, in part because of the long-standing linkages between science and policy and, in part, because of the nature of science-making within China (Greenhalgh and Zhang 2019). For example, all scientific organizations are a part of the government and top scientists are members of the Party. This means that their work is tied by design directly to policymakers and their needs.

There are various explanations for how and why science influences policy decisions. One theory focuses on the type of knowledge involved. For example, Cash et al. (2003) identify salience, credibility, and legitimacy of knowledge as a prelude to scientific knowledge influencing practice. Others have focused on the way scientists and policymakers are connected through interactions like joint-fact finding. It is the engagement of scientists and policymakers in joint activities that ensures knowledge is perceived as legitimate (Susskind, Field, and Smith 2016). Haas. et al. (1993) take an institutionalist perspective. They point to the importance of institutional capacity to monitor environmental conditions and enforce rules as critical to effective science-based policies.

While all of these explanations have some merit in this case, none completely explain the interaction between science and policy that occurred during the emergence of the ERL. Rather applying an epistemic approach, I argue that the ERL development process was characterized by bottom up experimentation and what I term "scientific lock-in," whereby the scientific process produced a legacy that resonates throughout the lifetime of a policy. In particular, the ecological science behind the ERL was formed and entrenched as the dominant paradigm before the ERL had taken shape leading to its continued use even when the ecosystem service science could no longer be adequately captured with a more simplified policy

tool. This concept places ecologists and their scientific assessments as key to understanding how the ERL was formed, sustained and has adapted over time demonstrating "guerilla policy style" in action.

"Scientific lock-in" builds on Pierson (2000b) who has demonstrated how lock-in occurs when a policy intervention contains a logic that gives it durability. The idea is premised on the concept that policymaking is contingent and impacted by the historical timing of policy-relevant events (Pierson 2000a). The order of events leads components to be become locked-in or "sticky" (Levin et al. 2012) over time with their impacts influencing a policy for the rest of its existence.

This apparent stability, however, is far from automatic and often requires political action, given that institutions are embedded in a constantly changing context and therefore, are more likely to change than remain the same (Thelen 1999). This calls for understanding the institutionalization of the ERL within its wider political and social setting.

In the remainder of this chapter, I explore two narratives around the ERL: the science-policy story and the policy-science story. The science-policy story revolves around two scientific projects, the national ecosystem survey and assessment and ecological function zones and the ecologist who lead them. Next, I shift to exploring the origins of the ERL concept and its creator. Following this, I present the policy-science story which demonstrates how the ERL evolved and was institutionalized from 2011-2018. Finally, I provide an analysis of this policy process.

II. The Science-Policy Story

Ecosystem Services

Understanding the ERL, requires a basic understanding of the science behind it, ecosystem services assessment. Ecosystem services refer to the direct and indirect contributions of natural systems to human wellbeing, health and livelihoods (Costanza 2000; TEEB 2010). The Millennium Ecosystem Assessment (2005) (MEA), recognized four categories of services: *supporting* (e.g. nutrient cycling, soil formation and primary production); *provisioning* (e.g. food, fresh water, wood and fiber and fuel); *regulating* (e.g. climate mitigation, flood and disease regulation and water purification); and *cultural* (aesthetic, spiritual, educational and recreational). The ecosystem services concept is aimed at debunking the idea that protecting the environment undermines efforts to build the economy. It provides a method of valuing the environment in economic terms (Costanza 2000).

Ecosystem services is a relatively new idea that was promoted internationally by Costanza et al. (1997) and Daily (1997). In China, the term ecosystem service was introduced in an article published in the Chinese academic journal "World Science" in 1997, which was actually a translation of Costanza et al.'s (1997) seminal paper (W. Jiang 2017). The ecosystem services framework became even more visible in science and policy communities with the release of the MEA in 2005. The report, completed by more than 1360 experts from 95 countries including from China, offers a comprehensive assessment of the world's ecosystem services and their implications for human well-being (MEA 2005). The Chinese government provided financial support for the publication and used the report as a basis for its own policy report (CCICED Task Force 2010). Following MEA's publication, ecosystem services has been promoted by international organizations and in international reports such as the Stern Review on the Economics of Climate Change (Stern 2007), which pointed to the decline in the economic value of ecosystem services

caused by climate change.

The ecosystem services framework is now a widespread tool used to evaluate alternative environmental policies, and make the case for market-based incentives for conservation, including payment for ecosystem services. While scientific research on ecosystem services has increased, ecosystem services is still not used in many policy-making situations (Posner, McKenzie, and Ricketts 2016). Moreover, there is no generally accepted way to calculate the value of ecosystem services, especially across large areas, leading to a variety of conflicting methodologies and calculations. This makes interesting? the choice of ecosystem services as a basis for national Chinese policy-making worthy of examination. How did the idea take hold in China? The story begins with the leader of the primary scientific projects leading to the ERL, Dr. Ouyang Zhiyun.

Dr. Ouyang Zhiyun

As the science for ecosystem services became internationally recognized, it was employed by Dr. Ouyang, a scientist at one of the most prestigious scientific institutes in China, and then came to be used by other national level scientists. Following Cash (2003), this added to the legitimacy of ecosystem services as a policy focus. At the same time, the national government was searching for a way to determine which areas should be protected and which should be developed in the face of China's rapid urbanization. Officials in the Ministry of Environmental Protection (MEP) (now renamed as the Ministry of Ecology and Environment (MEE)) knew that Dr. Ouyang was conducting research on ecosystem services and asked him if he would help determine which areas should be protected.

Dr. Ouyang Zhiyun is an ecologist and Director of the Research Center for Eco-Environmental Sciences at the Chinese Academy of Sciences (CAS). He is credited with combining geographic tools (i.e. remote

sensing), ecological analysis, and land use and conservation planning to make the case for using ecosystem services as the basis for national planning. In the 1990s, Dr. Ouyang studied the spatial distribution of ecosystem services in Hainan Province. Ouyang et al. (1999) offered the first study of ecosystem services in China, estimating the economic values of terrestrial ecosystem services using ecological models and economic valuation techniques. This approach has since become a standard technique used by Chinese academics, second only to Constanza's work (1997) (W. Jiang 2017). It was also adopted by the State Forestry Administration in an effort to standardize and guide the assessment of forest ecosystem services (SAF 2008).

Dr. Ouyang graduated from the Research Center for Eco-Environmental Sciences at the Chinese Academy of Sciences with a PhD in 1993. He studied under the renowned ecologist, Dr. Ma Shijun (1915-1991) who received his PhD from the University of Minnesota in 1950. Dr. Ma was a leader in sustainable development theory in China in the 1970s and the only Chinese member of the Brundtland Commission which wrote the sustainable development treatise, "Our Common Future" (World Commission on Environment and Development 1987). Dr. Ma proposed using both ecological and economic concepts to define development (G. Jiang, Li, and Polunin 1991). He is credited as an early environmentalist in China and established the Research Center for Eco-Environmental Sciences at the Chinese Academy of Sciences to address soil, water and air pollution. According to one obituary, he held unique views for a Chinese academic such as "it is not only the science and technology, but also the consciousness of ecology by the public, which can resolve the environmental crisis in the country" (Kang and Li 2011).

Ouyang is said to be carrying on Ma's legacy as current head of the research center. The center continues to use Ma's sustainable development ideas to guide its work (Interview 1302019). Ouyang sees his approach to development as part of a longer history:

> "In 1984, Shijun Ma and Rusong Wang made known the theory of "Social-Economic-Natural Complex Ecosystem"; in 1996, the United States promoted research on the "Natural- Social Complex System"; in 2007, the concept of "Coupled Human and Nature Ecosystem" was proposed....The common point of these concepts is that they all regard mankind as a part of the ecosystem, stressing the interaction, coordination and collaborative development between human and nature. If we exclude human from the ecosystem, setting human and nature against each other, or regarding mankind as the master of nature, then harmony between human and nature would be out of the question." (Ouyang 2016).

These concepts provide the normative basis for the ERL and grounds the ERL within a sustainable development frame.

Ouyang's research began with a focus on panda protection and has over time shifted to ecosystem assessments and ecological planning. He led the scientific teams involved in the two main research projects that informed the ERL: the National Ecosystem Survey and Assessment and the study of Ecosystem Function Zones which are discussed in the following section.

National Ecosystem Survey and Assessment: Providing the Evidence Base

The ERL process is predicated on previous ecosystem service assessments in China that established a framework based on measures of ecosystem services. China's Ecosystem Assessment provides the most detailed and comprehensive analysis of China's ecosystem services that exists. Commissioned by the State Council and funded by Ministry of Finance at a cost of 25 million RMB (US$3.7 million), the study was conducted between 2012 and 2014 and led by MEE and Ouyang's team at CAS. It was also supported by the international Natural Capital project, which was started by Dr. Gretchen Daily at Stanford and has been a key institution in building the models used by Chinese scientists and providing technical support to the project.

The goal of the Ecosystem Assessment was to understand the impact of China's extensive investment in

various large-scale environmental improvement projects such as the nature reserve system, ecosystem restoration and payment for ecosystem service programs from 2000-2010. China invested 351.6 billion RMB (US$49.9 billion) in these programs between 1998 and 2015 (Bryan et al. 2018). The study focused on understanding ecosystem distribution patterns, changes in ecosystem quality, and changes in ecosystem services and on identifying crucial areas for the provision of ecosystem services. It included an analysis of seven different ecosystem services: food production, carbon sequestration, soil retention, sand storm prevention, water retention, flood mitigation, and habitat for biodiversity.

The survey found that China's ecosystem quality was very poor (Ouyang 2016). Despite large investments, there were only minimal improvements in ecosystem services over the ten-year period. There was no improvement in "habitat protection for maintaining biodiversity" which demonstrated that expanding protected areas was not enough to reverse long-term degradation (Ouyang et al. 2016). These report findings made the case for new efforts to maintain ecosystem services (Interview 5232018).

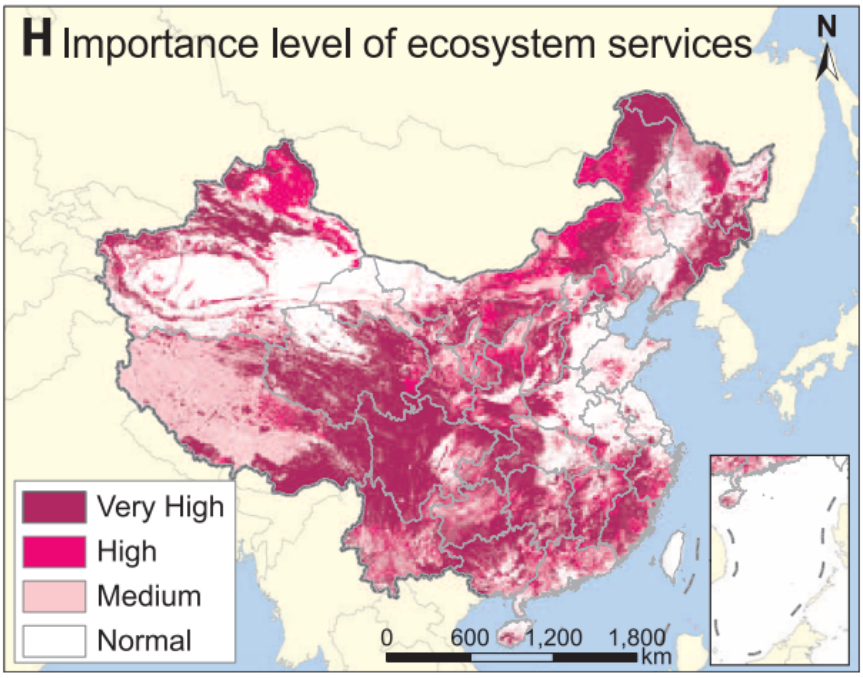
The study determined that the main reasons for environmental degradation were urbanization and expanding agriculture. According to Ouyang, there is a need to take a more holistic view of development in order to change negative environmental trends:

> "First of all, the conclusion [from the NEA] is a warning to China's urbanization — China's urbanization has already made a great impact on regional ecosystems. In future urban development and construction, we should coordinate the relationship between urbanization, industrialization, and ecological protection, reduce the impacts of urbanization on ecosystems, and try to avoid the "repair after destruction" mode of urbanization" (Ouyang 2016).

These are the drivers that need to be controlled in order to halt ecosystem loss and that the ERL is seeking to address. The full report has not been released to the public demonstrating the intense politics that are working against this scientific effort and its conclusions.

The assessment specified important spaces for protection and was used as a key input to policy-making. For example, it has also been used in national transportation network planning to identify sensitive areas such as those prone to soil erosion, land desertification, rocky desertification, and salinization (Ouyang 2016). Most importantly, it was used in the revision of the National Ecological Function Zoning Plan, the adjustment of key national ecological function areas (described below) and as the baseline for national and regional ERL mapping (Ouyang 2016). The first national ERL map was developed by determining areas with very high levels of ecosystem services worth maintaining (see below) (Ouyang 2016). The map includes 34.4% of the country in this category. It has become the basis for comparison with the provincial level ERL maps before their approval by the State Council. This map and its methodology were published in Science, providing international legitimacy to its scientific processes.

Levels of ecosystem services



Source: (Ouyang et al. 2016)

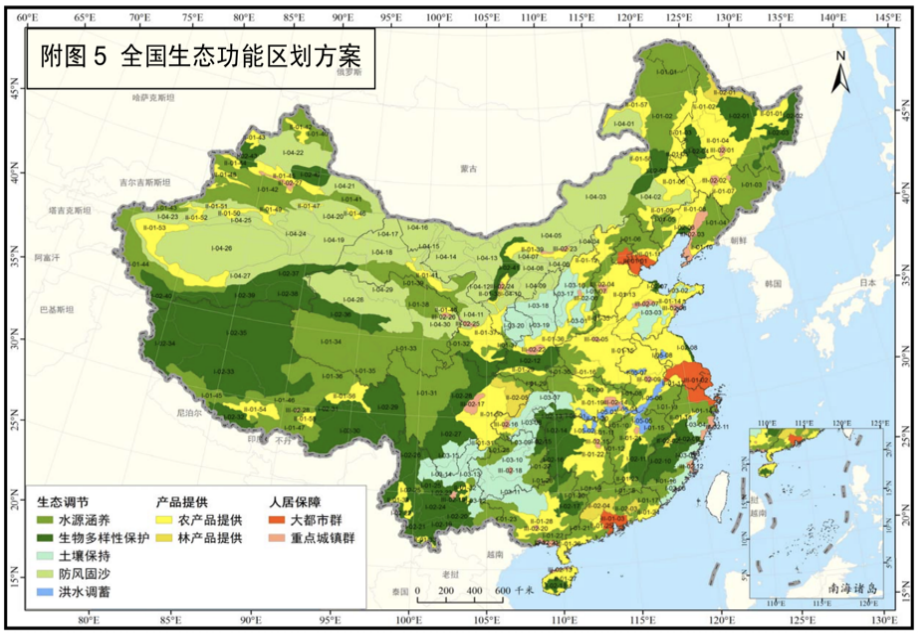
Ecosystem Function Zoning (EFZ)

Research

Ecosystem function zoning, a large national project that took place over four years and involved 14 government departments, was the first attempt to develop a national zoning plan based on ecosystem service criteria (Ouyang, Zhiyun et al. Forthcoming). Drawing on their previous ecosystem services research, the MEE (then called the State Environmental Protection Authority) requested Ouyang's team to carry out national ecosystem function zoning research in 2003 (Yan, Nai Fenglin, and Shen 2014). In 2008, MEE and CAS officially published "National Ecological Function Zoning" (MEP and CAS 2008).

The project divided China into zones based on five kinds of ecosystem services: (1) water retention; (2) biodiversity protection; (3) soil retention; (4) sandstorm prevention; and (5) flood mitigation. In order to complete the final map, the team conducted a comprehensive analysis of the status and spatial differentiation of ecosystem types, ecological problems, ecological sensitivity and vulnerability, and ecosystem services. A series of maps were created to ensure that land that was vulnerable was set aside. The maps produced as part of the project identified ecological ecosystems, urban ecosystems and agricultural ecosystems, provided a new vision of China's land, placing ecological principles at its center.

National Ecological Function Zoning Map



Source: (MEP and CAS 2008).

Note: Colors denote different ecological functions (greens = ecological functions, yellows = forest and agricultural land

Since the zoning plans in the mid-2000s, subsequent plans reinforced the link between environmental protection and ecosystem services measures in China. In 2015, the MEE and CAS revised the National Ecological Function Zoning plan on the basis of the National Ecosystem Survey and Assessment. The list of sensitive areas was expanded from 50 to 63 locations and increased coverage from 25% to almost 50% (49.4%) of China's total land (MEP and CAS 2015). The areas collectively provide 78% of China's carbon sequestration services, 75% of soil conservation services, 61% of sandstorm prevention services, 61% of water resource conservation services, 60% of flood mitigation services, and 68% of natural habitat for biodiversity (Ouyang et al. 2016). A series of measures have been proposed to protect these areas, including pollution controls, grazing limits, reduced mining and road construction, and promoting the recovery of natural vegetation (Ministry of Environmental Protection and Chinese Academy of Sciences 2015).

Policy: Scale and Payments for Ecosystem Services

The concept of ecosystem service protection was officially translated into policy at the highest levels of the Chinese government. In 2010, the National Key Ecological Functional Zones Plan was issued by the State Council. This was then used as a basis for Major Area Function Zoning, which divides the country into four land use categories: optimized, major, restricted and prohibited areas. Key Ecological Function Zones were established as "restricted development zones," to protect the sustainable provision of ecosystem services from new development. This document has been used for many kinds of strategic planning purposes and has changed how Chinese land is categorized nationwide.

In order to implement the National Key Ecological Functional Zones Plan, the maps were downscaled to the county level. All counties that were inside National Key Ecological Function Zones receive subsidies from the central government to proceed with environmental protection and basic public service support (He et al. 2018). Originally, 436 counties were within these areas. It has now expanded to 676 counties. Payment for ecosystem service protection follows a trend that has been gaining attention worldwide as ecosystem services assessments has expanded as a policy tool (Pan et al. 2017). The amount of annual subsidies for this purpose has increased over time from 6 billion RMB in 2008 to 62.7 billion RMB (US$9 billion) in 2017 (Ouyang, Zhiyun et al. Forthcoming). To date, the central government has spent over 300 billion RMB (US$43 billion) on ecological transfer payments (Ouyang, Zhiyun et al. Forthcoming). This payment for ecosystem services model has also been the primary intervention at the heart of China's large scale national environmental protection efforts (Bryan et al. 2018).

Designated counties are required to maintain a level of ecosystem services to qualify for continued funding. In regions where ecosystem services and quality continue to deteriorate, 20% of the transfer payment is suspended until there are improvements. For counties where ecosystem service levels

deteriorate for three consecutive years, transfer payments are suspended for the following year. Payments do not resume until services, including water quality, are restored to the pre-2009 level (Ouyang, Zhiyun et al. Forthcoming).

Challenges

This policy has been difficult to implement since the ecological function zones are not spatially grounded. Many counties include both areas with important ecological functions and areas without ecological functions. This means that counties are not clear as to which areas are expected to be protected. There have also been issues resulting from the mis-alignment of function zones and county boundaries. Some scientists that worked on the project have asserted that many boundaries are not accurate due to rapid development -- important ecological function protection areas have shifted (Yan, Nai Fenglin, and Shen 2014). Others I interviewed report that some policy requirements were impractical (Interview 5232018; Interview 6222018) for financial reasons. There is not enough money budgeted to pay all the counties what they should be receiving. Some officials also believe that the policy never should have been translated to the local level, but rather should have remained as a national strategic policy given the spatial mismatch (Interview 6222018). Even the leaders behind the effort have acknowledged that "maps are useful as a strategic planning tool but the identified areas lack protective legal status and have little meaning for ground level management. It was impossible to translate a national effort to the ground" (CCICED 2014). Institutionally, the plan never involved the Ministry of Natural Resources who is mandated with addressing land use planning. These issues point to some of the tensions that the ERL must address and have provided lessons which have been incorporated into ERL management demonstrating adaptive management.

Ecological function zones provide a general means of identifying various types of ecosystem services.

The challenges that have emerged from implementing this policy has brought forward questions. How should the quality of each ecosystem service be assessed all over the country? How is the determination made whether ecosystem services have improved or declined from year to year? Developing standards capable of accurate assessment across the entire country is challenging and may not be achievable. The policy involved also requires implementation to address specific ecosystems services. How could up-to-date local land use plans be made for the whole country based on national ecosystem service maps which were being regularly modified? How can the national government explain to local officials that they need to maintain ecosystem functions? What will that mean to them? These questions led to the need for a more practical approach which turned out to be the ecological red line.

III. ERL as an Environmental Management Tool

The concept of ecological function zones turned out to be difficult to implement across the country. Moreover, the concept did not indicate the relative importance of protecting these areas (Interview 4132017). It became clear that different ecological functions required different mechanisms for effective protection; this led to further management complications.

Thus, the idea of a "red line" was quite compelling, especially given its cultural and historical connotation. Red line means "insurmountable boundary" in the traditional Chinese dictionary (He 2014). A research report on the ERL defines it as, "a line or limit that cannot be breached without severe danger, consequences, and/or penalties" (CCICED 2014). It underscored the level of seriousness and gave great clarity to the concept. As Xi Jinping recently told provincial lawmakers, "The ecological red line cannot be crossed" (Xinhua 2019) producing a simple and understandable message regardless of how the ERL is defined.

Ultimately, it provided a simple mechanism to address a complex problem. It made ecological protection "legible" (Scott 1998) in the Chinese governance system through creating a quantitative target. The ERL drew on these previous policy formulations in its development process. The first national "red line" for protecting natural areas was used to protect arable land in 2006. To ensure food security, the State Council proposed to red line 120 million ha across the entire country. This led the government to define areas where farmland cannot be destroyed. This story, however, is not just applying an old tool to a new problem but one that also combined learning from the challenges of the ecosystem function zones, adaptation and experimentation based on practical experience.

Origin Story: Dr. Gao Jixi and an experiment

According to the creator of the ERL concept, the idea was born in 2000, when Dr. Gao Jixi proposed delineating an "ecological red line" that would optimize the ecological security of the country. In 2002, while working as a planner in Anji County in Zhejiang Province, Dr. Gao proposed a "red line control" plan as part of ecological county planning and it was adopted by the county government (Ye, Zheng, and Cui 2018). As the story goes, an area was designated as a water source conservation area even though there was already a Taiwanese factory located there. In order to protect the water from pollution, the government paid the company 50 million yuan to relocate (Dai 2013). This is the general management model that the ERL still uses today.

This demonstrates how the ERL idea emerged from practical experience, one of the tenets of the "guerilla policy style" (Heilmann and Perry 2011). It also complicates the top-down story that is often told of the ERL (i.e. (Y. Bai et al. 2016) and demonstrates that it is actually an example of local practice influencing central policy. This bottom-up model of change has been used to explain how China has been able to innovate economically (Heilmann 2008a), but the ERL is an example of environmental innovation using a

similar pathway.

The ERL concept continued to be experimented with at the local level. The concept was applied in Guangdong Province, although by a slightly different name. Shenzhen issued "Regulations on the Management of Basic Ecological Control Lines in Shenzhen," (2005) with the goal of protecting the basic ecological security of the city, maintaining ecosystems, preventing urban sprawl and respecting environmental carrying capacity (Yan, Nai Fenglin, and Shen 2014). The "Pearl River Delta Environmental Protection Plan (2004-2020)" included a "red line zone," which was listed as the most strictly protected area.

Interestingly, Dr. Gao Jixi, as an ecologist and Director of the Nanjing Institute of Environmental Sciences, a research institute under MEE, has continued to play a key role in developing the red line concept. He held his position from 2011-2018. In this role, he proposed the key methods of defining and protecting the ERL (Ye, Zheng, and Cui 2018). In 2013, Gao Jixi was commissioned by the State Council to investigate the possibility of developing an ERL. In October 2018, he was promoted to Director of the Satellite Environment Center of MEE (SAE 2018). This organization developed the monitoring platform for the ERL, ensuring continuation of his ideas as he maintained a strong role in the next steps of structuring of the ERL (Ye, Zheng, and Cui 2018).

Gao received his PhD in 1998 from the Chinese Academy of Environmental Science and the Chinese Academy of Science. His dissertation was entitled, "The Theory, Method and Application of Ecological Carrying Capacity" and his work since then has been focused on the evaluation of ecosystem services, environmental assessments of regional development strategies and environmental pollution testing. Prior to 2011, he was Deputy Director, Department of Science, Technology and Standard in MEE. He held a

position on a policy task force on Ecosystem Service and Management Strategy in China which provided recommendations and policy options for integrating ecosystem services into development decision-making (CCICED Task Force 2010).

He also holds many positions within the Communist Party indicating his power in the political system, especially in Beijing. He is a member of the National Committee of the Chinese People's Political Consultative Conference, a member of the Standing Committee of the Chaoyang District Political Consultative Conference (Beijing), a member of the Central Committee of the Communist Party, a member of the Standing Committee of the Beijing Municipal Committee, and chairman of the Chaoyang District Committee (CPC Beijing Municipal Committee 2017).

Gao's vision of the ERL has influenced its development from the start. He understands the "red line" concept as a new stage in China's environment protection system, one that has progressed from nature reserves to ecological function zones. For Gao, the ERL is a uniquely Chinese concept; one he considers the most complete protection system in the world (beyond the widely used IUCN protection system) (Ye, Zheng, and Cui 2018). Ultimately, the ERL is a method of achieving sustainable development: "Our generation can't develop all the resources, destroy the natural landscape, and let the subsequent development lose its ecological support" (Ye, Zheng, and Cui 2018).

In a recent interview, Gao asserted that his model has been effective for Anji County's development more than ten years after the first ERL was implemented. It has been able to retain environmental quality while sustaining economic growth, "From 2003 to 2017, the forest and grassland area has increased, and there has also been rapid economic development. The environment has been used sustainably to develop eco-tourism and promote the development of various industries. It has not only protected the environment,

but also *clear waters and lush mountains are invaluable assets*" (the end echoing a famous quote used by Xi Jinping to describe Anji and which he still often uses today.) (Ye, Zheng, and Cui 2018).

IV. Policy-Science Story: 2011-2018

The institutionalization of the ERL began in 2011, one year after the State Council published the National Key Ecological Functional Zones Plan. It was also one year before Xi Jinping became China's president. How has the ERL developed, adapted and changed over time? This section details the many stages in the ERL policy process and points to the ways in which "scientific-lock in," experimentation and the wider institutional landscape influences the ERL institutionalization.

Ecological Red Line: National Policy Origins

At the beginning of the 12th Five Year Plan (2011-2015) period, the ERL concept appeared in national documents for the first time. The State Council, China's highest executive authority often referred to as China's cabinet, issued its "Opinions on Strengthening Key Environmental Protection Work" and proposed "delineating the ecological red line," putting the ERL on the national agenda. The document called for, "delineating ecological red lines in important ecological function zones, terrestrial and marine ecological environment sensitive areas, and vulnerable areas, and formulat[ing] corresponding environmental standards and environmental policies for various main functional zones." (Guofa [2011] No. 35). This was the first policy definition of the ERL and situated the concept within the existing framework of ecological function zones and main function zones. The vagueness of the definition left ample room for interpretation. This is common in State Council opinions and allows for future guidelines to specify a clearer definition.

A few months later, the "Twelfth Five-Year Plan for the National Environmental Protection" reiterated the

State Council Opinions officially making these actions part of MEE's assignment for the next five years. Thus, began the official technical planning to specify the ERL. It also called for ERLs in a few ecological function zones pilots, uniting the two ideas in practice and providing a mechanism for practice to influence policy.

In March 2012, MEE hosted the "National Ecological Red Line Demarcation Technical Meeting" inviting experts and provincial environmental protection bureaus to discuss the concept as well as techniques for mapping red line areas. That meeting also established a technical group led by the Nanjing Institute of Environmental Science under MEE, Chinese Academy of Environmental Sciences and CAS. Dr. Gao Jixi was the chair of the technical group (Xinhua 2017). These three institutions became the central players in ERL development and in the creation of ERL guidelines (Feng 2014). In December 2012, MEE set Inner Mongolia and Jiangxi as ERL pilot provinces; in 2013 Guangxi was added. The concept was to test the ERL methodology in these provinces and use the pilot to inform development across the country and institutionalizes practice into policymaking.

At the beginning of the following year, MEE, the NDRC and the Ministry of Finance (MOF) jointly issued "Opinions on Strengthening the Environmental Protection and Management of Key Ecological Functions in China." The policy again called for MEE along with relevant departments to issue technical guidelines for specifying "ecological red lines" within the national key ecological function areas while also defining roles for NDRC and MOF in developing environmentally sensitive economic policies. It was at this point that responsibility began to move down the bureaucratic ladder. Local governments were told to close or relocate polluting industries within their red lines. They were promised reasonable compensation. This is notable since it involved two ministries with strong implementation powers. It is also interesting given that red lines had not yet been drawn for any county.

Support from the CCP

In May 2013, only five months after assuming the presidency, Xi Jinping presided over the sixth collective learning session of the Politburo, CCP's political bureau. During a speech stressing the importance of the environment for development, he proposed delineating and strictly observing the ERL in order to improve ecological functioning. He called for "firmly rooting the concept of the ecological red line" and calling for punishing those that transgress the boundaries (Xinhua 2013). This strong language demonstrated that the ERL had support from the highest level of the Chinese government (and party).

By the next fall, on November 12, 2013, the Chinese Communist Party Central Committee released "Decisions on Several Major Issues of Comprehensively Deepening Reform" which mentions the ERL for the first time in a CCP document. It also uses strong language to indicate how the red line will be set and how the environment will be prioritized:

> we will unwaveringly implement the system of functional areas, establish the system of land and space development and protection, promote development in strict accordance with the functional definition of these functional areas, and establish the national park system…implement restrictive measures for regions where water and land resources, the environment and marine resources have been excessively exploited. We will cancel regional GDP assessment for regions under restrictive ecological development and for national key counties for poverty alleviation displaying ecological fragility. We will explore ways to compile a natural resource balance sheet and implement natural resource audits when leading officials leave their positions. We will establish a lifelong accountability system for ecological and environmental damage (CCP Central Committee 2013)

The combination of strong signals from the top and strong language from the party demonstrates that within China's diffuse and complex governance structure, there was now backing from both the Party and the State. This statement also links environment and economic development, demonstrating a reversal of long-term policy priorities.

First Provincial Red Line Map

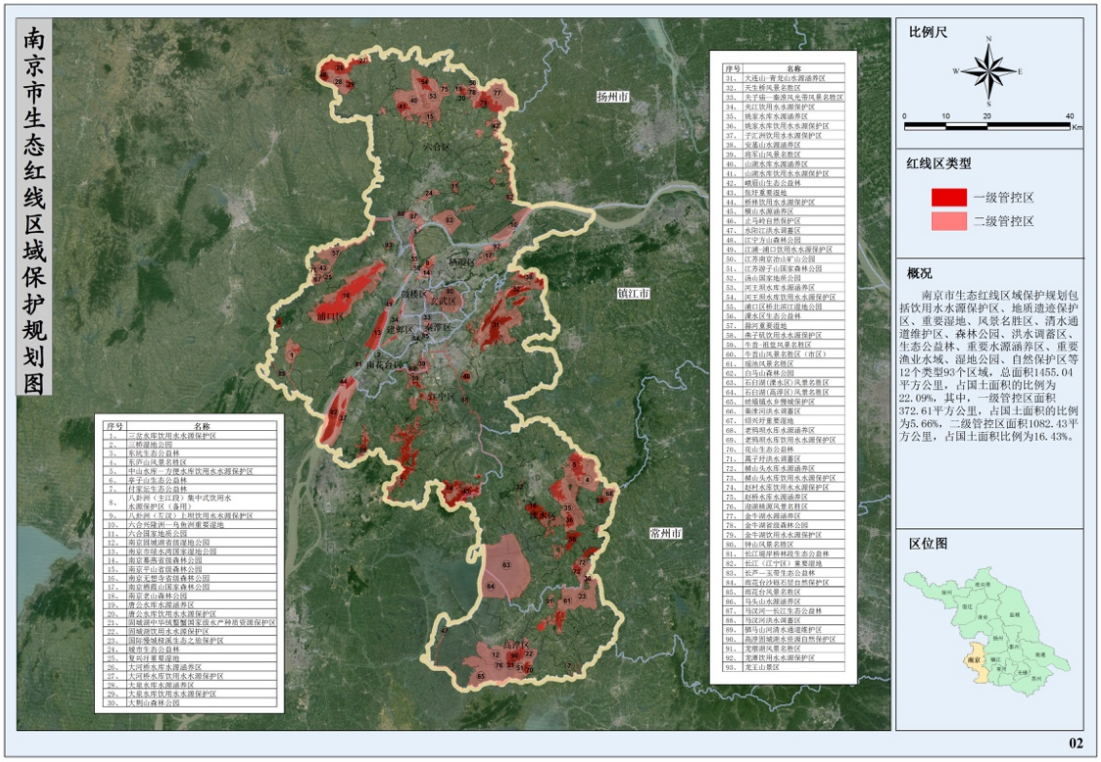
Jiangsu Province developed the first red line map in May 2012 and released it in August 2013. This map then became the first demonstration of what the concept might look like in practice and allowed for a test of the technical guidelines before its wider release. It was based on Jiangsu's first ecological function zoning which took place in 2004. The map was produced by researchers at the Nanjing Institute of Environmental Science. The scientists designing the national policy were also the ones creating the provincial maps allowing for a direct translation of the ecological concept into a spatial plan. The Institute is based in Jiangsu, making it an understandable choice as a first test case since there are likely connections between officials at provincial level and the lead researchers.

The provincial policy notes that the plan, "Regional Protection Plan for Ecological Red Lines in Jiangsu Province," was issued "after repeated research and multiple solicitations" (Jiangsu Provincial Government 2013). While the exact process is unclear, this likely means that the scientific process was not as straight forward as the ecologists would have liked. It includes 15 types of protected areas in land and marine areas, covering many types of protected areas such as nature reserves, scenic protected areas, water source protection areas, flood control protected areas and important fishing areas. There were 779 areas designated in total which accounted for 22.23% of the province's land. The areas were also divided into first level and second level control areas. In the first level areas, totaling 3.03% of the province, all development and construction is prohibited. In the second level areas, encompassing 19.2% of the province, there can be development activities, but not those that would damage ecological functioning (Yan, Nai Fenglin, and Shen 2014). This follows a pattern similar to national park protections where there is a core and a buffer zone. The management plan for each of the areas is based on the 15 types of protected areas following existing protected area regulations and the ecological function zone

management plan.[2]

After the maps were created, the plan was implemented using an ecological compensation scheme. The province spent nearly 2 billion RMB (US$298 million) per year on compensation. This has led to speculation that ERL success in this case was mostly due to the financial capacity of the province and that it was not a good indication of the ERL functioning in other places (Interview 4252018). Similar to the ecological function zone model, if protection was "good," more funds were allocated (People's Political Consultative Conference 2015).

ERL Map for Nanjing, the capital of Jiangsu Province



Note: The first level areas are dark red, and the second level areas are light red.

[2] It should be noted that much has changed. The final Jiangsu map only includes 8474.27 square kilometers, accounting for 8.21% the land area of the province. (Jiangsu Provincial Government 2016).

First Round of Guidelines

The first round of guidelines for an ERL was created based on the experience of developing the Jiangsu map, This was the first of several attempts to create the guidelines. In January 2014, MEE's Natural Ecological Protection Department issued the "National Ecological Conservation Redline-Ecological Function Redline Technical Delineation Guidelines (Trial)" (MEP 2014). These detailed how to produce an ecological function red line for land and marine areas, and provided expanded definitions for the first time in a policy document. It lists two types of red lines which are linked: "ecological protection red lines" and "ecological function red lines." The majority of the document uses the term "ecological function red line" which it describes as a method of "protecting natural ecosystem services, guaranteeing national and regional ecological security key functions in important ecological function zones, ecological sensitive areas, and vulnerable areas. It is the smallest ecological protection area." The only mention of "ecological conservation red lines" in the document is under the principles of enforcement. This includes language about the ERL directly from Xi Jinping's 2013 speech.

The use of these terms likely demonstrates that there was disagreement about the difference between ecological function zones and ERL as the ERL was taking form. This is also the beginning of the use of the term "ecological conservation red line" rather than "ecological red line." According to the MEE, the next steps needed to include national technical training and drawing red lines with provincial governments. The red lining process was supposed to be complete by 2014 (Xinhua 2014).

China Council for International Cooperation on Environment and Development

The China Council for International Cooperation on Environment and Development (CCICED) held the first working meeting of the Special Policy Study Group on "Institutional Innovation of Eco-Environmental Redlining" in Beijing in March 2014 (CCICED Secretariat 2014). CCIECED is a high-level international

advisory body supported by the Chinese government which provides policy recommendations to submit to the State Council. The ERL study group included national and international experts such as Gao Jixi and Ouyang Zhiyun, Peking University professors and international experts from IUCN and Forest Trends.

In December 2014, the group released a report drawing on international and national cases in Jiangsu, Shenzhen, Beijing, and the Bohai Sea (CCICED 2014). The report frankly describes failures in China's land use management and protected areas. It called for clarification of the ERL definition and integration into law aptly noting a quote from a senior official, "there are enough red lines to knit a sweater." The document states, "there is a lack of clarity and uncertainty in the understanding of this term, how it relates to red lines for environment and what it entails." The report authors agree on a single ERL "rather than several "ecological" red lines or lines of yet more colors" and see the line as "simply the tool to delineate spatial land units that require various measures of special protection or strict limits on activities and developments" (CCICED 2014).

This was an important step in the evolution of the concept. It signals some agreement by the main organizations involved. Surprisingly, the document makes no mention of ecosystem function red lines which had just been used in the MEE guidelines. The document defines the ERL as "a red line that defines those lands that deliver critical ecosystem services and require protection from threatening developments and activities" (CCICED 2014).

Legal Status

Institutionalization of the ERL began in earnest in 2015. One article credited this to Dr. Chen Jining, an environmental engineer and former President of Tsinghua University, who became the Minister of Ecology and Environment in 2015 (Q. Liu 2017). Others have also supported that the MEE work became generally

more effective and less corrupt under his leadership (Interview 842014). The ERLs legal status was formally established once it was included in the revision of the Environmental Protection Law (Standing Committee NPC 2015a) and the National Security Law (Standing Committee NPC 2015b). This is relatively fast for a concept to be integrated into Chinese law.

This move raised the status of the ERL above ecological function zones and all but ensured that the ERL concept would continue to be used rather than disappearing among many other policy ideas. Article 29 of Environmental Protection law states:

> The State defines ecological redline for strict protection on key ecological functional zones, areas of sensitive and fragile ecological environment. The peoples' governments at various levels shall take measures to protect regions representing various types of natural ecological systems, regions with a natural distribution of rare and endangered wild animals and plants, regions where major sources of water are conserved, geological structures of major scientific and cultural value, famous regions where karst caves and fossil deposits are distributed, traces of glaciers, volcanoes and hot springs, traces of human history, and ancient and precious trees. Damage to the above shall be strictly forbidden.

Including the ERL in the Natural Security law supported the position of MEE, whose current head had published an article in *Qushi*, the main theoretical journal of the Central Committee of the Communist Party of China, highlighting that the ERL was created to protect national ecological security (G. Li 2014). It also provided a legal basis for the concept of "ecological security," stating that "the State improves ecological and environmental protection system…drawing red lines for ecological protection…ensuring the air, water, soil and other natural environmental conditions upon which the people rely are not threatened or destroyed, promoting harmonious development of man and nature."[3] This definition links ecological security to sustainable development and the ERL, providing clarification to the concept and

[3] Using broad language to describe the goals of the government, the articles in the National Security lLaw provide high-level guidance to agencies comparable to the role played by the Five-Year Plans in setting out objectives and goals for China's national economy. Government agencies responsible for policymaking in the respective sectors will view these articles as directing them to draft more detailed implementing measures.

potentially providing support for more attention to be directed toward the ERL.

Revised Guidelines

After one year of pilot trials, local and expert feedback, and technical demonstrations, in May 2015, MEE formally issued the Technical Guide for Demarcating ERLs replacing the previous trial version (MEP 2015). This is evidence of the process of adaptation and experimentation combined with scientific support. This version did not include the concept of "ecological function red line," possibly indicating that MEE's vision had prevailed over CASs in clarifying the connection between key ecological function areas and the ERL.

It defined the ERL as the "strict control boundary delineated in key ecological function areas, ecological environment sensitive areas and vulnerable areas according to law, and is the minimum requirement for national and regional ecological security. The area surrounded by the ecological protection red line is the ecological protection red line area, which plays an important part in maintaining the ecological security pattern, ensuring the functioning of the ecosystem, and supporting the sustainable development of the economy and society." By July 31, provinces, autonomous regions and municipalities had been trained in using the technical guide.

By December, red line maps had been developed for 31 provinces and were at various stages of approval. These maps were made by teams of researchers at the three institutions working on the red lines (CAS, Nanjing and CAEP). According to a press release, Jiangsu Province and Tianjin had released their plans. Jiangxi, Xinjiang and Hubei plans had been approved by the provincial government. Hainan Province, Beijing and Shanghai had sent plans to the provincial government for approval (MEE 2015).

The majority of these maps included between 30-40% of each province's land in their red line area

(People's Daily 2017). Beijing was an exception including 73% of its land in December 2015. Many provinces used a two-tiered control area that had been specified in the Jiangsu pilot. (This two-tiered system later disappears as it was perceived as more difficult to implement and monitor compliance within the two areas.) The rest of the country was expected to be mapped by 2016. The timeline for completion had been pushed back one more year. This indicates that getting approval from provincial governments was proving to be more difficult than had been previously assumed and demonstrates the limits of central government control.

As provinces began to release their ERL maps, reports from one meeting demonstrated some initial push back on the red line maps. One member of the National Environmental Advisory Committee and the Chinese Academy of Engineering questioned the size of the ERL, "I am a little surprised that the scope of the ecological red line is so large… I don't mean that I do not support ecological protection, but the size of the ecological red line should be studied" (S. Wang 2015). At this point, it was unclear what would be possible within the red line areas as no implementation guidelines had been released, adding additional uncertainty to the whole process.

The ERL was also moving toward a new set of trials to test how implementation of the ERL would work after the maps had been drawn. In November 2015, MEE released a "Notice on Launching Ecological Protection Red Line Management and Control Pilots," selecting Jiangsu, Hainan, Hubei, Chongqing and Shenyang to carry out pilot projects.

Pushing forward new conceptions of Development

In September 2015, the Communist Party of China Central Committee and the State Council, published a reform plan entitled, "Integrated Reform Plan for Promoting Ecological Progress." The expansive policy

called for a new approach to development with the environment at its heart. This further cemented the idea of ERL within "an ecological civilization," China's new development framework. Specifically,

> Land use regulation will be extended to all natural ecological spaces, ecological redlines will be defined and strictly observed, and arbitrary changes to land use will be strictly prohibited. Efforts will be made to protect against ecological redlines being crossed by unreasonable development and construction activities. The monitoring system for all territorial space will be improved and a longitudinal approach will be used to monitor changes within China's territorial space (State Council 2015).

This raises the importance of the ERL and indicates a huge change from how land use had been managed for so long under a development-first approach where natural spaces were easily abandoned for urban or agricultural use.

In May 2016, President Xi Jinping made a major speech about ecological civilization, "Clear waters and lush mountains are invaluable assets," mentioning the importance of the ERL as a bottom line and lifeline, using direct words from the technical guidelines. He reiterated that the red line cannot be broken, or else it will damage the ecological security, people's livelihoods and sustainable development. He also once again emphasized that those that break the redline will be punished. This provides further tangible support for the recognition that the ERL is not just an arbitrary policy but one with the backing of the highest levels of government and signifies to the bureaucracy that among many policy priorities, this one is significant.

State Council Opinions

On Nov. 1, 2016, the 29th session of the Central Leading Group for Comprehensively Deepening Reforms deliberated and adopted "Several Opinions on Delineating and Strictly Protecting the Red Line of Ecological Protection." On February 7th 2017, it was issued by the General Office of the CCP Central Committee and the General Office of the State Council. This was a key policy released by the highest

body in China and was one of the recommendations from the CCICED study aimed at ensuring the institutionalization of the ERL. It should also be noted that this group is led by Xi Jinping and is a policy formulation and implementation body set up under the Politburo that is intended to develop economic reforms. It is therefore not a venue that is expected to develop environmental policy.

The Opinions specified the guidelines, overarching targets, and cardinal principles for drawing and observing the ERLs. It pointed out that the red lines are the bottom line and lifeline of national ecological security and that its core objective was to regulate key ecological space with red lines. It also codified the three ERL tenets: (1) ecosystem functions will not degrade, (2) the conservation areas will not shrink, and (3) natural environment and ecosystem types inside the red line area shall remain unchanged.

Specifically, it asserted that Yangtze River and Beijing-Tianjin-Hebei were required to define their red lines by 2017, while the rest of the county had until 2018 to complete their red lines. According to Dr. Gao Jixi, these areas were chosen because they had the highest technical capacity, institutional coordination and ecological connectivity (Ye, Zheng, and Cui 2018). According to a MEE press release, this approach was intended to meet the requirements of General Secretary Xi Jinping for "collaborating on ecological conservation rather than development activities" by taking a regional approach (MEE 2017). These areas were also well known as the most polluted locations (Q. Liu 2017).

The document was welcomed by MEE. The Leading Party Group of the Ministry held a thematic meeting to study the document and begin implementation. Minister Chen stressed that "we will implement the document with the spirit of nailing a nail (signaling perseverance)," map out a work plan to facilitate the implementation of the document as soon as possible, and organize the implementation of the plan very soon (MEE 2017). Following this, the National Ecological Protection 13th Five Year Plan (2016-2020),

included activities to support the State Council's document and reiterated its timeline. It called for speeding up the development of the red lines, establishing an ERL compensation mechanism and a monitoring platform.

Next Round of Guidelines

The opinion launched a new round of ERL maps (in some provinces for the third time). In March, the Nanjing Institute led a training course hosted by the MEE (MEE 2017). At that meeting, provinces shared their challenges in drawing the ERL, demonstrating that practical concerns around the lengthy process to establish ERL areas would likely influence the next round of maps.

In May 2017, MEE and NDRC formally issued the Technical Guide for Demarcating Ecological Conservation Red Lines. The issuance by both these ministries could be perceived as a positive move, as it places a much more powerful ministry, which is in charge of all development planning, and which has been involved in the main function zone planning as a key player in the ERL.

This document included the clearest definition of the ERL as:

> the area with special important ecological functions within the ecological space and must be strictly protected. It is the bottom line and lifeline for safeguarding and maintaining national ecological security, usually including important water source conservation, biodiversity conservation, soil and water conservation. Important areas of ecological function such as wind and sand fixation, coastal ecological stability, and other ecologically sensitive and vulnerable areas such as soil erosion, land desertification, rocky desertification, and salinization (MEP and NDRC 2017).

It places the ERL within the Main Function Zoning plan, and states that for areas to be changed for either major infrastructure or livelihood security projects, they would have to be reviewed by MEE and NDRC, and their opinions would be submitted to the State Council. This means that only the national government

can approve changes to the ERL. The inclusion of more than one ministry complicates the decision-making processes and allows space for disagreement and different opinions to be sent to the State Council. This is particularly important given the different mandates of the two ministries, MEE would likely be against any change to the red line, especially without additional expansion in other areas, while NDRC would likely support local development over environmental concerns as this has been their traditional position.

In July 2017, an Inter-Ministerial Coordination Leading Group for Ecological Conservation Red Line was established to coordinate the various tasks involved in implementing the ERL and addressing major problems. It was responsible for implementation of the mapping work, including the top-level design, the development of standard specifications, etc., and guiding the local red line mapping. The Group included the Ministry of Environmental Protection, the National Development and Reform Commission, the Ministry of Finance, the former Ministry of Land and Resources, the former Ministry of Housing and Urban-Rural Development, the Ministry of Water Resources, the former Ministry of Agriculture, the former State Forestry Administration, the Chinese Academy of Sciences, the China Meteorological Administration, the State Oceanic Administration, and other departments.

In Xi Jinping's important 19th Party Congress speech in October 2017, he stated that the country must complete the ecological red line process. In December 2017, Beijing-Tianjin-Hebei region and Yangtze River economic belt (11 provinces) and Ningxia finished their plans (15 total). The plans were reviewed and approved by the State Council. In July 2018, the plans were released to the public. In September 2018, the red line delineation plan for 16 other provinces were reviewed by the provincial government and sent to the MEE for review. It was expected that the national ERL system – including a new monitoring capability – would be completed by the end of 2020.

V. A New Paradigm

Ecology, a science often sidelined in the West, has been used to transform the basic thinking about categorization and management of land across China. The Ecological Function Zone's guiding ideology is "to apply the principles of ecology to optimize land development patterns" (MEP and CAS 2015). While ecologists have called for landscape-level planning for a long time (Fahrig and Merriam 1985), these ideas have been difficult to implement in practice and has never been done at a national scale. Moreover, no country prior to China's efforts had used ecosystem services as a national land planning method.

This is a paradigm shift. The ERL proposed that protected areas could be used to achieve goals beyond biodiversity, the longstanding and dominant reason for conservation. The goals include conserving land and water to reduce pollution, mitigate disasters, adapt to climate change and improve public health. The areas to be protected could be based not just on where was the most pristine but include areas that were more likely to be influenced by human activities or areas that were already severely degraded. Using ecosystem services as the method to determine categories for conservation, also allowed for ERL areas to ideally reach multiple goals. For example, protecting a water source area may provide economic benefits, promote public health, accomplish pollution reduction, increase animal habitat and additionally provide some or all of those benefits to downstream areas. The ERL also made a case for protection as necessary for sustainable development and national ecological security, offering it status as issue of national importance. In the process, ecological land was designated with a "function" that was legally and institutionally recognized and strictly enforced.

While it could be argued that this marked a new paradigm globally, it certainly marks paradigmatic change in Chinese environmental and land use planning. Hall (1993) demonstrates how paradigmatic policy

change emerges rarely, calling it third order change. It is paradigmatic in the sense that it changed the particular set of ideas about what can and should be done in environmental policy. These ideas then became reflected and reinforced by the ERZ and ERL demonstrating how policymaking processes can be structured by both ideas and institutions and that these processes are often interrelated (Hall 1993).

How did this unlikely shift happen?

I argue this paradigm shift was brought on through dynamic interaction and intersections within the policy process, local experimentation and the wider institutional environment over time. The years of scientific projects behind the ecological function zones and the ERL and the strong coalition combining top ecologists-policymakers including Ouyang and Gao and their teams were central to ecosystem services becoming a dominant concept in land use planning. It was also aided by the interaction between rounds of experimentation of implementing the ERL in various parts of the country.

It was also furthered by the form of the knowledge itself. The international credibility of ecosystem service science was supported by national and international organizations making it a form of science that was legitimate for policymaking. Additionally, the ability for the scientific assessment to create visible, compelling and quantifiable information provided a vision of China's land that had never before been produced. It provided evidence to support broader policy goals of an ecological civilization. Pierson (2000) drawing on Arthur (1994) demonstrates how lock-in occurs with new institutions as they often entail high fixed or start-up costs, considerable learning effects, coordination effects, and adaptive expectations. These effects are apparent in the numerous ecological projects that took place for more than ten years. For example, the National Ecosystem Survey involved over 3,000 scientists and the ecosystem function zoning project involved 14 different government departments leading to high costs of establishing new relationships, sharing and processing new types of information and coordinating

across many researchers and government officials.

At the same time, efforts were made to broaden and strengthen the coalition behind these ideas. The choice of the term "ecosystem function" rather than "ecosystem service" reflected China's land use planners' commitment to the term "function" (Interview 5232018). It also linked ecosystem protection to direct problems that local governments faced including water pollution and flood protection. This made it easier for local officials to connect to the concept. Additionally, the red line policy ensures that ecologists and the MEE, the institution's main stakeholders, maintain an ongoing role during mapmaking and monitoring expanding its power to control the forces leading to environmental degradation in a way not previously possible.

There were also wider institutional changes occurring in China that allowed these ideas to maintain their influence. First, was the changing discourse on the role of the environment in development and the ambition to build an ecological civilization. Secondly, the support of Xi Jinping toward green development. His strong language about the environment at a time of his increasing power within the bureaucracy, signals to local governments that the environment is more important priority than ever before. In this moment of centralization in Chinese politics, the center is exerting more power over the local governments enabling ideas that would be unpopular among local government to still take hold (although, admittedly not in the exact same ways). Additionally, the extent of the problem and its public outcry has raised the environment as a priority among other issues (Rooij et al. 2017).

This does not mean that all forces were motivating ecosystem services to become locked-in. In fact, to the contrary, ecosystem service science remained dominant even though there was considerable scientific uncertainty and political push back. The Ecosystem Assessment and its mapping of ecosystem services

which produced the first national ERL map was questioned by the scientists themselves. In a paper in Science, Ouyang and others list the many issues in capturing the true value of ecosystem services across China due to constraints in the quality, scale and frequency of available data (Ouyang et al. 2016). Other government scientists have also critiqued the data available in many localities and the simplistic models that the researchers used on the basis that they do not allow for a sophisticated analysis of ecosystem services (Interview 4252018; Interview 4262018). These critiques have continued with the ERL (Xu et al. 2018).

In an interview, Ouyang has also expressed some of the scientific challenges,

> First, where to delimit? In urban planning, there simply is not enough scientific support, either theoretical or technical, to help determine the scope of ecological protection. It is difficult to accurately determine the boundaries of protected land…. Second, how much to delimit? With the high yet ever-increasing cost of urban land, a small difference could cause enormous variance in value. Although the current urban ecological studies cannot answer the question of how much ecological land is needed to support a good living environment in the city," [we should hold on to the bottom line, which is avoiding deterioration of the urban living environment]. (Ouyang 2016)

One would expect that this level of uncertainty could limit the ability of the ecosystem services to be used as the primary means to define the strictest conservation policy the Chinese government has ever attempted to implement.

It also had significant political push back from the provinces as evidenced in the many rounds of the ERL and the continued delay in the development of the maps. First, the ERL was supposed to be finished by 2014 using the first set of guidelines. Then, maps were created in 31 provinces in 2015 using the revised guidelines but were never implemented. My understanding is that all these maps were scrapped. In Shandong, even the ERL map made in 2016 to be completed by 2020 was never implemented due to push back from localities. The possible reasons for some of these delays and local resistance will be further

developed in the next chapters.

Impacts of Lock-in

The results of this lock-in have yet to be fully observed. This new process of categorization has ideological, ethical and material impacts (Bowker and Star 2000). While the science became locked-in, the use of the policy tool changed over time from focusing on ecosystem function zones to the spatially bounded ERL. This shift to quantification, as a percentage of areas, follows a well-trodden policy path in China. In the process, the scientific ideas in the ecological function zones were ultimately transformed into a target management tool. While making it easier for implementation and addressing some of the issues with the Ecosystem Function Zone plan, it also leads to questions around how this will impact the ERL's ultimate goals given that the National Ecosystem Assessment demonstrated that increasing areas was not enough to ensure ecosystem quality.

The ERL points to the importance of examining science and politics as a dynamic process that produces unintended consequences as different, ongoing processes interact. What happens as the policy moves to the local level? How will these ideas translate in two different localities? The next chapters seek to answers these questions in order to understand how these ideas are translated into practice.

Chapter 3

Localized: Anhua County

A good environment is the most equitable common good.
- (Government of Anhua 2017)

I. Introduction

Anhua town, the county seat, sits along the lower reaches of the Zi River. The old town with its low concrete and brick buildings lies on the south side. The tree-lined streets are narrow, filled with cars, motorbikes and shops spilling onto the sidewalks. The new town sits in opposition on the other side of the river. It has lots of new empty high rises, wide streets and a large square along the river where ladies dance in the evenings. It has the look of many new Chinese towns, fulfilling the role of Chinese planning as a unifying force.

Leaving the town, the landscape quickly changes. There are 157 mountain peaks with an altitude of over 1000 meters dotting the landscape. The terrain slopes from west to east. As we drive in the car with local

officials, they point out a Russian-built dam which supplies hydroelectricity, a local temple that was built for a rich family's ancestors, and fields with vegetables and duck ponds. We wind further and further up the mountain and ice and snow appear. Our car has four-wheel drive. We can make it to the top but other cars are stuck. We stop along the way to help other people push their cars even though no one has snow boots.

We reach a red line area, Xuefeng Lake National Geological Park. The park covers 692.6 square kilometers and is known for its slate, quartzite, and karst mountains. It is also home to 39 protected plant species. It became a provincial-level park in 2002 and in 2014 was approved by the Ministry of Natural Resources to become a national Geopark, an expensive and lengthy process (Anhua County Government 2017).

We continue to drive up the mountain reaching a plateau filled with tea farms covered in white powder. There are many signs that promote addressing poverty through tea farms. Even the lowest paid tea sorters make 1,700 RMB ($246) a month, almost ten times what they could make farming their own small pieces of land. As we drive through the park, there is a museum, tea plantations, homes, and guinea pigs for sale. One local emerges from the forest with freshly cut wood. According to a local official, many people still live in the park. The ERL restrictions will stop them from renovating their homes and require them to meet more stringent pollution standards on their farms. An official from a nearby village is against the ERL for these reasons and comments that the ERL will hurt local people, especially the poor and make his job more difficult.

The park is empty of tourists on the cold day. Most of the tourists are local but there are plans to attract more from further away. After the new highway is built, Anhua will be an easy weekend tourist destination for middle class Changsha residents. Changsha, the capital and largest city in Hunan, has more than 7

million residents. There are already homes being built on farmland along the edge of the park to house them. We walk uphill along a path filled with large sculptures from Chinese folktales and reach a large icy glass-floored overlook with a view of miles of mountains, many terraced with tea plantations. There were no signs or physical markers for the ERL lines and no one was sure where the ERL areas stopped and started in the park. The scenery is beautiful. It also is clear that there are already people and pre-existing plans and uses for this land.

The Anhua ERL

According to the technical guide (MEP and NDRC 2017), the ERL is the product of a simple process. According to one expert, the process was expected to go as follows: A national red line map was produced following the national technical guidelines and provided to each province. The province altered it, and then sent it to the county. The county was able to remove areas from the map and then return it to the provincial EEB. The provincial EEB then sent it to the national government by the end of 2018 (Interview 252018).

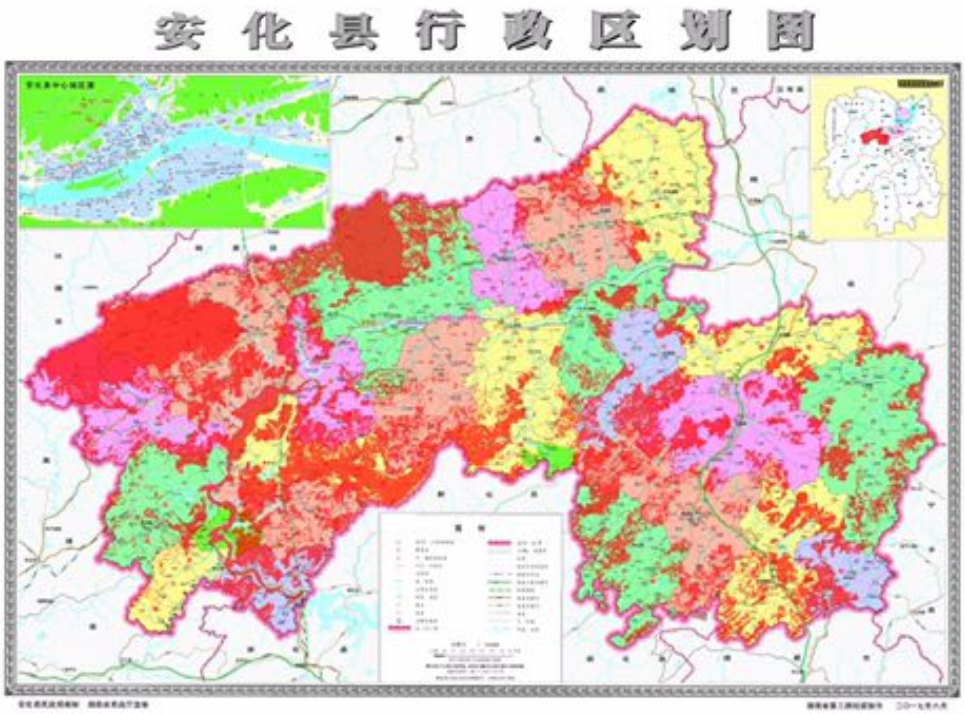
These easy steps obfuscate a more political and contingent process that emerges from the Anhua case. The ERL in Anhua county began as a top-down process. The initial maps were made by a provincial technical team and severely curtailed the area for development. Anhua is considered under developed by Chinese standards and still has significant levels of poverty. Given this challenge, one would expect that there would be fierce opposition to the ERL in Anhua. While the first round of the ERL was resisted, over time and subsequent rounds of negotiation, the process was able to address local concerns and was accepted. Over time, the ERL was more adaptive and flexible than expected. As such, the Anhua ERL is characteristic of a guerilla policy style where top-down targets are ad-hoc and localized. At the same time, given the low technical capacity at the local level, much of the ecosystem services science was not

discussed and scientific concepts underlying the ERL were lost in translation.

The political economy, existing levels of environmental quality, ERL planning processes, challenges and long-standing institutional dynamics were the main determinants of the shape and size of the ERL in Anhua. I argue that the ERL outcome has been shaped primarily by interactions among existing institutions in the face of the political, economic and moral incentives as understood by local officials. In particular, the alignment between Anhua's development plan and the ERL encouraged the adoption of the ERL.

The result of multiple forces has produced an ambitious, albeit fragmented ERL. The Anhua ERL covers just under 32% of the land in the county, or 601 square miles. This is about the size of Rio de Janeiro or Milan. The ERL is predominately on Anhua's mountains with many areas excluded for highly valued urban, forest and farmland. It also covers large areas within existing protected areas. These are important spaces for biodiversity demonstrating that if implemented there could be positive environmental outcomes from the ERL. The Liubuxi Provincial Nature Reserve, for example, is included in the ERL. It has hundreds of hectares of native vegetation in the core area of the park. There are 103 families and 1022 species of woody plants, including 23 species of ginkgo, southern yew, and fragrant fruit trees. There are more than 100 species of animals, including leopards and yellow-bellied horned owl.

Anhua ERL Map



The rest of this chapter explores how the Anhua ERL map was created and the various factors that influenced the final version of the map. In the following section, I offer an overview of the political economy and environmental issues in Anhua. Then, I describe the multi-scale policy process that unfolded to reveal how the map was made and how it changed over time. Next, I unpack the framing of the ERL by various units of the county government to understand how local officials interpret the ERL and their negotiation tactics. Finally, I explore how technical, capacity and finances limited the county government's ability to alter the map along with how existing institutions are acting as enabling and constraining forces.

II. Context

Political Economy

Anhua County is located in central Hunan Province under the administration of the city of Yiyang. It is the third largest county in the province, larger than Rhode Island. It is composed of five townships and 18 towns. The population with a household registration in the county is 1.04 million. There is a resident population of 862,600 (Anhua County Government n.d.). Many residents have migrated to Changsha and other big cities such as Beijing, Shanghai and Guangzhou. It is a primarily rural county with an urbanization rate (calculated as the percentage of residents in urban areas) of 27.46% (Anhua County Government n.d.). According to the master plan for the province, the resident population is expected to increase to 940,000 by 2030 with an urbanization rate jumping to 60% (City Planning Design Research Institute 2015).

The county is listed as a national poverty county[4] with high levels of income inequality. This inequality is also spatially varied. The western part of the county is the poorest and includes the highest percentage of ERL area. The urban per capita disposable income is 10,637 yuan ($1,531) with rural households' income only reaching 4182 yuan ($602) (Anhua County Government n.d.). While income has increased 9.5% and 10.5% respectively, over the last year, disparities continue (Government of Anhua 2017). The designation as a national poverty county makes poverty alleviation a high priority for county officials.

Most residents are poor rural farmers. There is very little available arable land due to the mountainous terrain. This leaves farmers with only .3 mu of land (about 2150 square feet) per family, which is not

[4] This status is determined by a combination of the percentage of the population living below the poverty line, per capita average income and counties with low GDP and government revenue (State Council Leading Group Office of Poverty Alleviation and Development 2006).

enough to sustain livelihoods. Many have planted trees on their land in hopes that this will be more profitable. This has been supported by subsidies through a national program called Returning Farmland to Forest Program (RFFP). Fruit farming brings in more income, but there is not enough land for this to be a widespread livelihood option. This led these farmers to work on tea farms and in tea processing, forestry or aquaculture.

Anhua began developing rapidly and began to receive substantial outside investment beginning in 2012 (Interview 212018A). In 2017, the GDP reached 21.46 billion RMB (US$3.1 billion) with fiscal revenue reaching 1.3 billion RMB (US$448 million). Anhua's primary industries are tea, medicinal products, tourism, clean energy and lithium battery recycling. There are various types of mining operations for tungsten, gold, manganese, lithium and coal. Black tea production was the first billion RMB industry in the county.

Environment

The county is considered to be an area with plentiful resources. The forested area covers 5.36 million mu (1379 square miles) with forests covering 76.51% of the county land (Anhua County Government n.d.). Three river systems cross the county. The main channel of the Zi River has been taken for hydropower with a large drinking water reservoir. The main environmental issues are water and soil pollution due to small- and large-scale industry such as pig and poultry farming and mining. The town has also experienced earthquakes, landslides and in 2017 there were several rounds of severe floods (Government of Anhua 2017). Climate change has increased precipitation during the winter and summer, and is expected to continue to increase (Jiadong Peng et al. 2017). There will likely be more floods in the future.

Beginning in 2014, Anhua was designated as a key ecological function county as part of the implementation of the ecological function zone policy (which preceded the ERL). Following this, several

actions were taken to reduce pollution. A 70 million RMB (US$10.1 million) green industrial park was built to consolidate industrial production, reduce energy inputs and pollution. High energy consumption industries were closed (Interview 212018B). Polluting and illegal industries have also been shut down. In 2017, this included 51 illegal sand mining sites, a brick factory that did not meet the national production capacity standards or environmental protection requirements, and large-scale livestock and poultry farms in the county's prohibited development areas (also the ERL area) (Government of Anhua 2017). Aquaculture farms were also closed on the reservoir to address water pollution from excessive fertilizer use in the town's primary drinking water source. This effort took three years (DRC interview). It involved moving at least 875 households with compensation reaching 43 million RMB ($6.2 million) (Yiyang Government 2016).

The pilots and increased enforcement from the MEE has encouraged the local government to respond to environmental problems. There are now drones that monitor the national park land (Interview 222018D). MEE sends photos of any problems to the local government and requires EEB officials to address them. National inspections have also increased. This central enforcement has not solved all the environmental issues. On a recent inspection in May 2019, the Anhua County government was reprimanded for not addressing the wastewater pollution from a closed mine which was leaching high levels of cadmium and arsenic into the groundwater (W. Shi and Gao 2019).

III. ERL Process

The Hunan mapping process demonstrates how the ERL is more adaptive, negotiated and flexible than expected. In Hunan, ERL areas including spatial areas and overall targets were set by technical teams at the provincial level and then sent to the county. This was just the first step that began multiple rounds of

negotiation. Over time, the targets were responsive and able to adapt to local circumstances. The local ERL mapping process in many ways follows a "guerilla policy style" (Heilmann and Perry 2011) including an "acceptance of pervasive uncertainty, a readiness to experiment and learn, an agility in grasping unforeseen opportunities." This is seen in the ad-hoc and fluid nature of the ERL at the local level as this new policy appears at the door step.

Provincial Level

The ERL mapping process began at the provincial level in 2015. In April 2015, the provincial government released, "Hunan Province Ecological Red Line System Construction Reform Pilot Implementation Plan" (2015). This plan was released before MEE formally issued the Technical Guide for Demarcating ERLs (MEP 2015). Pilot projects, a primary component in the a "guerilla policy style" were started in three counties, Guidong, Yucheng, Yizhang and in Zixing city (Xiaoxiang Morning News 2015). Most of this area was within the key ecological function zones for forests and biodiversity in the Nanling Mountains. One pilot area was located in the upper section of Dongjiang Lake. Dongjiang Lake is in the flood basin of the Yangtze River and a key national ecological protection lake as well as a water source for Changsha (China Environment News 2015). The pilot projects began in summer 2015 and were scheduled to be completed by the end of 2015. This timeline put Hunan's ERL process behind many parts of the country.

The provincial level piloting demonstrates the multi-scale nature of pilots which are rarely highlighted in the policy process. While the policy had been tested by national officials, the process of adaptation and experimentation is done once again to understand the challenges the policy will encounter in Hunan. Even at the outset, it was clear that there were going to be political and technical hurdles. One of the researchers involved in the pilot, Tian Shiqiang, chief engineer of the Hunan Academy of Environmental Sciences, brought forward some of the challenges, "[t]he technical team has a very large workload. We

still need all the departments to put in a concerted effort to cooperate and strengthen coordination" (China Environment News 2015). This level of inter-government coordination is notoriously difficult in China due to its fragmented bureaucracy (Ran 2013).

The national rhetoric and basic practice, however, was translated to the provincial level. The pilots linked the ERL with ecological function zones following the connection of these two policy ideas at the national level. Local officials, interviewed in the newspaper, used the framing from the national government to describe the ERL's contributions. The Hunan Provincial EEB explains the ERL as a way to "solve our ecological environmental security problem." The local director of the Zixing EEB who is in charge of implementing the pilot describes the ERL as positive for development, "[i]t is very good news for local economic and social development, especially sustainable development and ecological civilization" (Xiaoxiang Morning News 2015). These officials were echoing national language demonstrating the tight translation from the center to the province.

There is no public data available on the results of the pilots. There is a hint in the Hunan Government Work Report released in February 2016 which states that Hunan will "explore the establishment and improvement of the ERL" during 2016, making it seem as though there had not been much progress (Hunan Provincial Government 2016). Following the national guidance document from MEE[5], the Hunan government stated its intention to approve the ERL plan and submit it to the Ministry of Ecology and Environment before the end of July 2016.

The pilot experience along with the 2015 National ERL Technical guide (MEP 2015), informed how the

[5] Notice on Accelerating the Red Line Delineation of Ecological Protection (Environmental Office Ecological Letter [2016] No. 534) 9《关于加快推进生态保护红线划定工作的通知》（环办生态函[2016]534号),

process moved forward. This indicates that lessons had been learned within the piloting stage. There was also an awareness of the technical guidelines, which have not been used across the country (Interview 4252018). The choice to follow the national technical guidelines also demonstrates an intention by provincial officials to follow national guidelines. This would led us to expect that Anhua County would also produce an ERL that follows these rules. This, however, did not occur as will be apparent in the following section.

Hunan Province released two related documents to guide ERL work. First, the Hunan Province Ecological Protection Red Line Delineation Work Plan was released in April 2016 (Hunan EEB 2016a). The multi-sector nature of the ERL is clear as 11 provincial bureaus were given defined roles and data requests in the ERL-setting process. (See table below for details). The Provincial Ecology and Environment Department was given the largest role including planning, coordination, mapping, creation of a management information system and to develop policy on ERL management. This combined the technical and management role under one institution. The need to coordinate across many parts of the government for basic data, and with the national and municipal governments indicates that the ERL is a highly political process and mapmaking should not be viewed as easy or simple. It is clear that it will not be possible for the EEB and its technical arms to do this alone.

It also included a detailed plan with the mapping beginning in April and finished by July 2016. This incredibly quick turnaround included two rounds of local government (municipal and county) opinions. This timeline, as will become clear, is especially restrictive for less developed localities such as Anhua County, which lack the staff and technical capacity to adapt the map in limited timeframes.

Provincial Government Roles in ERL Mapping

Government Bureau	Roles
Environmental Protection Bureau	Responsible for the overall planning and coordination of the provincial ERL, organize the ERL mapping, creation of a management information system, develop policy on ERL management and other work; responsible for the assessment of ecological sensitivity, ecologically important areas and ecologically sensitive areas; complete the drinking water source protection areas boundary map; verify other types of ecological protection areas initially identified by other departments based on remote sensing images and ecological assessment results.
Provincial Development and Reform Commission	Responsible for providing information related to the main function area planning-related map documents; reviewing the coordination of the province's ecological protection red line and the "Hunan Provincial Main Functional Area Planning."
Provincial Finance Bureau	Coordinate arrangements for existing special funds to support ERL mapping, study the establishment of ecological compensation mechanism for the ERL.
Provincial Economic and Information Committee	Responsible for the integration of the ERL results into the "Digital Hunan" database
Provincial Natural Resources Bureau	Provide data; complete the boundary map of national protected areas; provide the spatial boundary of the existing mining rights and exploration rights; provide the urban permitted construction area and the conditional construction area vector data above the county level; review the coordination of the red line with the overall land use plan and the overall planning of mineral resources.
Provincial Housing and Urban-Rural Construction Bureau	Completion of the World Natural Heritage Site, the boundary map of scenic spots above the provincial level; completion of the urban construction plan (county city) to determine the scope of construction land; review the coordination of the red line and the overall urban planning.
Provincial Transportation Bureau	Review the coordination of the red line with the road network construction plan.
Provincial Forestry Bureau	In charge of provincial nature reserve boundary, provincial level forest parks, provincial wetland park boundary and important wetlands; compile and maintain the province's forest resources database; provide national Grade I and II protected forest land, national I level II and II public welfare forest data; compile and maintain the province's rock desertification land distribution database; verify the rock desertification sensitive area ERL map
Provincial Water Resources Bureau	Compile and maintain the soil erosion remote sensing monitoring database; verify the red line protection of the red line and water and soil loss-sensitive areas in the water source conservation area.

Provincial Agriculture Committee	Complete the map of the provincial-level and national level nature reserves under the supervision of the agricultural department; provide data on the distribution of soil types in the province
Area Management Committee	Responsible for the boundary map of the Changsha, Zhuzhou and Xiangtan Ecological Green Area
Municipal and Municipal People's Governments	Establish coordination mechanisms to manage coordination of relevant work within respective administrative regions; responsible for verifying the ERL results proposed by the technical mapping group, and proposing amendments and improvements for the administrative area; in conjunction with the relevant units directly under the province, verify the boundary of the ecological protection red line.

Source: (Hunan EEB 2016a)

Technical Mapping Process

The technical mapping process guidelines provides a view of the ERL that differs both from what is presented in the Work Plan and what occurred in practice at the local level (explored in the next section). These documents downplayed the dynamic nature of the ERL process. In practice, the production of the initial technical map required significant local political influence to coordinate across so many parts of the government. Instead, it presents the ERL as a linear, technical and expert-dominated process.

In May 2016, the Hunan EED released its own ERL Technical Plan (Hunan EEB 2016b). The document stated that following the national technical guidelines combined with Hunan's local context, the red line identification process included five steps: (1) assessment of important ecological sensitivity including main ecological function areas, ecological sensitive areas, prohibited development areas and other specified ecological conservation map areas, (2) expert consultation, (3) preparation of the province-wide proposed plan, (4) sending the proposed plan to counties and cities for opinions, and (5) expert review. The Technical Plan stated that the mapping work with the city and counties strongly considered "policy, high technical demands, under a short time span" (Hunan EED 2016b).

The technical assessment was, however, just the beginning of the mapping process. The team was led by the Provincial Academy of Environmental Sciences in collaboration with the Provincial Environmental Monitoring Center Station and the Dongting Lake Ecological Environment Monitoring Center. At the same time, experts from various provincial bureaus including the Development and Reform Commission, Finance, Natural Resource, Forestry, Water Resources and Agriculture were also involved. This indicates that political officials were also involved in the "technical" mapping stage.

According to the plan, the mapping team was responsible for replying to the opinions of the districts and counties and summarizing them to form a red line opinion list. If the opinions were adopted, the mapping working group was responsible for modifying the vector data of each county mapping plan, or if not, explaining why. If the mapping team was unable to respond to the opinion, the Technology Group was supposed to provide a response. On paper, there was no political bargaining in the ERL process. We know, however, that a great deal of bargaining occurred in Anhua and in other localities such as Shanghai (Y. Bai et al. 2018). This will be discussed further later in this chapter.

According to the document, the ERL mapping was based on high resolution remote sensing combined with land use maps and field surveys. The guidelines called for dividing the ERL into first-tier and second tier areas, following the same format as the initial red line map made for Jiangsu Province. The top 50% of all conservation areas (water conservation, soil and water conservation, and biodiversity conservation and key ecological function areas) and 50% of ecological sensitive areas (soil erosion and rocky desertification), based on order of importance, were included in the first-tier areas. The rest were placed in the second-tier areas. The two areas have different management regulations. In the first-tier area, all development and construction activities are banned. In the second-tier area, construction is allowed as long as it is not detrimental to the ecological function (Tan 2016). This process informed the initial map

that was given to the counties but this was just the first step in an interactive process.

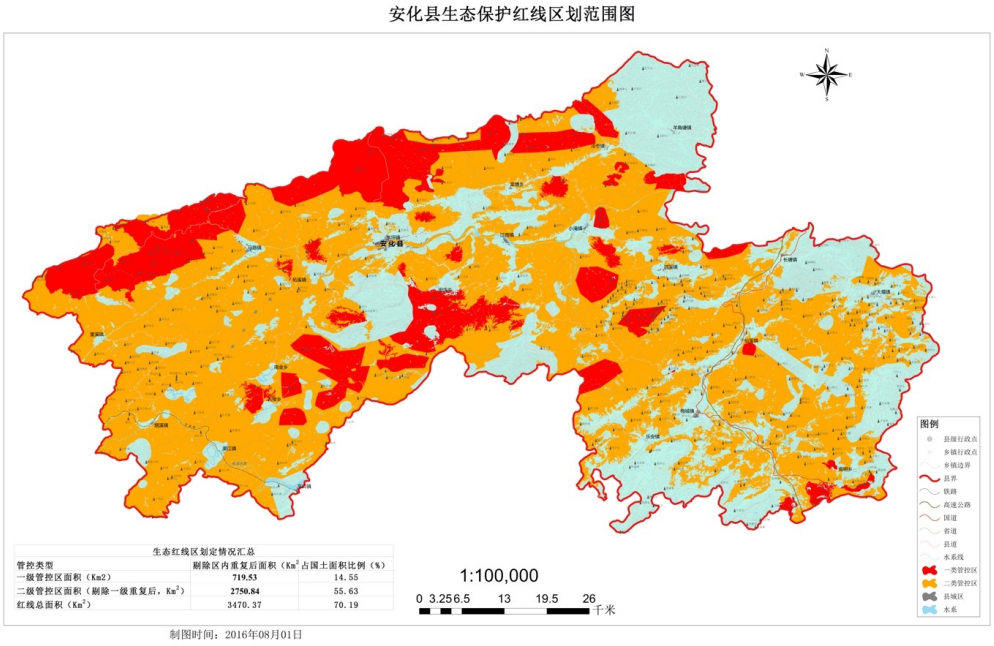
Anhua County Mapping Process

The mapping process then moved to the county. In Anhua County, the first ERL map was received in April 2016. At one point, according to provincial documents, the first-tier management area was 25% with a second-tier area of 51%. In total, the red line was slated to include 77% of all land (Hunan Province Key Ecological Function County Ecological Protection Red Line Delineation Preliminary Results List). While high, other national key ecological function counties in Hunan have similar percentages. For example, the Yongshun County ERL was set at 73% (Yongshun County EEB 2016).

By June, the Anhua map was combined and linked with Yiyang City (Anhua County is under its jurisdiction). By August, the map had been adjusted: 70% of the land was included with 15% in the first tier and 55%, in the second tier. So, the total amount of land covered was reduced by 7% and the land in the first tier was reduced by almost 50%. This is pictured in the map below. The red area is the first-tier area and the orange marks the second-tier area. The blue signifies the watershed area. After two attempts to align the map with Yiyang City and multiple revisions, a final map was produced in October 2016. This version was never published. According to interviews, the head of the county government ultimately rejected the map, because the ERL area was still too extensive. Anhua's position was not considered especially controversial since other counties had rejected their maps for the same reason (Interview 212018A). This suggests substantial push back from the localities against the national ERL mandate. This is not surprising given the high percentages of area that were included in the ERL area. At this point, there were still no specific guidelines on what could occur in the ERL areas and that uncertainty is also suspected to have made localities nervous. In other parts of the country, this has been a concern with the ERL areas. Many protected areas include mines and state-owned commercial forests and officials

want to continue to use protected areas as revenue sources (Interview 7122018).

Anhua County ERL Map (August 2016)



Source: Hunan Province Land Survey Planning Institute 2017

Some local experts in Anhua thought that the ERL concept would be abandoned. All of the departments I interviewed in Anhua, other than the Ecology and Environment Bureau (EEB), were against the first map. The process also missed the national deadline as well as the one set out in the Hunan ERL Work Plan, indicating that it was more difficult to achieve a result than originally expected. It is likely that provinces were also bargaining with the national government about the ERL targets which slowed the process. This occurred in Jiangsu where MEE wanted them to increase their target while the province wanted to reduce it (Interview 7142018). This bargaining over quotas has also occurred over other policies. For example Jilin, Shanxi, Inner Mongolia negotiated with the central government over reducing their energy intensity targets (energy per unit GDP) from 30%, 25%, 25% respectively to 22% for all three provinces (D. Zhang et al. 2011).

Round Two

The two-tier maps disappeared. The original maps were discarded and a new mapping process began in 2017. This seems to have been spurred by the State Council opinions on the ERL released in February 2017. A new round of maps included only one ERL area rather than the two-tier system that was used in the previous version of the map. Several reasons were given for this change from a two-tier to a one-tier ERL. According to the Anhua County Ecology and Environment Bureau, the change was precipitated by national MEE officials who decided that a two-tier system was too complicated and too flexible. MEE thought that it added too much ambiguity to the red line mandates since different activities are allowed in the two areas. There was also a concern that this would ultimately reduce enforcement since there were two sets of rules to enforce. It is likely that local attempts at producing the ERL maps led to national policy change. This is one of the ways that the central government has adapted and compromised on the ERL as a result of the challenges of local implementation. Some have argued that this indicates a responsive quality in China's authoritarian system (Zinda et al. 2017).

On June 6th, national MEE officials came to Hunan to promote work on the red line (Hunan EEB 2017). The "Eco-Environmental Damage Compensation System and the Ecological Protection Red Line Reform Work Symposium" was held. Afterward, the provincial map was re-made yet again by the various technical institutes at the provincial level and sent to Anhua County in July.

The Anhua County government received a new map with a 44% ERL area (8215 square miles), much lower and more palatable than the 70% in the previous map (Interview 222018D). The county then established an ERL coordination mechanism and an ERL Mapping Leading Group. The head of the county government was the leader of both groups.

After consulting with the county government, the county EEB organized a meeting to discuss the ERL and delegate tasks among the different parts of the county government. The county government and the relevant departments of land, housing, environmental protection, forestry, transportation, water resources, agriculture and the development and reform commission were all in attendance (personal communication). The meeting was the beginning of multiple rounds of negotiations where feedback was collected to provide to the provincial EEB. The positions of WHAT? and how the map was changed were based on these discussions.

There were various roles for different parts of the county government. The Anhua County Development and Reform Commission (DRC) was officially the main bureau in charge of seeking consensus on the new map. The DRC's primary concern is to support the continuation of currently planned development projects. In practice, the Ecology and Environment Bureau (EEB) was the agency most involved in the ERL process. For the mapping process, the EEB was part of the negotiations along with the other bureaus. Specifically, the EEB officials viewed the ERL as a multi-bureau project with their primary roles as supervision and enforcement. They continually emphasized that the ERL requires collaboration across various parts of the government including providing data and advice.

The role of the Anhua County Natural Resource Bureau (NRB) in the ERL was to "actively cooperate with the EEB to delineate the ecological red line, avoid overlapping between key project areas and the ecological protection areas, and to review whether priority project site selections are within the ERL areas" (NRB personal communication). The NRB's main concerns were that good agricultural land was not lost and to maintain areas for urban expansion.

While the Forestry Bureau should have been supportive of the ERL given its mandate, officials were

primarily interested in how the ERL would impact commercial forests. In the negotiations, Forestry Bureau officials agreed to changes in the ERL based on two considerations: (1) the relative importance of projects with regard to supporting livelihoods or ecological development and (2) the importance for forest protection. All other bureaus were required to cooperate following the guiding principle, "seeking truth from facts, be scientific and reasonable" (Anhua County EEB, n.d.).

According to the Anhua EEB, the county was not sure how to produce a final ERL map and address the technical and political issues involved (Interview 222018D). This lead the ERL process to be more ad-hoc and localized. In the end, the process included collecting documents, negotiations with various county bureau and negotiations with the township governments (one bureaucratic level below the county). A range of documents and formal suggestions from various parts of the county government were collected to determine what areas should be removed from the ERL area. This included planning documents, feasibility studies, GIS data and future plans for relevant departments (Anhua County EEB, n.d.). Bureaus also submitted their opinions (this is a form of policy document) on ERL locations. For example, the Bureau of Housing and Urban Development provided the master plan to use in the planning process, participated in many meetings and shared information with the EEB to influence the mapping process (Interview 212018C). This made previous plans take precedence over the ERL and provided the county with a clear reason for rejecting areas from the ecosystem services-based map. Experts from the Provincial Academy of Environmental Sciences were "invited to give guidance" and work with the Dongting Lake monitoring station, which was the primary technical agency in charge of making Anhua's map. These two agencies were in charge of creating the actual map. All changes to the map had to occur through their efforts.

While formal negotiation in bureaucratic bargaining is usually only one round (Zhou 2010), the ERL process seems to have involved multiple rounds of negotiations. A revised map was sent to the county

after it was approved by the provincial technical expert group. This gave them another opportunity to change and view the new map although not many changes were made in the next round. The final map was approved by the head of the county government.

This final map was submitted to the provincial EEB in December 2017. (This is different from the dates according to the provincial timeline.) It includes 32% of the county (1557 square kilometers). Overall, the maps were reduced by 12% or 239 square miles (Anhua County EEB, n.d.). While EEB officials considered this "not large," they pointed out that given the relatively large size of the county, it is a larger area than many other counties with larger ERL percentages. The reasons for these changes are explored in section 4 below.

Moving back up

On November 21, 2017, a meeting was held on the provincial ERL plan. Lead by the deputy secretary of the provincial party committee and governor and attended by all the provincial deputy governors and deputy secretary generals, and the municipal and state people's governments, the plan was approved. Within a week, the plan moved to the national level. The province was trying to move fast to make the State Council's deadline. On November 29, 2017, the MEP and the National Development and Reform Commission organized a meeting of the Inter-Ministerial Coordination Leading Group for Ecological Protection Red Lines in Beijing to review Hunan's red line plan. According to the press release, the plan passed inspection and was praised,

> The expert group gave a high evaluation to the province ecological protection red line work and believed that the province's red line work has been highly valued by the provincial party committee and the provincial government. The work is solid and meticulous, and the red line management and control measures for ecological protection are forward-looking (Hunan Province EEB 2017).

Hunan released its final ERL plan to the public in July 2018 (Hunan Province People's Government 2018). It does not include a map or percentages by county although a map had been produced. In total, the area is 42,800 square kilometers, accounting for 20% of the province's land area. The primary ecological functions that are protected are biodiversity conservation and soil and water conservation. Anhua County is listed as part of the Xuefeng Mountain biodiversity conservation - water conservation ERL. The goal of this area is to "strengthen the protection of Central Asian tropical forest ecosystems and their biodiversity resources, endemic species such as Xianghua fish, Wuqiangxi Reservoir and the water conservation area of Tunxi Reservoir (which is located in Anhua County). It is also aimed at reducing soil erosion and rock desertification. The plan calls for all levels of government to use the ERL as an important component in future spatial planning. Party committees and governments at all levels are responsible for connecting the map with actual land areas and strictly observing the ERL.

How did the ERL areas change?

The adaptive, negotiated and flexible quality of the ERL allowed for the map to meet the goals of various parts of the local government as areas were added and removed from the map. Highly valued urban, agricultural and forest land was removed from the map in exchange for the expansion of protected areas. This produced a map which has many gaps for specific pieces of valuable land and reduced the influence of the ERL on existing urban areas. This allows the county seat to continue to grow which is important to maintain land sale revenue to support local government expenditures.

What justification was given for the removal of these areas? The primary reason was the initial exclusion of all existing plans. This allowed for any preexisting plan to take precedent over the ERL. According to officials, their role was to "make sure there was no overlap between plans" (Interview 222018D). (This is an impossible task since there are already overlapping plans for many areas, regardless of the ERL.) In

the formal report, the reason provided was in order to "guarantee normal production and life in all areas of the county and district," several areas were removed (Anhua County EEB, n.d.). According to the *Anhua County Ecological Protection Red Line Work Plan* and my interviews, the following plans were deducted from the red line: Anhua County Urban Master Plan, Anhua County Land Use Master Plan, Hunan Province 13th Five Year Transportation Development Plan, township planning, relocation project, Anhua County Mineral Resources Master Plan, Anhua County Tourism Development Master Plan, forest health conservation project, hydropower station, a newly built reservoir and the Dahuping Reservoir. This action removed the entire county seat and its surrounding areas from the ERL area, reducing the total percentage of area.

Some existing development projects were also removed from the ERL. This was supported by the county DRC, which is in charge of development planning and approval of all development projects. Overall, existing projects reduced the total ERL area by 2%. Not all projects, however, were able to be excluded. For areas to be excluded, they had to be considered "livelihood infrastructure" projects. This definition includes basic infrastructure projects such as a new highway, infrastructure for one of the townships under the county government or a tourism project. Projects that would not be considered in this category include sand mining and real estate development and therefore if the ERL map included a sand mining area, the ERL designation would remain.

Some of the areas seem to be removed simply because the county government wanted to remove them. This signals the more ad-hoc decision-making in the Anhua ERL. For example, a tea village was removed because the county government did not agree that it should be inside the ERL. There was also input from provinces and the township governments demonstrating that the province and the administrative level below the county was able to influence the ERL. For example, the Provincial Forestry Department also

requested that the county apply to deduct the area between two power plants and the Fenghu Lake Wetland Park. There were also projects which had been approved as part of a regional infrastructure program across the Yangtze River Economic Belt. These were also removed.

The county was able to decrease the ERL in highly valued areas by expanding the percentage of protected areas covered by the ERL. The red line area around protected areas and the county's ecological function area was increased from the original plan in order to "strengthen the ecological environment." Drawing on "input from the provincial technical expert team and the local conditions," the areas include Tunxi Forest Park, Xuefeng Lake Geological Park, the Anhua Xuefeng Lake Wetland Park and other areas (Anhua County EEB, n.d.). The ERL is providing a more stringent layer of protection for existing protected areas. The large areas in the map are the provincial parks and nature reserves such as Liubuxi National Nature Reserve, Tunxi National Forest Park, and Xuefeng Lake National Geological Park, Xuefeng Lake National Wetland Park, Hongyan Nature Reserve, Chama Ancient Road Scenic Area, Longquandong Scenic Area and other ecological protection areas. This changes the management rules within these parts of the protected areas.

In order to understand why this is the position of the county government, it is important to understand how local officials interpret the ERL. The next section then goes on to explore three other factors that have influenced the ERL process and form: negotiation tactics, capacity and existing institutions.

IV. Vision, Framing, Knowledge

How do the various officials that were involved in the negotiations perceive the ERL? Framing refers to the principles and assumptions underlying the policy (Forsyth 2002) and is regarded as a social process,

not altogether determined by the objective characteristics of a problem (Hajer 1995). For the ERL, this framing is important for several reasons. First, the ERL was created by central government officials and therefore it is a new concept at the local level. This provides insight into how the ERL, a paradigmatic idea, is translated. More practically, how officials perceive the ERL shapes their position within the negotiation, the map and ultimately, its implementation. The gap between policy and implementation is influenced by whether the ERL is considered a high enough priority and whether local officials see value in its implementation. This section reveals how local officials interpret the ERL and its impacts on the county's development.

Views of the ERL: Soft v. Hard Policy

Environmental policy at the local level in China is usually considered "soft," given the ambiguity in policy documents and are "born to remain unimplemented" (Ran 2013). This has made environmental policies a low priority. This is in comparison to "hard" policies such as economic development, increases in local income, and birth control where implementation is monitored and expected (Heberer and Senz 2011). In Anhua, the ERL now is considered a "hard" policy by most parts of the local government. This signals a change in how land-based environmental policies have been traditionally perceived by local officials. At the same time, there is indications that this "hard" vs "soft" may be too strong a dichotomy for the functioning of the ERL in practice. This calls for considering the flexibility and adaptability that exists in the ERL, even while it is an area that is "strictly protected."

The ERL is viewed as a strict "hard" policy. For EEB officials, their ERL definition closely follows the national technical guidelines, "the area that has special important ecological functions within the ecological space and must be strictly protected. It is the bottom line and ecological lifeline for safeguarding and maintaining the national ecological security" (personal communication EEB). Local EEB

officials are echoing the national framing and understand the importance of the ERL concept. For the DRC officials interviewed, the ERL meant a "no development zone. It is not a line, or a point, it is a big area" (Interview 212018B). When asked to define the ERL, the NRB official's response was, "the ERL is the smallest space with the highest or lowest threshold limit that must be strictly protected." While this definition is different from the national guidelines, the seriousness of the protection is maintained.

This strict quality also brings advantages to the EEB and support the county to reach wider environmental goals. This policy has required different county bureaus to consult with the EEB, and has resulted in an increase in communications among the EEB and the other bureaus. It has also helped to change long-term processes which made EEB's oversight useless. For example, it is difficult for the EEB to control the location and types of industries based in the county. One of the primary advantages of the ERL, according to officials, is that once the ERL is in place, the EEB will have the ability to reject a project from the outset. Officials not in the EEB have found this to be useful as it provides cover for projects that were difficult for the county to reject. Now, by using the ERL as the reason for rejection, there is little room for negotiation. This is also a much simpler assessment than an environmental impact assessment which provides an opportunity to continually alter and negotiate land uses. This is a large change from the existing system. Currently, the DRC approves the creation of a factory, the NRB provides land permits and then finally the EEB is asked to review the environmental impact assessment. This is clearly so late in the process that it rarely changes anything.

Some, however, were against the strict quality of the ERL and the types of areas which were included. The Transportation Bureau views the ERL as flexible and expects that there will be future adjustments. Not surprisingly, this bureau was also the part of the government that is most resistant to the ERL. It wants to build roads through protected ERL areas. While the transportation bureau did not get all the

areas they wanted rejected from the ERL, transportation officials are convinced that they will be able to petition the State Council and get the changes they want to the ERL approved in the future.

Forest Bureau officials also had issues with the strict rules. They thought the ERL should allow for land compensation. This official strategy, "*zhan bu ping heng*," allows for any forested land that is taken away for agriculture or urban development, to be replaced somewhere else. The officials mentioned that this process is actually increasing forested land in Anhua and good for the ecological environment. This is due to passive measures such as people leaving the agricultural land fallow and proactive measure such as tree planting. All of these are considered forestry without addressing the question of what a "forest" is in the first place. The officials also believed that the ecological benefits of commercial forestry should be considered, which would require the rules to be more flexible. In their eyes, commercial forests provide ecosystems for other animals and soil stabilization, benefits that are touted for non-commercial forests which are included in the ERL.

The DRC was more creative in their position against the strict rules of ERL areas. While in theory the DRC will have no ability to plan for any activities in this area, it was still planning for future development. For example, they plan to build bike paths through protected areas. While it is illegal to build new road, they are going to use an existing road that used to run to an old factory.

This perception of a "hard" policy by most officials sits in contrast to localization and flexibility. Zhou (2010) discusses different types of flexibility in Chinese policy. They are "flexibility by purposive design", flexibility in central policies; "flexibility of unintended design", flexible implementation at the local level; and "flexibility by special interests," which means that central government policy is sometimes undermined by the interests of local cadres. The ERL is exhibiting attempts at all these types of flexibility

while also being framed and considered as a "hard" policy. This apparent contradiction is readily accepted by local officials.

Impact on Development

Officials understand the short- and long-term implications of the ERL. For many, the ERL was directly linked to development, "The ERL is strictly protected in order to allow for a good economic development environment for Anhua's future. From a long-term perspective, it allows Anhua to have stable development" (Interview 222018D). Other officials in Anhua are aware that in the long term, the ERL is important "to preserve the ecological environment and mountains and rivers of Anhua." Finally, officials view the ERL as having a positive impact on *national* environmental protection, rocky desertification and forest protection. The Forestry Bureau views the ERL as having a positive impact on forests, and thinks it is the right direction for Anhua's development since "good development follows from good conservation" (Interview 222018E). This position is also supported from the head of the county. At a government meeting, he expressed his support for the ERL and stated, "We have just one planet. We only have a limited amount of land. Thinking about spatial planning and the ERL is important."

There are some concerns, however, on whether the ERL is striking the right balance between conservation and development. The DRC recognize that the ERL will slow down development projects. They noted, "ecological protection is restraining development," as it limits jobs in mining, timber extraction and fishing (Interview 222018B). The officials I talked with also mentioned "conflicts" with development, indicating that the new restrictions would limit livelihoods, transportation and basic infrastructure improvements which they believe Anhua needs. They know that while big cities have better economic development, the air is not as clean as in Anhua. They see this as a trade-off between environment and development. One official, using terms from the 19th National Party Congress, mentioned that Anhua

needs to build a "wealthy and healthy society" (小康社会) and that this process will require sacrificing resources. Officials, however, do not see the ERL as taking protection too far: "while the ERL will restrain development, it will not make it backward."

V. Negotiation Strategies

The Anhua government found it difficult to meet top-down ERL goals while also responding to various local interests, many of which are also encouraged by existing nationally driven policies and incentives. These interests are "needs, desires, concerns, or fears – the things one cares about or wants. They underlie people's positions – the tangible items they say they want" (Fisher, Ury, and Patton 1991). How do the weak negotiate with the strong? The ways to address differences in power has been a key question in the negotiation literature (Zartman and Rubin 2002). Anhua is a weaker party and is considered unlikely to get their interests met because of their position in the administrative hierarchy and other financial and technical limitations, which will be discussed in the next section.

In practice, negotiation strategies allowed county officials to shift ERL areas to spaces that they preferred rather than the form that the province desired. There were two primary tactics that the county government used to support the negotiations among the county bureaus and with the province: taking advantage of conflicting or ambiguous national rules and bundling. While the former was used to physically change the map areas, the latter was used primarily as a framing tactic to create a shared narrative within the negotiations. These tactics relied on officials understanding of the local context, which an important mechanism to increase negotiation power (Fisher 1983).

"Following the Rules"

The county government has been able to meet the numerous interests of various parties by taking advantage of conflicting or ambiguous national rules. The EEB and others stated that the lines were changed "following the rules." This has provided a negotiation strategy used by parts of the county government and between the county and provincial government. Ultimately, this led to changes to the actual map.

Fisher terms this form of power in a negotiation, "an elegant solution," since it provides an option that meets the legitimate interests of both sides (Fisher 1983). In this case of asymmetric power relations, the Anhua local government is creatively using central government rules to advance their own cause. Using the rules to their advantage is a tactic being used beyond Anhua. For example, Dongting Lake was included in the ERL in several counties along the lake. Through adding the area in the lake, the locality was able to increase their subsidy although the area will never be developed since it is underwater.

One of the most contentious issues is the amount of forested area in the ERL. Anhua has both non-commercial and commercial forests. Originally, the local government was told that all types of forests should be included in the ERL area. The MEE clarified the rules and issued a letter that allowed for the removal of commercial forests, designating those areas as a "development zone" (EEB personal communication). In response, the county Forestry Bureau wanted to change the land designation from non-commercial to commercial forest to be able to remove more land from the ERL. Officials used their knowledge about local forests and called for a new scientific study to support their vision of the ERL. The use of scientific information is a common tool in public policy debates in China and beyond (Susskind 2008).

In order to decide how much forest to recategorize, a department from the Provincial Forestry Bureau did a survey and inspection. This part of the Forestry Bureau is perceived as having high levels of technical expertise, and their work is well regarded by Anhua county and provincial planning officials providing legitimacy to the process for all parties. After the assessment, they proposed including less than half, 140,000 mu from 300,000 mu, as ecological non-commercial forest. This reduced the overall ERL and determined which forests would continue to be used for logging. According to a provincial planner, this is evidence of how the Forestry Bureau takes a short-term view of forests as timber products rather than a long-term view of protecting forests to reduce landslides and maintain water and soil quality.

The county also took advantage of conflicting rules. According to the guidelines, all protected areas were supposed to be in the ERL. The county government was allowed to take out a protected wetland which was on the Hunan protected area ERL list since it was inside the urban center and listed in an existing development plan. Park boundaries were also altered to remove areas with existing villages. The boundaries of all the ERL areas were adjusted to leave the parts of the parks with the largest population outside the ERL area. For example, in Liubuxi Provincial Park, after they originally set the ERL area, they found pig and chicken farms in the ERL area. These are not allowed uses. They then had to redraw the lines to permit these farms. It is impossible to include all of the protected area and have no farms inside those areas since people already live in the parks. Localities are using discretion and the spaces between the existing rules to better meet local conditions.

Bundling

Local government bureaus are framing the ERL in ways that meet their various interests and combine their efforts to meet their own interests as well as existing policy priorities, mainly, tourism, poverty alleviation and environmental protection. This linked conceptualization has supported their ability to "bundle" the

ERL with other policies and programs. Linking interests is one way that weak parties can influence stronger parties (Pokharel 1996). The key to this tactic is understanding the interests of the central government and devising ways to match them by making trade-offs. Policy bundling is a means to do this. It refers to a set of techniques that are used to combine different policy objectives to facilitate the implementation of some or all of the policies in the composite bundle (Harrison and Kostka 2014). This is similar to how mediators "package" various options to reconcile competing priorities during a negotiation (Susskind 2008).

Kostka and Hobbs (2012) have shown how Chinese government officials use "bundling" as a way to balance local priorities with efforts to implement national energy targets. These creative measures allow for energy conservation policies and projects that also address salient business, economic, safety, pollution, and political legitimacy concerns in their localities (Kostka and Hobbs 2012). Bundling is not a discreet stage in the process, but is part of continuous efforts to support the search for implementation pathways.

County plans and interviews demonstrate how the county is using the ERL to support its forestry, tourism and tea-focused development plan, called Green Anhua. This is consistent with its designation as an ecological function county. The ERL has become a means to meet all these goals simultaneously by addressing development and livelihood concerns. According to the EEB, "There is no conflict between tourism and conservation" (Interview 222018D). The DRC agrees, as was noted in the previous section. It is planning development projects around the ERL. The Housing and Urban Development Bureau also sees it as positive since the drinking water sources for the city are within the ERL. The ERL then is used to address water pollution and heavy metal pollution leaking into the watershed. According to a government press release, trees will be planted in these polluted areas as part of another national policy, "Returning

Farmland to Forests" (Xinhua News Agency 2017). This meets the interests of the Forestry Bureau, which needs to meet these targets as well.

The ERL is also being framed as a poverty alleviation mechanism since it will lead to migration out of the mountain areas. Isolated families in the mountains are often elderly subsistence farmers and the target of existing poverty alleviation programs. According to the DRC, "[i]t's more efficient to move them (from protected areas). It doesn't make sense to build a road for a few families and it damages the environment" (Interview 212018B). These officials are explicitly using environmental language as a means to move people to town. This is also supported by the lack of other social services in the park such as the health care and schools that officials want families to have access to.

Bundling is supported by structural forces such as national government subsidies and classification systems. The ERL subsidy funds are divided so that half of the money is for environmental protection and the other half is for development. This allows local government to frame the issues as connected because the funding can support linked projects. According to interviews, ecological compensation financing (i.e. payment for ecosystem services) is also helping to address poverty alleviation through combining poverty and environmental goals. These subsidies encourage farmers not to farm and keep forests from being cut down. While small, only 300 RMB ($45) per mu, the subsidies support subsistence farmers. It is also supported by the flexibility in how national government targets for local officials are counted. For example, tea farms are counted as non-commercial forests and hence forested areas. Tea farms are also considered an ecological tourism site to meet those development targets and a poverty alleviation tool by providing jobs. This allows for seemingly hard targets to be more flexible than anticipated.

The combination of these policy priorities marries economic, social and environmental interests. Van Rooij

et al. (2017) have shown that this overlap occurs while implementing environmental regulations in richer localities, but here it is happening in a poor area. Bundling also directly links the ERL to the county's existing development goals and addresses priorities for several of the bureaus that were directly involved in the ERL negotiations. This allows officials to align their different interests and build relationships, and thereby increase their chances of achieving their own objectives (Pokharel 1996).

VI. Challenges

The mapping of the ERL was influenced by technical, capacity and financing considerations. While Anhua was able to alter the map, its negotiating power and its ability to influence the map outcome were constrained by considerable financial and technical limitations. These factors are known to hinder local environmental policy implementation (Zhang, Mol, and He 2016, Kostka and Nahm 2017).

Technical constraints commonly cited in the literature are a lack of technical equipment and insufficiently trained local staff (Mol and Carter 2006). Anhua has weak spatial data management and technology. There are no digital maps available at the county level and most plans are made using traditional survey mapping. (The exception is the master plan which was completed by professors from Tongji University in Shanghai). This has led to significant confusion across the various plans and conflict over where the exact lines are on the ground. The county leader noted that this has hampered all land use planning, not just the ERL. This also made compliance with the rapid timeline for the ERL exceedingly difficult.

The ERL requires human resource capacity to understand the map. Officials in the EEB readily admitted that they did not know the process through which the map was created or how it was meant to protect ecosystem services. The only staff member with GIS knowledge was a graduate student intern. This made

it difficult for the county officials to engage with the provincial technical expert team that produced and then altered the maps for them.

There also appears to be a lack of technical knowledge of environmental issues at the local level. When asked about the goal of the ERL, the EEB officials said that biodiversity was not their concern. For them, biodiversity meant only that introduction of non-native species should be avoided, "if you buy animals and plants from other places, it will hurt the local environment" (Interview 222018D). The ERL will not be able to meet goals of increasing biodiversity if there is not even a basic understanding of the concept in the county. This is part of a general trend. In an analysis in 2010, only one provincial EEB head had training in environmental science and only 25% were promoted to their leadership position from within the EPB which might allow them to gain specialized knowledge on the job (Kostka 2013). This also may be a nationwide issue Tell details of survey that showed lack of knowledge per what you said at defense.[Also include this in conclusion in paragraph I separated about public participation]

This lack of knowledge limited how the maps could be altered. In Hebei, for example, Dr. Li Yuyu from the Hebei Academy of Environmental Sciences, who worked on the ERL mapping in Hebei, stated that it required more than 20 experts more than half a year to manually modify the red line boundary one meter at a time. After that, there were also comments, five centralized checks, revisions, improvements, and countless separate revisions (China Environment News 2018). Yueyang, a city in Hunan, had a similar process that required technical expertise, as the city "held several technical evaluation meetings for the city's ecological protection red line work program, repeated field visits and verifications, multiple communication and coordination with provincial department, and required managing large amounts of information" (Yueyang Daily 2018). This was clearly a challenge for Anhua and likely many other rural counties across China.

There is a need for significant financial support to implement the ERL mapping and enforcement process. This was echoed across the bureaus interviewed. Financial resources are required to inspect the locations and match the areas on the map to areas on the ground. In Anhua, the management of non-commercial forests is expensive because of the salary of forest rangers, reforestation costs, management for fire prevention, pests and diseases and monitoring (Geng 2019). While there is a subsidy that is given to the county based on the area in the ERL, officials are concerned that it is not going to be enough to cover costs. This has been a concern with other environmental policies as well. In terms of reaching energy efficiency targets, Kotska (2019) finds that there are mixed signals as the demands by upper-level governments are not always matched with a corresponding increase in financial resources.

Political capacity constraints can result from coordination difficulties, conflicting priorities within agencies, and low bureaucratic status and authority granted to the bureaucracies (Kostka 2019). Officials acknowledged that different departments must monitor together, but this is hampered by a fragmented bureaucracy which is not accustomed to working together. Data sharing which is a basic need for the ERL, is especially tricky. Officials do not want to share data. During our visit, a provincial planner asked the Forestry Bureau for data and they politely avoided giving it to him, saying that the data collection was not finished. A similar request several months earlier received the same response. Data provides power and bureaus have no incentive to share with one another, hampering their ability to plan collaboratively.

VII. Layering with Existing Institutions

"Layering," is a form of institutional change whereby new rules are introduced on top of or alongside existing ones (Streeck and Thelen 2005). In Anhua, the ERL is interacting with existing land use regulations. This is producing both enabling and constraining forces on the ERL mapping process and its

subsequent implementation.

Constraining Institutions

Existing land use rules constrain the ERL's ambitions in Anhua as the ERL directly contradicts several existing targets for the local government. In Anhua, the primary tension centers around how to manage the balance between agriculture, forests and protected areas. Forest land is considered more valuable than agricultural land. Tea farms, which are a main part of the economy, are counted as forests. There are also many forest products that the government is trying to promote such as honey and mushrooms.

There is, however, a national policy which requires the county to protect farmland called the prime farmland policy. This policy is considered another red line and like the ERL includes spatial and total percentage targets. In Anhua, 335.5 square kilometers (130 square miles) of farmland is protected (City Planning Design Research Institute 2015). This limits the amount of land that can be forested in Anhua.

Officials lamented that the quota for the county is much higher than the total arable land area. This makes it impossible to use the land as the policy intended, for farming. One reason is ecological. The soil is very rocky, which makes it good for timber and tea production but not for many agricultural crops. The other reason is institutional. The NRB has conflicting mandates. On the one hand, it is expected to manage the prime farmland policy including monitoring farmland to ensure that there is no development. On the other hand, it is expected to achieve ever increasing yearly targets for land development. Previously if a developer wanted to build on farmland, an equivalent amount of farmland space would need to be replaced in another area. This generally meant that a forest or a wetland would be replaced by farmland. Now, with the ERL, these ecologies are being re-categorized as prohibited development zones. This further constrains where and how new urban development can occur. As one official plainly explained,

land planning is much easier when you have more options about where you can put buildings (Interview 232018A). This places the NRB in a tenuous position.

Officials also recognize that not all agricultural land can be used all the time. Land needs to be left fallow to permit soil regeneration. Given the strict boundaries of the prime farmland policy, it is not possible to adjust between forest land and agricultural land, making the land less fertile over time. Given this restriction, there is a fear that with more land protected by the ERL, in the long term the county will not be able to meet agricultural targets. Along with this, local officials lament that the livelihoods of farmers may also be affected, which is also not directly considered with the ERL policy.

According to national land use planning experts, the trade-off between forests and agriculture is common in many areas of China (Interview 252018). Ultimately, there is a conflict between meeting national ecological security and national food security goals since the two involve areas that physically overlap. The food security issue is driven by China's land and water scarcity, where 7% of the world's farmland feeds 22% of the global population (Lichtenberg and Ding 2008). However, these policies have not been managed in an integrated way. By considering prime farmland and the ERL separately, there is no opportunity to examine how agricultural land is influencing what and how land is being protected. When asked how this problem might be addressed more effectively, officials called for more authority to adapt policies locally (Interview 1262017).

It is not only the NRB whose targets are impacted by the ERL. The Forestry Bureau also has conflicting targets. Officials are expected to increase protected forest areas which gives them a strong incentive to support the ERL. Another target requires them to increase the economic value taken from the forest every year. These contradictory missions within one agency make achieving and advocating for both goals

challenging.

Even the EEB is facing a challenge to meet all of its yearly targets. Officials were concerned that the ERL expanded the work they had to do without an increase in staff or extra resources to support additional work, making it difficult to reach other existing targets. This concern is prevalent among EEBs across the country as there is not a capacity for monitoring ever increasing environmental policies. (Rooij 2006). The EEB in Anhua is already understaffed and therefore the new policy adds further strain on officials.

Enabling Institutions

Anhua has begun to shift its development model as it has become an "ecological county." The alignment between Anhua's development plan and the ERL acts as a strong enabling factor for the ERL and supported its eventual adoption. Beginning in 2014, Anhua was designated as a key ecological function county as part of the implementation of the ecological function zone policy. This policy along with Anhua being chosen for other pilots such as National Ecological Protection and Construction Pilots has set in motion changes to Anhua's development from a resource-intensive model to a more sustainable development strategy. Importantly, the combination of existing policies has begun to alter the long-standing growth oriented political, financial and moral calculus of local officials in Anhua. It is the failure to align these incentives which has been used to explain the policy implementation gap in China's local environmental politics (Ran 2013).

This connection has allowed the county to recognize economic development opportunities that could spin off from the ERL. The county wants to brand Anhua as a tea and eco-tourism center. It is planning to apply for national park status for several provincial parks to bring in more tourism to the area. Officials view the expansion of protected areas as good for tourism. In 2018, the county aims to have 6.5 million

tourists and tourism income reaching more than 5 billion RMB ($723.6 million) (Government of Anhua 2017). As part of this plan, there are efforts to develop next to the ERL areas including hotels and other tourism infrastructure. Officials also view planting forests in the ERL as an economic development opportunity because it will provide jobs.

These policies, among others, have made the environment a higher priority providing political incentives for environmental protection. The master plan calls for Anhua to "[v]igorously develop the ecological economy, promote a leapfrog transformation of resource-based industries, achieve a win-win scenario for economic development and environmental protection, and build an ecological economic demonstration pilot where nature and the economy are coordinated" (City Planning Design Research Institute 2015). The language only became stronger through the ERL process, as its 13th Five Year Plan for Environment states, "[a]dhere to the ecological red line and prioritize environmental capacity. When the county's social and economic construction and ecological protection conflict, priority is given to ecological protection" (Anhua County EEB 2017).

Officials are aware of the reordering of priorities. The officials acknowledge that Anhua faces environmental problems that are important to address. They talked about the fragility of geological and ecological environment which has led to landslides. They also recognize the impact of industrial pollution especially from mining on water and soil quality. Many mentioned that "our county is prioritizing the environment" and "protection is more important than development." They are also attentive to the changing economy in Anhua as lifestyles and policy concerns change. The timber industry is no longer an economic driver and forestry work now focuses on forest products such as honey or collecting mushrooms. Officials also know about changes in the national accounting system for economic development which will allow for more green development indicators to be measured in the future.

The designation as a demonstration county has also provided Anhua with national government subsidies and led to changes in land use planning rules. For example, an environmental evaluation is now required for all development projects. As part of the pilot project thus far, there has been 10 square kilometers of key projects including returning farmland to forests (RFFP), rocky desertification, long-term forest protection, comprehensive agricultural development and replanting more than 12.6 million seedlings (Yiyang Government 2016).

Officials are proud that Anhua has green mountains and clean air. They have visited large polluted cities and recognized that there are significant trade-offs. The head of the LRB said, "forests are important for our people. Environmental protection is important" (Interview 12142017B). Other officials also used language from Xi Jinping's speeches to call attention to the importance of the environment to development, signaling that Xi's focus on an ecological civilization is even reaching local county officials.

This position is in contrast to other research which has shown that there are no moral incentives for environmental policy implementation, with officials "believing that implementation of environmental policy would not bolster their self-esteem or generate admiration or even approval from others within the current political system; accordingly, they do not feel a sense of guilt upon failing to implement environmental policies" (Ran 2013). This concept that local governments have no incentive to implement environmental policy is assumed in the China environmental literature. Anhua suggests that a new dynamic may be emerging. This may also aid in the implementation of the ERL going forward.

VII. Conclusions

Various factors influenced ERL mapmaking in Anhua including the size of the area, type of spaces protected, and the fragmented pattern of land uses. The ERL process in Anhua occurred at time when

increased economic investment collided with increased environmental protection efforts. It is also intersected with other existing and historical institutions seeking to meet their mandates.

The natural environment, a primarily mountainous region, decreased economic incentives to oppose ERL expansion. It allowed for more space to be added to the ERL since it is hard to develop mountainous areas. The RFFP, a long-standing environmental policy, had reduced agriculture on steep cliffs to limit soil erosion and landslides. Anhua's national designation as an ecological function county and other national pilots had raised the environment as a local priority and generated increased enforcement of environmental protection laws. Kostka (2016) finds that in China binding environmental targets serve an especially important function in the early phases of greening growth, when mobilizing resources and political support are the key tasks. There is evidence of this in Anhua, where increasing focus on the environment has aided in the shift away from mining and other polluting industries. The ERL continued to entrench these efforts, supporting the focus on tea and tourism in the county's development plans. This has led to an ambitious localized ERL, which would not be expected in a poor rural county.

The ERL process also led to changes in the mapping outcome. The process did not follow the expert-driven process laid out in the technical guidelines. The maps did not turn out the way the central or the provincial governments had imagined them. Local officials in other localities have pushed back against urban land quotas and other attempts to reduce development land (Zhu and Tang 2018). I therefore expected that the ERL would face similar resistance. In Anhua, the map-making process was adaptive and flexible enough to be fit into existing development plans. Officials were creative and were able to change the expected balance of power in the ERL negotiations by bundling multiple issues and taking advantage of some conflicting or ambiguous rules. Other authors have shown that when local economic interests are more aligned with environmental protection, there is stronger enforcement (Rooij et al. 2017). This should,

in theory, make the ERL policy more likely to be implemented. There are, of course, technical, financial and institutional constraints that may yet hinder the ERL going forward as planned in Anhua.

Chapter 4

Limited: Jiaxing

[W]e have to establish new concepts of development, which will attach more importance to ecological construction and environmental protection and pay more attention to harmonious and sustainable development among economy, society, population, resource and environment.

– Xi Jinping, Zhejiang Party Secretary, 2002

I. Introduction

Jiaxing is located less than 100 kilometers from both the powerhouse of Shanghai and the tech center of Hangzhou. It is part of the Yangtze River Delta region, the most economically developed and rapidly urbanizing city cluster in eastern China with a GDP larger than Italy. While Jiaxing was once considered Shanghai's vegetable basket and Zhejiang's grain basket and was jokingly known for having more pigs than people, the city is urbanizing, industrializing, and becoming richer along the way. If things go as planned, Shanghai and Jiaxing will soon melt into one another.

Given its grand location, Jiaxing feels relatively sleepy. Its neighbors see it as their smaller, economically backward cousin. Parts of Jiaxing are brand new with wide streets, tall buildings and a giant new, mostly

empty mall. There are lots of fancy cars and even the rural areas are relatively prosperous. The old town is tree-lined and full of small shops. Classic white walls with black tiled roofs line the canals in one of the few preserved sections of the city.

Jiaxing started during the Qin Dynasty and has a history of more than 2,000 years. It has been a prosperous place since ancient times. It is known as the "land of plenty" and the "home of silk." This long history has also led to changes in the low-lying environment as river channels were carved through the area to provide transport for people and goods and water for farming. Water dominates the landscape as it is crisscrossed with dense canals, rivers and lakes. The city's total river length is 13,800 kilometers with 1,832 diked areas, covering an area of 2438.42 kilometers^2 and over 2,000 pumping stations and gates of all sizes. The Grand Canal, the oldest canal in the world, runs through Jiaxing. This water-dominated landscape has continued to shape Jiaxing's development and its ERL.

Jiaxing's ERL story had lots of promise. The city is situated in a pioneering environmental province. The planning process was bottom up, embedded within a more comprehensive environmental land use plan (called environmental function zoning) and was developed over a longer timeframe. The city has the technical and financial capacity to produce a strong ERL. It has severe and extensive water pollution that could inspire action. All these factors would lead us to expect an ambitious ERL. Instead, the ERL is small and maintains the status quo.

Why is this the case? I argue that existing institutions acted as stronger inhibitors of change. Fiscal decentralization and the tight linkage between land use and economic development along with city, provincial and national development ambitions for the area moderated any political and economic incentive for environmental protection. This overall picture is likely the story for many rapidly developing

coastal cities and indicates how environment and development priorities are influenced by multiple conflicting central directives and perverse incentives.

First, it is important to understand the form of the ERL. The Jiaxing ERL includes seven complete pieces, which gives it a cohesive rather than fragmented quality. It covers 3.95% of the city's land area or 38.96 square kilometers. All the areas are water resources. Four of the areas are called water resource red lines and are drinking water reservoirs. Two are designated as biodiversity red lines and are wetland areas. One is South Lake which is called a scenic resource red line area. The South Lake is a popular tourist attraction. The Chinese Communist Party was founded on a boat on the lake, giving it historical significance and providing another reason for ERL protection that was not included in the guidelines. The ERL map for Jiaxing is below. This map was taken from the Zhejiang provincial map and therefore it is difficult to see the exact areas. The takeaway is that there is very little that has been protected.

Jiaxing ERL map

Source: (Zhejiang EEB 2018)

This chapter proceeds as follows. I begin with an overview of the political economy and environmental issues in Jiaxing to provide background for the case study that follows. Next, I present the ERL process for Zhejiang Province and Jiaxing. This case exhibits characteristics of a multi-scale "guerilla policy style" (Heilmann and Perry 2011). It also demonstrates how Xi Jinping has been a champion promoting the ERL from the beginning. The third section shows that the bottom-up mapping process was characterized by a systematic technical procedure, was largely science-based, was part of a longer planning process and included several rounds of adaptive management. I also argue that Jiaxing was relieved of a higher ERL percentage while less developed parts of the province were used to compensate. The ERL was largely viewed as an environmental project, which limited its ability to restrain development. The fifth section presents the two primary strategies used to alter the map and address both national and local interests: technical expertise and bundling. The sixth section explores the environmental, technical and institutional challenges facing the ERL. The seventh section argues that the primary tension influencing the ERL has been between fiscal decentralization and the strong link between economic development and government-driven land planning. While this is an issue in all localities, it is particularly acute in Jiaxing given its geographic location and the push from all levels of government to connect the city to Shanghai.

II. Context

Political Economy

Jiaxing is a second-tier city located in northeast Zhejiang Province. The Jiaxing City is one of the cities in the southern wing of the Yangtze River Delta and the Taihu Lake basin areas. To Jiaxing's southeast is Hangzhou Bay, to the north is Shanghai and neighboring Jiangsu province, to the west is Hangzhou City and to the south is Ningbo City. Jiaxing is located 90 km from Shanghai to the northeast, 90 km from Hangzhou to the southwest, and 70 km from Suzhou to the north.

Jiaxing has jurisdiction over 2 municipal districts (Nanhu District, Xiuzhou District), 3 county-level cities (Haining, Pinghu and Tongxiang) and 2 counties (Jiashan county and Haiyan County). In 2015, the population was 4,585,000. By 2020, the permanent population of the central city will be 1.3 million (State Council 2017).

The Jiaxing region has been undergoing extensive rural industrialization and experiencing significant economic and social change (Shao 2010). Urbanization has been steadily increasing. In 2000, the rate of urbanization (calculated as the percentage of residents in urban areas) was 38%, in 2003 it was 40%, 2014 it was 59.2% and this reached 60.9% in 2015 (Shan, Yu, and Wu 2017). The urban area is also continuing to expand. Jiaxing City has changed from 3,915 square kilometers to 4,234.46 square kilometers in the revised 2017 master plan (State Council 2017).

According to government statistics, GDP reached 435.524 billion RMB (US$63.564 billion) in 2018 with 7.8% growth. According to the Jiaxing Statistics Bureau, for the six months that ended 30 June 2017, Jiaxing City's GDP was 190.4 billion RMB (US$27.788 billion) and it was ranked the ninth in terms of the GDP growth rate among 16 cities in the Yangtze River Delta (Jiaxing Statistics Bureau 2017). This has been attributed to its small population and the consequently low total labor force which has affected the total economic output (Sina Finance 2017). The low ranking, however, is misleading because Jiaxing is being compared to the fastest and richest growing region in China.

In 2017, the per capita disposable income of urban residents and net per capita income of rural residents reached 53,057 RMB (US$7,743) and 31,436 RMB (US$4,588) respectively, and both rose by 8.4%, or 6.1% in real terms. Jiaxing also has a sizable consumer market with an average disposable income of 46,000

RMB (US$6,713), almost 50 percent higher than the national average. In addition, total retail sales of consumer goods in the city rose by 11% in 2016 to reach 163.85 billion RMB (US$23.914 billion) (Handley 2017).

Its close geographic connection with Shanghai has been a driver of Jiaxing's economic transformation and growth. As of 2016, there were 7,149 foreign-invested enterprises in Jiaxing from 98 countries, including Fortune 500 companies such as Abbott, Philips, Mars, Heineken, and Wal-Mart. Jiaxing received a total of 17.94 billion RMB (US$2.69 billion) of foreign direct investment in 2016. Recently, Lego built a new 160,000 square meter sustainable "green" factory to produce toys for the Asia market. At present, Jiaxing's 20 provincial-level development zones, which account for 20% of the city's land area, have gathered nearly 75% of the city's actual use of foreign capital, contributing nearly half of the total industrial output value and one-third of the tax revenue (Zhejiang News 2019).

Rural residences in Jiaxing are numerous, small and scattered. The city's 620,000 rural households are scattered across 17,000 villages. Villages are generally small, and each has an average of 22 rural households, with each rural person having 350 m^2 of land. Farms are scattered and decentralized, duplicating rural infrastructure (Shan, Yu, and Wu 2017). Pig farming was a major industry in Jiaxing. There used to be more pigs than people in the whole metro area. Now, much of the pig production has been shut down. At the end of 2017, there were only 185,900 pigs to address the rampant pollution and the state-led industrialization.

Environment

With development, Jiaxing has faced severe pollution problems including air pollution, water pollution and soil pollution with clear public health impacts. Air pollution is a serious problem in the Yangtze River

Delta (MEP 2012). The air in Jiaxing has been getting worse, especially during the winter. This has been attributed to high energy consumption and large emissions of atmospheric pollutants, and to the influence of the East Asian monsoon which carries the pollution (Ming et al. 2017).

Water pollution is the most severe environmental problem, rendering approximately 90% of the surface water in the Hangzhou–Jiaxing–Huzhou Plain contaminated and undrinkable (G. Cao, Han, and Moser 2013). This has led to water shortages in a region filled with water (B. Li 2014). The primary cause of contamination is uncontrolled industrial and domestic sewage disposal. Locally, the problem mainly has come from pig farming and rural industrial pollution, fertilizer and pesticide use (Shao 2010). There were 7.4 million pigs in 2006, and stockbreeding wastes became the most serious and the largest source of pollution in Jiaxing City (SAEP 2007). Pollution is also transported into Jiaxing rivers from neighboring Jiangsu province and the municipalities of Huzhou and Hangzhou (He and Zhang 2006). This is due to Jiaxing's location in the watershed, as water resources come mainly from upstream where there has been rapid development in industrialization and urbanization since the 1990s (F. Xu, Xiang, and Higano 2014). While there have been efforts to address this pollution, according to EEB officials the water quality has only returned to the pollution levels from twenty years earlier (Interview 6282018A).

Water pollution is creating a vicious cycle with climate change as groundwater has become an increasing percentage of water supply since the surface water is no longer drinkable. Overdrawing of groundwater has led the city to experience one of the highest levels of subsidence in the country (G. Cao, Han, and Moser 2013). The lowering of land surfaces and urbanization combined with increasing precipitation and typhoons from climate change has increased flood risks in Jiaxing (Zhong et al. 2014). Since 1949, more than 30 large floods have occurred in the Jiaxing area, with huge economic loss in the 1954, 1991, 1999 catastrophic floods. In recent years, flooding has led to high economic costs. In 2010, the costs reached

2.430 billion RMB ($US345.657 million) (Zhong et al. 2014). This could also provide a motivation to increase the green space in the city for flood management.

III. ERL Process

Zhejiang ERL Process

The Zhejiang ERL process starts at the beginning of the ERL. The province was home to the first ERL which was created by Dr. Gao Jixi in Anji County in 2000. The province has continued to be a pioneer, as it was one of the provinces that piloted environmental function zones, a method to develop land use plans based on environmental factors. Later, the province incorporated ERLs into their environmental function zone mapping, explicitly linking the two zoning efforts. This places Zhejiang at the forefront of applying environmental principles in land use planning in the country. This particular history influenced how the maps were formed and altered over time. It also made the process in Zhejiang much longer than in most of the county. This had several repercussions. It allowed for adaptive learning to influence the process, it provided time for ideas to take root and become normalized in the minds of local officials and it provided a means for the ERL to not be a siloed planning process. All of these positive factors would lead us to expect that Jiaxing would produce an ambitious ERL.

Xi as a Green Leader

Zhejiang's position as an environmental champion is also closely intertwined with President Xi Jinping, who served as Zhejiang's party secretary from 2002-2007. Xi Jinping was and is well known for promoting environmental actions in Zhejiang during his tenure. Many interviews in Zhejiang mentioned Xi's role as an environmental leader and described Zhejiang's current efforts as building on his legacy. During Xi's tenure, the National Ecological Environment Assessment Report prepared by the China National

Environmental Monitoring Center's ecological environment index, ranked Zhejiang Province as number one nationally (People's Daily 2007). One could argue that Zhejiang was a test for Xi's ecological civilization plans for the country.

At the beginning of his tenure in December 2002, Xi Jinping "proposed to actively implement the sustainable development strategy, aiming at building 'green Zhejiang' to build an ecological province" (Zhejiang News 2017). While Party Secretary, Xi spoke about the need for Zhejiang to change its development path as "rapid economic development has yielded pressure on resources and environment" explicitly linking these two factors (Xi 2003). In a speech in Beijing in 2003, he explained the tight interconnection between environment and development,

> [w]ithout fundamental transformation in economic development, more serious resource waste and environmental problems will be the avoidable result, which will in turn, further substantially restrain economic and social sustainable development. Therefore, we have to establish new concepts of development, which will attach more importance to ecological construction and environmental protection and pay more attention to harmonious and sustainable development among economy, society, population, resource and environment (Xi 2003).

During his term in 2005, Xi visited the first ERL in Anji County, and stated, "We do not promote economic development at the expense of the environment. Clear waters and lush mountains are invaluable assets." This last sentence is a phrase that he often uses today, is echoed across the country and has become a central tenet in his ecological civilization strategy (Zhejiang News 2017). Xi was and continues to be a champion for the ERL. Both Xi and Gao Jixi who created the ERL are still supporting the process today demonstrating continuity in the Chinese political system and how officials can act as a channel for ideas to move up from the local to the national level.

Anji County has continued to receive attention with articles on the national government website as a green development model, a winner of national awards and praise from the United Nations (Zhejiang

Daily 2013; UNEP 2018; People's Daily 2007). This continued promotion of Anji County and likely its connection to Xi has made Anji a continual source of news and praise for its environmental efforts, further promoting the ERL in the province. This is another reason we would have expected a different result.

Environmental Function Zoning

Zhejiang was home to many of the experiments around the ERL linking policy and practice. In 2007, Zhejiang was set as one of three environmental function zone pilots for the national environmental function zone policy. Environmental function zones were a zoning plan that applied different environmental quality standards to different areas. It is more directed at pollution than the current form of the ERL. This led to developing function zones for the whole province and the first attempt at drawing ERL areas. I am unclear about what happened to this effort.

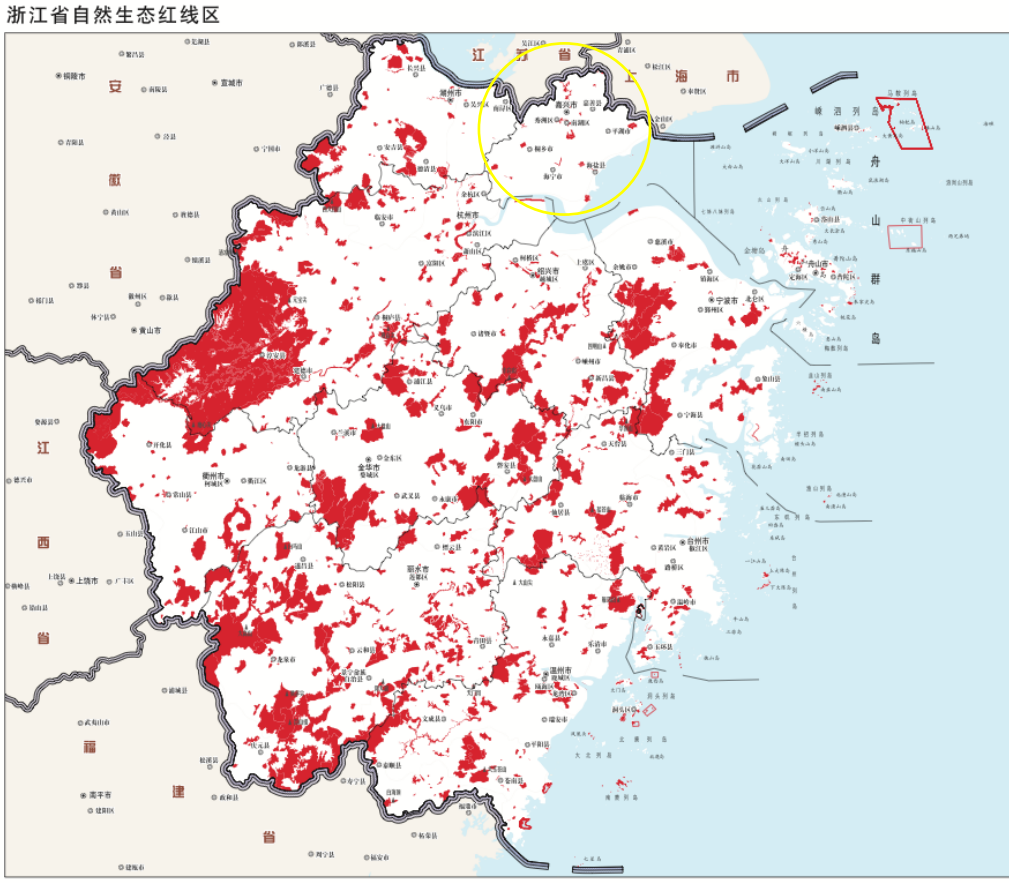
After a hiatus, the ERL emerged again in 2013. This is immediately after the first national ERL pilot had been completed in Jiangsu (which is Zhejiang's neighbor and rival). Zhejiang published a main function area-planning document which stated, "[s]trictly control the development intensity. Delineate the ecological red line, gradually reduce the land space occupied by various construction and development activities, and ensure a virtuous ecosystems cycle." (Zhejiang Provincial Government 2013). This policy places the ERL in a wider environmental plan providing what should be another way for the process to be improved.

In 2015, Zhejiang began once again to develop environmental function zones. There are six types of function zones including a "natural ecology red line area" which is essentially the ERL under a different name. This zoning process produced maps that were approved by local, municipal, provincial and the National People's Congress. It was then published officially in July 2016 as "Environmental Functional

Zoning"(Zhejiang Provincial Government 2016a). The ERL lines in this plan were identified using the 2015 ERL guidelines (Interview 6282018). The ERL area was also equal to the prohibited development zone which maintains its alignment with the Main Function Zoning Policy (Zhejiang Provincial Government 2013). The alignment between all these policies is a feat that is rarely achieved (Xibao Xu et al. 2018) and demonstrates the high technical capacity in Zhejiang which should also have led to an improved ERL.

The Environmental Function Zoning Plan included 20.35% in the "natural ecology red line area" (see map below) and 45.53% in the ecological function protection area. Water resources were a primary focus of the plan. The ERL areas included nature reserves and first and second level drinking water source protection areas. The ecological function protection areas mainly include the middle and upper reaches of the rivers in the province and important estuaries. The province had designated 704 natural ecological red line areas. It mainly included: nature reserves, natural cultural heritage, scenic spots, forest parks, geological parks, wetland parks, and marine special protection zones (Zhejiang Provincial Government 2016a). It included 297 drinking water source protection areas (including primary and secondary protection areas) and some important areas for water conservation and biodiversity conservation (Zhejiang Provincial Government 2016a).

Zhejiang Natural Ecology Redline Map



Note: Jiaxing is in the yellow circle Source: (Zhejiang Provincial Government 2016a)

This was immediately followed by another policy outlining zoning requirements for each of the functions in a policy (Zhejiang News 2017). This aligns with the ideas present in the National Ecological Function Zoning and is one of reasons cited for its failure at the local level. Zhejiang, however, stepped up to define specific measures for each zoning area. At the provincial level, there are 4 categories and 36 standardized control measures for industrial pollution prevention, agricultural pollution prevention and ecological protection.

Zhejiang Supportive Policy Measures

In 2016, the provincial 13th Five Year Plan for Environment states,

> With the goal of improving ecosystem service functions….Establish a red line system for ecological protection, delineate the red line of ecological protection, establish a list of red lines for ecological protection, effectively strengthen the originality and integrity protection of natural ecological environment and ecological functions in the red line area, implement the dynamic status of the ecological environment in the red line area and dynamically monitor the changes to ensure the spatial area is not reduced, the ecological function is not reduced, the nature of the land is not changed, and the use of resources is not exceeded" (Zhejiang Provincial Government 2016b).

This follows the national technical guidelines and further embeds the ERL in the wider planning process.

In response to the State Council opinion on the ERL, Zhejiang released its own opinions in July 2017. "Opinions on the Comprehensive Implementation of the Delineation and Strict Protection of the Ecological Protection Red Line" (Zhejiang EEB 2017). The opinions included many details and high ideals for the ERL. It provides details on the "serious consequences" that officials will face if the ERL is not implemented. It also outlines the roles of local government and contains a timeline. The definition follows the technical guidelines and demonstrates the high level of importance that the province is signaling with the ERL. It uses strong language such as, "We will not remove the road of "Clear waters and lush mountains are invaluable assets," [this is Xi's saying] adhere to being problem-oriented and goal-oriented, improve the quality of the ecological environment as the center of our work, protect and maintain the ecological function as the main line" (Zhejiang EEB 2017).

The opinions provide cities and counties with a variety of tools to exercise the power to define the ERL. Local officials are mandated with organizing across various bureaus, including environmental protection, development and reform, land and resources, forestry, marine and fishery, surveying and mapping, and geographic information. The ERL is be developed "in accordance with the needs of protection and the

status quo of development and utilization." This allows localities to adapt the ERL to their local context. It requires the ERL to be in line with other existing policies such as the ecological function zones and prime farmland policy. It also calls for the ERL to have clear boundaries and connect with the actual space on the ground. This is a comprehensive view of the ERL as a land use policy.

Timeline

The stated timeline for localities to complete this process was very tight and seemed unlikely to succeed. According to the plan, they were expected to submit the plans to the Provincial Environmental Protection Department and the Provincial Development and Reform Commission in September 2017, giving them only three months to complete the maps. The Provincial Environmental Protection Department and the Provincial Development and Reform Commission and relevant departments then were directed to conduct a "technical review" and produce opinions on the map. The map was then sent to the provincial government for approval and to create a provincial map. It also called for linking the land and marine ERLs. By the end of 2017, the province was required to demarcate the province's ecological protection red line.

The plan continues to be ambitious. By the end of 2019, it calls for the province to complete the exploration and definition of the province's ecological protection red line, establish the province's ecological protection red line system and confirm that the ecological space of the province has been optimized and effectively protected and that the ecological function has remained stable. It further provides that by 2030, the red line layout of the ecological protection of the province has been further optimized, the red line system of ecological protection has been effectively implemented, damaged ecosystems have been fully restored, and the ecological functions have been significantly improved, forming an economic and social support.

Jiaxing: 1st Round - 2014 Plan

In September 2014, the Jiaxing ERL map was approved by the expert team at the MEE in Beijing. The ERL was included in the "Jiaxing Ecological Civilization Construction Plan." The ERL was based on the eco-environmental functional zoning compiled by counties (cities, districts) in 2007, and proposed to build a healthy and stable ecological security system. The Municipal Ecological Office in Jiaxing stated "the ecological red line is the bottom line of ecological protection in the current land area" (Jiaxing Daily 2014). The ecological red line area is a prohibited area for industrial development and is the bottom line for project development.

The ERL included 1167.93 square kilometers, accounting for 29.83% of the land area. This included three tiers of protected areas. The first-tier areas were 2.98% of the land area. It included the primary protection area of drinking water sources and its land area, the sensitive wetland and mountain area and the prohibited development area in the main function plan. The area of the secondary control area is 362 square kilometers, accounting for 9.25% of the land area, including scenic spots, wetland parks, important wetlands, etc., including biodiversity conservation, water conservation and hydrological storage, soil and water conservation, desertification control and nutrient control. The third-level control area was 689.1 square kilometers, accounting for 17.6% of the land, including important ecological corridors such as rivers and roads, which are important landscape components.

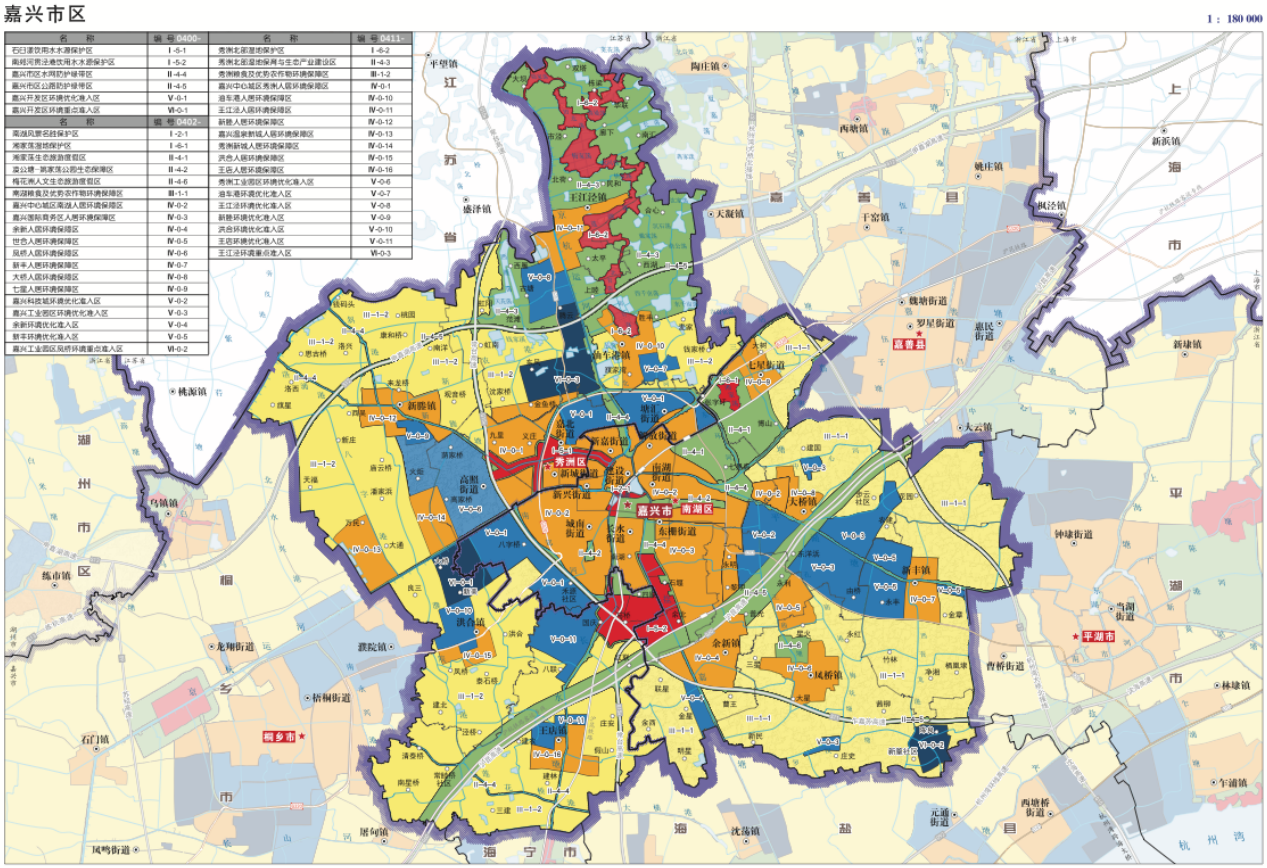
The result of this effort also influenced the master plan. For the first time, at least since 2003 when the master plan began, space was protected within the urban area. It stated that the ecological protection red line was defined as 9427 hectares and emphasized the importance of the effort: "Combined with the environmental function zoning of each county, the ecological function of Jiaxing City is extremely important, and the ecological environment is extremely sensitive" (Jiaxing Daily 2014). This would seem

to secure the ERL as part of city planning going forward.

Round 2 and 3

The 2014 ERL does not seem to have been implemented. The ERL was completed again as part of the National Environmental Function Zones pilot in 2015. This map was based on the 2015 national ERL guidelines. This piloting of the ERL areas was used to influence the next round of the national technical guidelines (Interview 6282018). This is another characteristic of the ERL, it has been informed by rounds of practice. While according to the guidelines, it seemed that the province would make a map to provide to the locality, in fact the locality was in charge of producing the map. After a review by the provincial EEB, it was then approved by the local government and the National People's Congress. The Environmental Function Zone plan for Jiaxing that was published in 2016 includes five ERL areas: Nanhu Scenic Area, Shijie drinking water source protection area, Nanjiao River Drinking water source protection area, Xiangjiadang Wetland Reserve and Xiuzhou North Wetland Reserve (Zhejiang Provincial Government 2016a). This became the baseline for the ERL mapping and negotiation.

Jiaxing Environmental Function Zone Plan (2017)



Note: ERL areas are in red

Source: (Zhejiang Provincial Government 2016a)

Environmental Function Zone ERL Areas (in red in map above)			
Number	**Name**	**Size (km^2)**	**Environmental Quality Targets**
0402-I-2-1	Nanhu Scenic Area	2.11	The surface water environment quality has reached Class III standard; the air environment quality has reached the Class II standard; the acoustic environment quality has reached the Class 0 standard; the soil environmental quality has reached the corresponding evaluation standard.
0400-I-5-1	Shijie drinking water source protection area	5.33	The surface water environment quality of the first-grade protection area has reached Class II standard, and the surface water environment quality of the second-level protection area has reached Class III standard; the air environment quality has reached the second-class standard; the soil environmental quality has reached the corresponding evaluation standard.
0400-I-5-2	Nanjiao River Drinking water source protection area	13.71	The surface water environment quality of the first-grade protection area has reached Class II standard, and the surface water environment quality of the second-level protection area has reached Class III standard; the air environment quality has reached Class I standard; the soil environmental quality has reached the corresponding evaluation standard.
0402-I-6-1	Xiangjiadang Wetland Reserve	1.38	The surface water environment quality has reached Class III standard; the air environment quality has reached the second level standard; the acoustic environment quality has reached the functional area requirement; the soil environmental quality has reached the corresponding evaluation standard.
0411-I-6-2	Xiuzhou North Wetland Reserve	17.25	The surface water environment quality has reached Class III standard; the air environment quality has reached the second level standard; the acoustic environment quality has reached the functional area requirement; the soil environmental quality has reached the corresponding evaluation standard.
Source: (Zhejiang Provincial Government 2016a)			

Jiaxing ERL areas (these are the same as the red areas in the map above)

(Zhejiang Provincial Government 2016a)

This process was started again in June 2017 after MEP and NDRC released new guidelines in February 2017 (Lu 2018). According to my interviews, the new map did not reduce the total area, but it adjusted the boundaries. The map is mostly the same as what was produced as part of the environmental function zoning produced in 2015.

The initial deadline for submission was July 2017. The EPB hired a professor at Zhejiang University to draft the map. The researcher was paid RMB 200,000 (US$28,794) and submitted a map at the end of August. This is the same professor that made the environmental function zone map. As one of the officials described it, "technology is providing the inputs and the government makes the final decision" (Interview 6282018A).

After the map was received, it was sent to the two city district governments with a formal letter that requested feedback on the map. The map was then adapted according to their opinions. (More information on how the map was changed is provided later in this chapter.) In November, the city and counties within its jurisdiction submitted the map to the province. Interestingly, the province then rejected some areas from the red line because of conflict with existing development plans. This makes clear that it is not just at the municipal level that there is tension between environment and development outcomes. It also demonstrates that there is a discrepancy between province and local plans which adds further challenges for environmental protection.

In 2017, implementation had already begun because the environmental function zoning plan had been approved. According to the 2017 Environmental Status Report, the ERL will be delineated based on the "Jiaxing Environmental Functional Zoning." The report states that environmental function zoning will be strictly implemented, and construction projects will be strictly controlled. To demonstrate their commitment, in 2017, the city vetoed 90 projects that did not meet the entry requirements, and rejected the investment amount of RMB 3.727 billion (US$544 million) (Jiaxing EEB 2017).

Moving Back Up

In October, the local maps were completed. This was remarkably on schedule. This demonstrates the influence of the environmental function zoning on the ERL mapping. The existence of these maps which were already approved and included ERLs made this round of mapping less contentious. It also shows how this was perceived as an important policy by local officials. Officials understood that they needed to meet this deadline and should prioritize this effort over others. It also is indicative of the high levels of capacity of officials in Zhejiang to meet the requirements placed on them by those above them.

Following the submission of the maps a meeting was called for review by the relevant leaders and representatives of various government departments, national and provincial experts. This included the Ministry of Environmental Protection, the Provincial Department of Land and Resources, the Construction Department, the Department of Transportation, the Water Resources Department, the Agriculture Department, the Forestry Department, the Marine Fisheries Bureau, the Tourism Bureau, the Meteorological Bureau, the Provincial Surveying and Mapping and Geographic Information Bureau (Zhejiang PDRC 2017).

At the meeting, Deputy Inspector Xie Xiaobo pointed out that there was still much to do and demonstrated the amount of coordination it will take to implement the ERL,

> First, all departments should further raise their awareness of the importance of the red line for ecological protection. In the demarcation of work, we must deal with the relationship between protection and development, the relationship between the province and the local, the relationship between the status quo and the future…The second is to do a good job of convergence and revision. Do a good job in the coordination of land and sea, coordinating with various types of planning, and connecting up and down. The third is to improve management and control measures and supporting policies. Strict management, classification and control and effective control (Zhejiang PDRC 2017).

The Plan successfully passed the expert review at the meeting. The plan was then set to the provincial government, followed by the National Development and Reform Commission, and the Ministry of Environmental Protection after the recent revision and improvement.

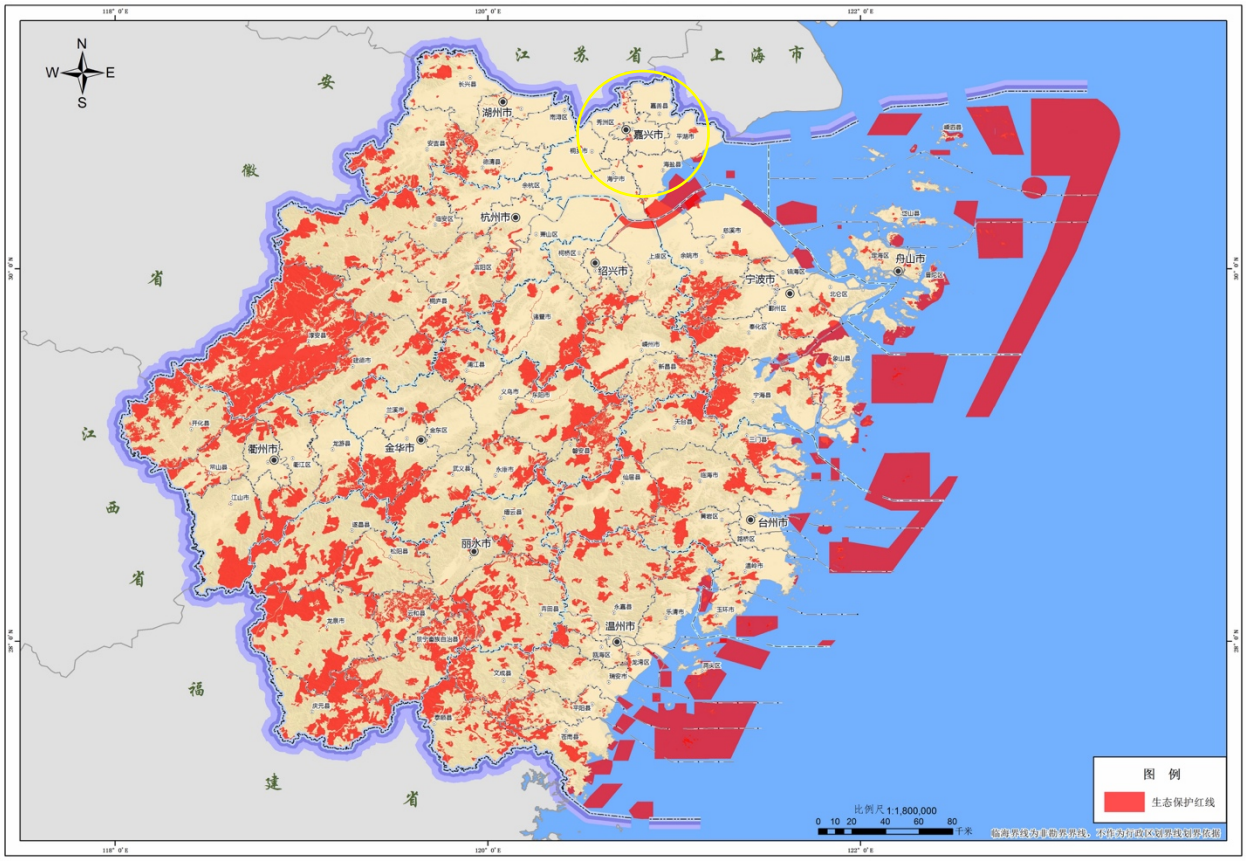
How does the Jiaxing map fit into the province?

The Zhejiang red line covers 26.25% or 38,900 square kilometers of the provincial land area (Zhejiang EEB 2018). The red line is mainly focused on water conservation, but it also includes biodiversity and soil conservation areas. The pattern for the red line is termed, "three areas, one belt, many points." The "three areas" are the biodiversity conservation and water conservation areas of hilly areas in southwestern

Zhejiang, the water conservation and biodiversity conservation areas in mountainous areas in northwestern Zhejiang, and the soil and water conservation and water conservation areas in the hills of center and east of the province. "One Belt" is the coastal biodiversity conservation and coastal ecological stability zone in eastern Zhejiang. "Many points" are the prohibited development area and other provincial and national protected areas. These areas are meant to secure water and biodiversity conservation. The map below is the final version of the ERL for the province. It also includes the marine ERL which is not discussed in this chapter.

As shown on the map below, other parts of the province compensated for Jiaxing's small ERL. This process provided a way for the Zhejiang to concentrate the ERL in areas that were not developed and reduce pressure on its existing development areas. This also indicates that the ERL process allowed for provinces to localize the process more than has been allowed with previous plans. For example, the prime farmland agricultural targets were the same in every locality. This was a large burden for growing economic areas which wanted to use agricultural land for development. In response, Zhejiang started to internally trade quotas within the province to transfer from the developed coast to the less developed interior of the province (Cai 2012). This policy was not officially approved by the central government. While solving the quota issue for some localities, it was very expensive to transfer quotas because developed areas had to pay relocated areas 1,000 to 1,850 RMB per mu. In 2003, reallocation fees totaled 0.73 billion RMB (US$106.5 million) (Cai 2012). Quota transfer permits both the province and locality to be responsive to local development needs when drawing the ERL. This demonstrates how there is more flexibility in the target setting system than expected. It also points to how in this time of centralization, there are still ways in which China's decentralized structure is impacting the planning process. Additionally, this pattern cements existing development inequalities. While these are not as unequal in Zhejiang, it does question the outcomes if this pattern plays out across the country.

Zhejiang ERL



Note: ERL areas are in red. The red area on the coast and in the water is the marine ERL. Jiaxing is circled in yellow.
Source: (Zhejiang EEB 2018)

How did the Jiaxing map change?

The ERL mapping in Jiaxing was altered through high levels of technical expertise and negotiation leading to defined trades between areas. Throughout the interviews, technical explanations were provided for the changes in the maps. This was facilitated by the clear boundaries, small areas and the high levels of scientific and technical expertise by local environment bureau officials.

According to interviews, the "adjustment was quite big from the draft to the final version." While there were changes, the total area was not changed. Due to the small size of most of the areas, small pieces

were added and taken away. For example, in one area, .76 square kilometers were deleted and .63 square kilometers were placed on another side. The EPB knew exactly the size of each ERL area and how each piece was changed. Officials emphasized that all the land that was included met the requirements of the technical guidelines. This led to a much more cohesive ERL with complete pieces rather than ones filled with gaps.

The primary reason that areas were taken out was because development was already there and it would be too expensive or difficult to move. For example, the Construction Bureau examined if there were any issues with the map and existing city plans. One issue was that the red line crossed a road that links two counties and so this area was deleted. In one of the water reservoirs areas, there were existing houses so a piece slightly larger than one square kilometer was taken out. Another area was next to a theme park, so they decided to delete some land that was in the nearby park with a lake to give the theme park more space.

Several of the areas were changed because local officials thought it would place too much "pressure" on them to meet their existing targets if the ERL stayed as originally drawn. One local official was worried that there would be extra monitoring for the ERL and did not want the added challenges that would come with it. Another ERL included a village with small companies and a residential area. The local official did not want to move people and was concerned about limiting development in the area. The local EEP official was sympathetic to these issues and understood the immense stress that these officials face. In the end, both these areas were taken out the ERL.

Areas were also removed because the provincial government did not want them included. This demonstrates that there was also push back from a higher level to reduce the ERL. Most of the literature

contends that municipalities are the level which is responsible for bad implementation outcomes (Kostka and Nahm 2017) but in Jiaxing, there was some effort by the municipal government to be a better environmental steward. One area near a temple was removed from the map because the provincial government has plans to develop a wetland area as a tourism site. This leaves no protection on this site. This was removed and replaced by land in another area. The water resource department also wanted to protect more water sources under the ERL and the province rejected this suggestion.

IV. Vision, Framing, Knowledge

This section explores how the Jiaxing Environmental Protection Bureau and other bureaus understand the ERL in order to unearth how national directives have been translated at the local level and to try to discern how the ERL may be implemented in the future.

Municipal Ecology and Environment Bureau (EEB)

The EEB has been the driver of the ERL in Jiaxing. The EPB is aware of all the rules and definitions of the ERL. Gao Mei, from the Planning and Finance Department of the Municipal Environmental Protection Bureau, said that the

> ERL refers to the area with special important ecological functions within the ecological space and must be strictly protected. The red line of ecological protection is an important starting point for ecological environmental protection. It must be strictly protected, and the red line is also the bottom line and lifeline for safeguarding and maintaining national and regional ecological security (Lu 2018).

The use of the same language as in the technical guidelines demonstrates that the local officials are aware of the national policy. The EPB views the ERL as strict, not flexible and unlikely to change over time. This reflects the rules and the preferences of the city government. The only way they expect it to change is if the function of an area changes. For example, if a new water reservoir is built or another one is moved.

According to the officials interviewed, the ERL areas are important and will have positive impacts on Jiaxing. Officials understand that it has value for their organization and for Jiaxing's long term development. Organizationally, it provides an "umbrella" to support many of their goals such improving water quality. It also gives them the power to persuade other parts of the government and provides a strong enforcement tool. They also appreciate that it is supported at higher levels of government. In the long term, they recognize that it will benefit future generations. The ERL is a way to reduce the conflict between the environment and development by delineating strict limits on land use in ERL certain areas.

There are also understandings of the socio-economic and financial implications of the ERL. Officials were "careful" during the mapping as there will be repercussions on how the mapping happens. Since there cannot be buildings in the ERL, they will need to move people and businesses. There is also a financial cost, "You can't save everything. Some areas don't meet the requirement and others don't have sensitive ecology so you don't need to spend money on it" (Interview 6282018A).

Views of other Municipal Bureaus

All the departments interviewed, environment, water, land and resources and development and reform commission, were aware of the ERL. They all saw the ERL as the highest level of protection, "very strict" and "the bottom line, the strongest layer of protection" (Interview 6262018B, Interview 6272018A, Interview 6272018A). Control over the ERL areas was understood as a serious matter. This is in line with the perception of the ERL by the EEB and the national policy guidelines and its "hard" quality. This would lead one to expect that it was contentious or at least there would be some opinions about what areas were included under the ERL. But this was not the case.

Why is the ERL not contentious? While other departments interviewed were aware of the ERL, and its

significance, it was deemed the job of the EPB and outside the mandate of the other parts of the government. The two officials interviewed at the Jiaxing DRC both told me to ask the environment bureau about it. One seemed to think I was completely wasting his time by asking him questions about it in the first place. This was odd, especially because the ERL is under the mandate of the provincial EEB and the DRC. This should in theory make it under their purview as well. This is another example in the gaps between policy and practice and the need to alter the wider mandate of the DRC with the ecological civilization development plan.

The water resources department officials understood more about the process. According to Water Resource Bureau, they advocated for a bigger ERL but the areas were not increased. They said that during the meeting they had asked why the ERL was so small and wanted to enlarge it to protect more water sources. Their opinion was not considered, however, and the expansion was rejected by the province.

According to the EPB, there are already a lot of land regulations in Jiaxing. The ERL is only adding to the ecological function zoning regulations which had already been approved after several rounds of review. The ERL also does not have many conflicts with existing development. EPB officials agreed that the lack of conflicting regulations was significant, "[t]here won't be a lot of resistance here" (Interview 6282018A). The lack of resistance is also likely due to the small size of the ERL.

V. Negotiation Strategies

Jiaxing used two sources of negotiation power, the "power of skill and knowledge" and the "power of an elegant solution" (meeting the interests of both parties) (Fisher 1983) to alter the map. Specifically, the mechanisms to achieve their goals involved "following the rules" and bundling. While many localities lack the technical expertise to implement mapping, this does not appear to be the case for ERL planning

in Jiaxing.

"Following the Rules"

The EPB officials were aware of the ERL rules. This enabled them to come up with an "elegant solution" (Fisher 1983) that met both local interests and national visions. During the interview, one of the officials had a large binder with all ERL policies and guidelines. As I asked a question, she would answer it and then move to the page to repeat the exact line in the policy. While I have seen local officials quote national rules, this was a whole new level of understanding of what was the official framework. As I asked how the ERL was being changed, I repeatedly was told "by following the rules." Other officials also echoed the sentiment that the "EEB has clear rules to decide what should be included" (Interview 6262018A) although this is not the case in reality as the rules leave space for ambiguity and negotiation over the ERL. Understanding of the rules makes it easier to work around them and repeating the rules is a performative tactic as a "good official."

The officials used the rules as an explanation for how the ERL changed. In the previous guidelines, it was possible to include villages, cultural areas and farmland in the ERL but in the new guidelines, this was not allowed. In 2015, the rules required the ERL to include all Class 2 water areas but this is not included anymore. Both of these rules led to changes between the two versions of the map. When one of the water officials wanted to include more areas, he was told "it was against the rules" so they could not expand beyond the current area. The "rules" provide cover for the city's ultimate decisions and are a strong negotiation tactic within the city government and with higher levels of administrative authority.

As Fisher discusses regarding a negotiation, "knowledge is also power" and in particular knowledge about a particular place and skills (1983). Jiaxing officials had the technical skills and knowledge to

advance their interests. The local officials made it clear that areas could not be chosen randomly and understood the science behind the mapping. In fact, the official in charge of the mapping in Jiaxing had a PhD from the Chinese Academy of Science and had studied ecology and ecosystem services. During our interview, she showed me the ERL map in GIS and could discuss the technical aspects of the mapping process. She was aware of the technical guidelines and understood the equations to calculate ecosystem services. While we discussed the map, she gave me several papers written by Chinese academics about the mapping process in other localities that had completed maps earlier than Jiaxing. She mentioned how the process had adapted over time to address many of the issues that come up in earlier mapping process. She talked about how she had read a lot of the academic studies on the ERL and this was guiding how the lines were being drawn in Jiaxing.

This high level of scientific and technical understanding changed how the Jiaxing was able to alter the map and better negotiate for the outcome they desired. Contending interests frequently seek to manipulate scientific advice to provide a rationale for the decision they prefer (Ozawa and Susskind 1985). Jiaxing could do this easily since this expertise was situated in the EEB. It allowed the city government to make various versions of map over time. This provided the locality the ability to continually remake the map and try different pathways to meet all the parties' interests. (This is different than in Anhua where the mapping was all done by another technical organization.). Given that Zhejiang also had the available data needed to prepare the ecosystem service equations required for mapmaking which was not the case in all provinces (Interview 45252018). This includes data on water reservoirs and ecological areas. This provided another source of negotiation power.

Bundling

The ERL is being used to address Jiaxing's largest environmental problem -- water pollution. This is a way

to "bundle" or combine an on-going and pressing issue for the municipality with the national ERL directive. This is a tactic that has been used for implementation of national energy targets (Kostka and Hobbs 2012). All the ERL areas are water resources.

There are various reasons why they would decide to focus on water pollution. First is the extent of the problem. For example, South Lake, one of the ERL areas, water quality is at the lowest water quality standard. The lake is filled with pollutants from the industrial waste water, sewage, fertilizer, pesticide and has experienced eutrophication. The poor water quality has influenced irrigation water, fish farms and the food they supply and the municipal drinking water (B. Li 2014). While some have called China's environmental actions a form of symbolic legitimacy (A. L. Wang 2013), there are efforts to address water pollution in Jiaxing and there was genuine concern on the parts of officials who also have to live in a city without drinkable water.

Secondly, there has been a history of public protest over water pollution in the area. In 1995, several hundred Jiaxing fishermen and their family members dumped loads of smelly dead fish in the courtyard of the Shengze town government headquarters in Suzhou City in neighboring Jiangsu Province to express anger over upstream water pollution that was flowing into Jiaxing (Eng and Ma 2006). In 2001, as the water pollution persisted, there was a protest that brought national attention to Jiaxing's problems. The fishermen raised 1 million RMB (US$145,950) to block the 50-meter wide Maxiang River with several thousand sandbags and 28 sunk boats loaded with cement (Eng and Ma 2006). In 2011, 500 residents gathered outside a solar panel plant in Jiaxing municipality, overturning eight company vehicles, smashing windows and destroying offices (LaFraniere 2011). According to Chinese news reports, residents claimed that improper storage at the plant had resulted in runoff from solid waste laced with fluoride being swept into the nearby river after heavy rainfall. They said that a sea of dead fish rose to the surface, covering

hundreds of square yards of water. Pigs whose sties had been washed with river water also were reported to have died. The state-run China News Agency reported that government inspectors later found that the water contained 10 times the acceptable amount of fluoride.

Popular protest has shifted to be focused more around public goods (Steinhardt and Wu 2015). Officials understand that there is more pressure for the government to secure public goods including environmental improvement (Interview 6262018F; Interview 6282018A). According to a recent report by the Chinese Academy of Social Sciences, environmental pollution has triggered half of the "mass incidents" that attracted 10,000 or more participants between 2000 and 2013 (cited in Steinhardt and Wu 2015). This has made the environmental protests a perceived threat to the legitimacy of the CCP (Muldavin 2008).

VI. Challenges

Institutional fit, or the matching scales of bio-geophysical systems with scales of management systems (Cash and Moser 2000), is a challenge as ecologically, Jiaxing is different from most of the province. Zhejiang as a whole is 70% mountains, 20% water and 10% agriculture. Jiaxing is flat, full of canals and many of its wetlands have been filled in and developed. This factor was used an explanation for the small size of the ERL by multiple parts of the government. Mountains are seen as an easy area to include in an ERL since they are not heavily developed or populated. Officials mentioned that the lack of mountains made the ERL harder to draw. It was also a challenge to draw the boundaries around wetlands. Where does the wetland begin and end? If the environment was managed differently, much more of Jiaxing would be in a wetland. This made it difficult to define the exact areas around the wetland in the ERL.

One of the other challenges for the mapping was finding area where the ERL could be added. According to the rules, if an area was removed, it needed to be replaced by the same-sized area that was still connected to the ERL. This meant that most of the changes shifted the ERL area from one side to another. For example, one piece of land was included in the northern section of the ERL in exchange for land in the southern part. With limitations on the total size of land, it was hard to find an area to add to the ERL once an area was removed.

Cross-scale dynamics are the largest challenges with the ERL and one common in socio-ecological systems according to Cash and Moser (2000). The ERL cannot address the majority of the severe and widespread pollution problems in Jiaxing that are impacting ecosystem services. Both the water pollution and air pollution are transboundary issues that cannot be solved by one area alone although efforts have yet to be made to link ERLs across jurisdictions. The paradox is while the ERL is not seen within the mandate of other parts of the municipal government, all those interviewed talked about the pressure from the public to improve the environment and also mentioned the limitations of the EEB to address environmental issues alone. There is pressure to improve water sources because it is widely polluted and there is not enough water to support agricultural, household and industrial needs. Some noted that the EEB has a hard time restraining or changing other department actions. This makes it difficult them to achieve their work since they are often not the implementation entity (Interview 6262018B). The EEB agreed with this assessment and talked about how important it was to communicate the purpose of the ERL at both the planning stage and to ensure its future implementation.

There is also an issue in the mapping process within the local government because the NRB and EEB maps do not match. The planning software that the EEB has is not as fine grained as the map at NRB. This makes the final ERL maps not align with the NRB maps. While providing a large technical challenge

to produce a map that is accurate on the ground, this is also a political issue as NRB does not want to share these higher resolution maps.

VII. Layering with Existing Institutions

The reasons for Jiaxing's cohesive small areas are largely due to the way that land is linked to economic development. This existing institutional structure has removed both the economic and political incentives for ERL planning in Jiaxing. While largely ignored as a reason for China's economic development (Cai 2012), land development plays a critical role in economic growth (X. Bai, Chen, and Shi 2012). GDP growth rates in China closely parallel growth in the amount of arable land occupied by construction.

In the 1990s, fiscal reforms allowed for localities to keep a greater share of land income (Ding 2007), while also reducing the money from the central government to cover costs of government services. Land provides a primary source of local revenue. Unlike other taxes, almost all land-generated revenue is retained by local governments and its use is completely under the control of local officials (Cai 2012). The former leader of Jiaxing, the son of former president Hu Jintao, used the significant funds from land auctions to finance local government budgets (Wu 2017).

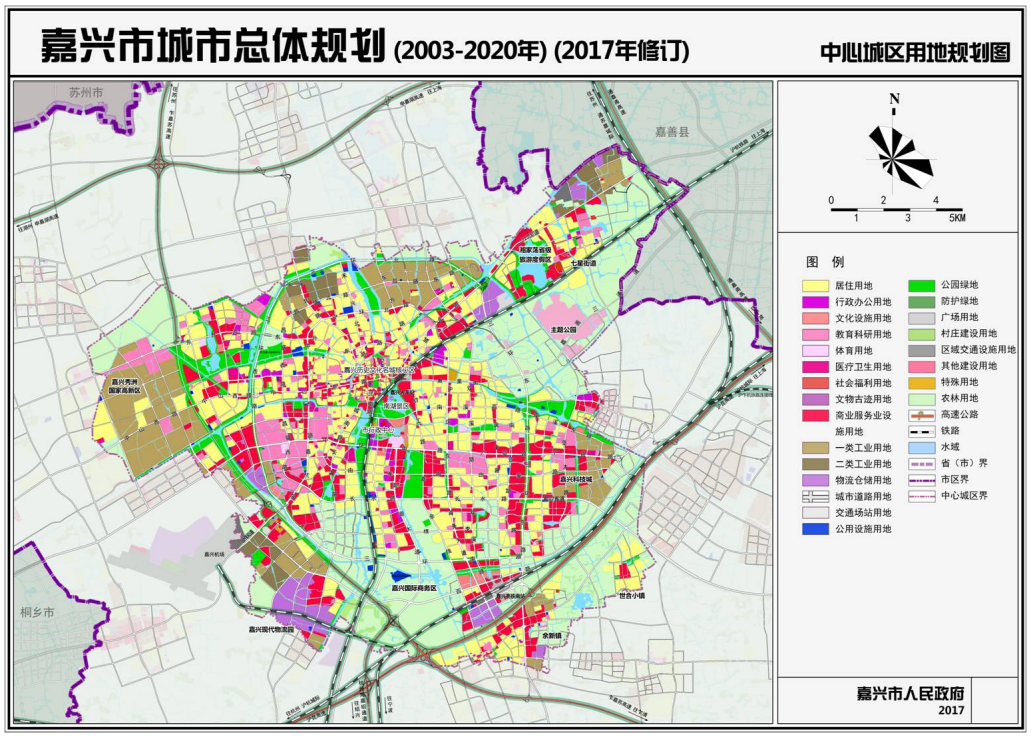
This pressure is more acute, however, in Jiaxing where the government has been trying to promote its connection with Shanghai for years as an economic development driver. This will, however, require lots of land. Xi Jinping proposed that Jiaxing become a gateway to Shanghai when he was the party chief of Zhejiang province in 2003 (Ko 2017), but this did not lead to instant changes. In the past ten years, Jiaxing has seized the opportunity of the southward shift of Shanghai's financial, scientific, and logistics trade maritime transport centers to engage in lucrative land development in adjacent areas.

Cross-provincial coordination is especially difficult in China and a neighboring city in Jiangsu Province spent many years negotiating for stronger ties with Shanghai (Y. Li and Wu 2018). In light of this, the success of Jiaxing's regional integration with Shanghai is seen as a huge political success. This regional integration has been a project that has full support from all levels of government. Locally, the Jiaxing Municipal Party Committee and the Municipal Government have proposed a strategy to attract big business and foreign investment connected to Shanghai since 2013. The Zhejiang Provincial Development and Reform Commission issued the "Implementation Plan for the Establishment of a Comprehensive Decentralized Shanghai Demonstration Zone in Zhejiang Province" and "Jiaxing City's Action Plan for Establishing Zhejiang's Comprehensive Integration of Shanghai Demonstration Zones (2017-2020)" both of which call for construction of a hub for integrated transportation system between Zhejiang and Shanghai centered around Jiaxing. Nationally, the Regional Planning for the Yangtze River Delta (2010-2015), approved by the State Council, requires Jiaxing to further develop its regional driving capacity. In addition to transportation, Jiaxing also plans to deepen cooperation with Shanghai in the fields of information infrastructure, public services, education, health, and social security, and promote the integration of three key cooperation platforms: industry, innovation, and talent (Hangzhou Daily 2017).

These increasing connections with Shanghai have also led land prices to rise rapidly. In 2017, Jiaxing was the country's hottest land market due to cheaper prices, booming local economy and development prospects (Wu 2017). Many people from Shanghai have bought a second home in Jiaxing or are elderly people who think that Shanghai has become too expensive. There is also tension as due to urbanization and ongoing expansion, Jiaxing's limited land supply cannot meet the requirements of urban development. The contradictions and conflicts of urban-rural space utilization continue to intensify (Shan, Yu, and Wu 2017).

This process makes the ERL a very expensive project. This is something that officials in Jiaxing are acutely aware of and limits the size of the ERL. In 2017, Jiaxing revised its Master Plan. This plan was approved by the State Council which also approved the ERL plan. It does not include the ERL (see land use map below). This leaves a paradox. There are now two conflicting plans for Jiaxing, both approved by the highest levels of government, which support and do not support the ERL.

Jiaxing City Master Plan (2003-2020) (Revised in 2017)



Source: (State Council 2017)

VIII. Conclusions

The Jiaxing ERL is small, cohesive and maintains the status quo. It is unlikely to have a meaningful impact on the ecosystem services in the municipality. This case demonstrates some important lessons about ERL implementation. First, is the role of time. The ability for the ERL to be completed over a longer period and within a larger zoning planning process allowed for there to be more time to get all the officials onboard and to view the ERL as part of a general land use plan. Rather than simply defining ERL areas, the ERL decisions were made in unison with wider zoning decisions. The other aspect of time is that the ERL is not as effective as a post-pollution measure. While it can require industry or farms to relocate, it likely just moves the problem somewhere else. This means that there will need to be enforcement of higher pollution standards across all areas so when relocation happens, industry will be compelled to comply and build their new factory with more pollution abatement measures. While the ERL in Jiaxing will not be fully able to address existing severe and widespread pollution, it could be useful to address upstream pollution problems if the ERL is expanded across transboundary areas and combined with other efforts such as expanding sewage treatment plants. This demonstrates one of the general drawbacks of the ERL, while it is trying to secure ecosystem services, it is mostly relying on places where ecosystem services have been relatively well maintained. This has caused Zhejiang to focus their ERL on the western and less developed part of the province and on drinking water sources.

It is clear, however, that the environment has risen on the overall agenda. Officials are feeling public pressure to address the environment. The DRC is working to focus on greening industrial practices and Jiaxing is courting cleaner industries. The new multi-million-dollar Lego plant is using solar energy and meeting environmental standards. The ERL is clearly not the dominant policy tool in Jiaxing.

For Jiaxing, the decision to focus on water areas is a clear one. It is a huge issue, water spreads across the surrounding environment and there are significant public health and livelihood risks. It has also led to public protest. This small area will not be able to address the increasing risks of flooding with climate change. While the chapter focused on Jiaxing City plans, the wider municipality has a coast that has been left out of the ERL. This does not allow the ERL to meet also meet coastal ecological stability ecosystem service goals. It also raises questions about what this will also mean for coastal flooding since the area continues to be developed and may be under water at some point in the future.

The case of Jiaxing suggests that the ERL is not likely to be effective in highly developed places with little land area unless there is a restructuring of the formal link between land use and economic development. This is a state driven process that is shaping both economic and political incentives. In Jiaxing, there is national and provincial support for neglecting environmental protection in favor of economic growth. This is the more general China narrative with a twist -- the center is pushing different visions of ecological civilization in different localities. This will likely solidify the current economic development trajectory where development is allowed to continue along the coast while the interior will be left as underdeveloped protected space ensuring national ecological security. This discrepancy poses some serious ethical questions while also ignoring severe urban environmental problems and the loss of potential ecological adaptation gains.

Chapter 5

Conclusion

As the Chinese economy goes from high-speed growth to high-quality development, pollution prevention and environmental governance are important barriers to cross … We must grit our teeth, climb over this slope and pass this ridge.

President Xi Jinping, March 2019[6]

I. Introduction

China is facing a severe environmental crisis. To address it, China has put forward an ambitious plan to shift its development strategy away from resource-driven growth. China's drive to create an ecological civilization is in essence a commitment to social-environmental change. It includes a vision, a plan and adequate financial support. A key component of this strategy is the ERL.

[6] (Xie 2019)

In this dissertation, I have examined the history, form, and development of the ERL at the national level and within two localities, Anhua and Jiaxing. My focus has been on two puzzles. First, how and why did China, known in the past for its weak environmental performance and widespread environmental degradation, create the world's most comprehensive ecosystem-based land planning strategy? Second, How and why would China which is applying top-down command and control environmental regulation, and is increasingly politically centralized, be able to support local variation? My approach to answering these questions emphasizes the dynamics of multi-scale policy-making and the nature of institutional reform. For analytical convenience, I separate the discussion that follows into separate sections on process and outcome, although in practice the two are linked.

National policy documents set certain expectations regarding the process and desired outcomes of setting Ecological Conservation Red Lines. The ERL is meant to ensure that sufficient protected areas will be set aside to preserve sustainable ecosystem services into the distant future. Specifically, it aims to protect water supplies, biodiversity and reduce soil loss in sensitive areas including previously protected areas (Ministry of Environmental Protection and National Development and Reform Commission 2017). The ERL's ultimate goal is to place environmental concerns at the center of development.

The ERL is usually depicted as a top-down process driven by the central government under Xi Jinping, who has worked to concentrate power. Indeed, the central government has determined the rules and techniques for ERL mapping. The process of ERL designation originally was expected to follow one of two pathways: either downscaling of a national map or allocation of target-based policies, (i.e., quotas set by the national government). In the quota approach, the national government would divide desired targets among the provinces which would allocates proportions of the quotas among the localities. Neither of these models, however, explain what actually happened. In practice, the process has not been

nearly so top-down.

Form

The ERL in both case study localities has been shaped by roughly similar dynamics. The political economy, existing levels of environmental quality, on-going planning processes, and long-standing institutional dynamics were the main determinants of the shape and size of the ERL in each locality. I argue that the ERL outcome has been shaped primarily by interactions among existing institutions in the face of the political, economic and moral incentives as understood by local officials. These have produced both enabling and constraining forces. In particular, the interaction between the new ERL mandate and existing institutions has generated unintended consequences that may well inhibit the ERL from reaching its goals and hinder progress toward a sustainable transition to a more environmentally sensitive approach to development.

Anhua is a large county with a lot of mountainous land. It includes large existing protected areas that were there before the ERL and space for their expansion. The interaction between the ERL and existing institutions responsible for managing protected areas has produced a fragmented albeit ambitious ERL. Anhua's designation as an ecological function county and the local government's desire to become a tourism and tea center, align nicely with ERL policies. This led to ready support of the idea of the ERL; implementation has been furthered by the support of local officials who find that the program fit with existing political, economic and moral incentives. All in all, this combination has led Anhua to a less resource-intensive development model than many other parts of the country. At the same time, conflicts with the prime farmland policy and incentives to continue harvesting forests produced a fragmented ERL map. This could make it difficult to expand or maintain the ERL in the future.

Jiaxing's ERL was expected to be ambitious. Instead, it yielded a small, cohesive ERL that maintains the status quo. Jiaxing began the ERL delineation process with limited undeveloped land area. This made an expansive ERL difficult to implement and much costlier, because it will require moving people and industry. Ultimately the political and economic incentives offered by the ERL program where superseded by existing development plans at the national, provincial and municipal level. These plans seek to unite Jiaxing with Shanghai and move Shanghai's industry and continually expanding population to the Jiaxing area. While the pressure still exists to expand environmental action, Shanghai's growth pressure limits the prospects of using the ERL as the policy tool of choice in Jiaxing, shifting the locality's environmental goal away from protecting sensitive areas to employing other forms of regulation.

Process

The ERL-setting process was nuanced, contingent and complex. The national history of the ERL reveals a particular policy style ("*zuofeng*" (作风)) – one that borrows and builds on previous policies. In many ways, it follows what Heilmann and Perry call "guerilla policy style" (Heilmann and Perry 2011), in particular the focus on pilots and local experimentation. This was then combined with target-setting by the national government, where the central government sets a national goal for a policy or program and then assigns specific binding targets or quotas for particular sub-areas.

This apparent contradiction in the ERL's design as dynamic with binding targets has produced an ERL process that was more adaptive, negotiated and flexible than expected. It was adaptive in that it changed and improved administratively over time. There were negotiations among levels of government and between scientists and policymakers. It was flexible because it was able to accommodate local environmental priorities and development goals. This "adaptive negotiation" approach allowed the ERL to change its shape across the country from ad-hoc in Anhua to technical in Jiaxing.

Mechanisms

The ERL has revealed ways in which local governments can influence planning in a period of centralization. This has been generally overlooked in the literature on government operations in China. This literature has mostly focused on why local governments often fail to implement national environmental policies, often placing the blame at the feet of local officials (O'Brien and Li 1999, Kostka and Mol 2013). In the case of the ERL, local officials were able to find ways to meet their development goals and ERL policy targets simultaneously. They did this in two ways, by "following the rules" and bundling, although these played out in slightly different ways in the two localities given their differing levels of technical expertise. While everyone agreed that the ERL was accomplished by "following the rules," subjective interpretation of the rules led to taking advantage of both intended and unintended flexibility (Zhou 2010). In Anhua, bundling was used as a framing tactic to link the ERL to wider development priorities and get everyone on-board. In Jiaxing, it was used to inform the choice of areas to target, addressing Jiaxing's most severe environmental problem -- water pollution -- while ignoring other ecosystem services.

II. Implications for Theory

My case studies suggest three additions to the literature on institutional change: guerilla policy style, lock-in and layering. Together, these suggest a new direction for future studies of institutional change in China, and perhaps elsewhere, especially as regards sustainable transitions. In particular, they demonstrate how important an historical perspective is identifying the ways in which change is negotiated. These three additions also ask us to turn our analytical attention toward the role of science and scientists and the role they can play in the wider policy process. Finally, environmental policies cannot be understood within a vacuum; they need to be seen in the wider spatial and institutional landscape.

"Guerilla Policy Style" and a Focus on Practice

Several features of the ERL process follow the pattern of "guerrilla-style policymaking" outlined by Heilmann and Perry (2011) who source China's current policymaking to its Maoist roots. This views Chinese policymaking as a process of continuous change building on experimentation and adjustment. Heilmann and Perry (2011) describe policymaking of this sort as one that "shapes itself in the making." This is certainly an apt description of the ERL process which included several rounds of testing and constant change as new guidelines were released and new maps drawn at multiple levels across the country. Ouyang described the ERL as a process needing "continual adjustment and improved methods for red line planning and management" (Zhejiang Daily 2016). These features were embedded in its very design.

The ERL process also reflects a kind of policy-making that is connected to practical experience and pilot efforts. According to Li Ganjie, the current head of MEE (when discussing the red line in 2015), "the final number should still come from practice…The theory comes from practice, and it will go back to guide practice, and then through further practice, the theory is improved" (Wang 2015). This idea of the importance of practice parallels Dewey's thinking which influenced Mao and the Communist Party (Heilmann 2011). Dewey presented an experimental method as a central feature of modern science and obtaining scientific knowledge.

Practice-based policy making has been used to explain how the central government encourages local officials to innovate and then selectively integrate local experience back into national policy formulation, providing a means for bottom-up change in a centralized system (Heilmann 2008b). The ERL experience is consistent with this idea. It began as a local experiment in Anji County, Zhejiang and slowly moved to become a national policy. There were also a range of other pilot efforts as it formed at the national and provincial level. This disputes the top-down assertion that is regularly used to describe the ERL process.

Experimentation and adaptation have implications for the ways that the ERL has changed over time and how it may be able to change in the future. Politically, it has permitted lessons and improvements to be incorporated into the ERL. I argue that this is also a product of the ERL's flexibility which has allowed it to be localized. Flexibility has allowed a policy which in many ways might have been politically untenable to proceed, accounting in large measure for the ERL's adoption.

Guerilla policy style is consistent with many of the ideas in the adaptive management literature in ecology and environmental policy. Much of this writing demonstrates why environmental policies need be responsive to changing ecological conditions and new information in order to be effective (Adger et al. 2011). Jiaxing officials described the ERL as a learning process which allowed them to incorporate lessons from implementing environmental function zoning. They described the ERL as follows: "it's like a relationship. It needs a period of adjustment" (Interview 45252018).

The ERL's ability to adapt over time could allow it to address changes in the environment and as well as current management challenges. It could provide for areas to be expanded over time and to incorporate new advances in ecological science. Gao has discussed how the ERL could be used as a means of climate change adaptation as ecosystems change with a new climate (Ye, Zheng, and Cui 2018). While this not currently considered in the ERL plans, there is a mechanism by which this could occur in the future.

Intertwining China's adaptive experimentation and ecological adaptive management, it is possible to see how the ERL process going forward could provide opportunities for improvement. It also points to ways in which China's environmental policymaking may have lessons for other places. While a fierce debate in the China environmental governance literature has been focused on whether China's authoritarianism is better for environmental policymaking than democracies (Beeson 2010; Gilley 2012; Eaton and Kostka

2014), it seems that this question is misplaced. It is not China's authoritarianism but its use of practice, experimentation and adaptation which may be the source of China's environmental policy innovations.

"Scientific Lock-in"

Important differences between the ERL process and Perry and Heilmann's "guerrilla policy style" (2011) model are the role of science and practice. Heilman's other work (2011) argues against the incorporation of science, this has become a strong centerpiece of Chinese governance since Deng. Heilmann argues that Chinese style experimentation is not "scientific" or "evidence-based," that it is all a political process driven by competing interests, ideological frictions, personal rivalries, tactical opportunism or ad-hoc compromises. This, however, does not take into account the role that science and scientists played in formulating and implementing the ERL.

While the ERL began as an experiment in one locality, it was buttressed by years of scientific research and international recognition of the importance of ecosystem services. A part of the story of institutional change in environmental politics that is not usually highlighted in China is the role of science, in this case, ecosystem service research. By examining the role of scientists and science within the ERL policy process, especially in light of the institutional change concept of "lock-in," it is possible to demonstrate the ways in which science influenced ERL development. The science behind the ERL shaped its policy trajectory as did the way it emerged in practice. In fact, the relevant pilot projects were undertaken primarily by scientists which demonstrates the strong linkage between science and policy.

The interaction between ecosystem services science with "guerilla policy style" (Heilmann and Perry 2011) and the target responsibility system also produced challenges for ERL management. In the mapping process, there were challenges such as how to quantify abstract ideas, especially in light of uneven levels

of data quality. The ERL was difficult for many provinces and localities to implement in practice, leading some to do little more than protect existing protected areas. It proved difficult for national scientific teams to get provinces and localities to follow the guidelines although the equations they were given were very simple (Interview 1302019). Jiaxing is an outlier in its ability to appreciate the science of ecosystem services. At the same time, there is still no scientific method of determining whether improving ecosystem services will lead to measurable changes on the ground, especially over a policy timeframe which produces continuous changes as the ERL. This is a problem for several reasons. First, how will the ERL be monitored to measure if it reaches its goals? Secondly, as ERL targets are being integrated into the cadre evaluation system (which the Chinese government uses to assess officials' performance and promotion opportunities), there could be strong repercussions for not meeting a policy which cannot be accurately measured.

My two cases demonstrate the differential impacts that localities were able to have on the mapping process based on their levels of technical expertise. The literature on environmental regulation has demonstrated the high degree in state capacity needed to select, allocate, implement, and verify environmental targets (Kostka 2016). The varying capacities across localities also raise doubts about whether localities will be able to manage these areas once they are identified.

The institutional change literature reminds us that institutions require active maintenance; to remain what they are, they need to be "reset and refocused, or sometimes more fundamentally recalibrated and renegotiated, in response to changes in the political and economic environment in which they are embedded" (Thelen 2004). In the case of the ERL, ecologists and ecological knowledge have been central to how the process unfolded over time. This suggests a continuing emphasis on the science of ecosystem services will be important.

Layering

Thelen (2002) defines several forms of gradual institutional change in post-war capitalist economies. One is "layering," which she defines as the introduction of new rules on top of or alongside existing ones. In this case, the ERL provides new land use planning rules which interact with a host of other rules. Others, have demonstrated that while some institutional arrangements may impose a dominant logic of action, these typically coexist with other arrangements, created at different points in time and under different historical circumstances, that embody conflicting and even contradictory logics (Orren and Skowronek 1994, 2004). The ERL is attempting to change land use logic while also being conditioned and constrained by existing logics. In fact, at times, it was the very same land use institutions that the ERL was attempting to reform, that limited its ability to generate change.

Anhua's ERL was supported indirectly by the Farmland to Forests policy which had already taken a great deal of land away from farmers. Additionally, Anhua had begun to focus its development on eco-tourism and tea. This met all the requirements of an ecological function zone and allowed Anhua to bundle its existing development priorities with the goals of the ERL. It is also constrained by existing targets that county government bureaus are incentivized to meet. In Jiaxing, while the existence of an environmental function zoning plan and strong provincial support for environmental planning added to the acceptance of the ERL, fiscal decentralization and the strong linkage between land and development vitiated some of the political and economic incentives that were meant to support the ERL.

I argue for adding a second conceptual level of layering. There are not just new rules being layered on old rules. There are also new land uses being placed on old land uses. Also, much like there are several conflicting rules, there are also often several conflicting land uses on one piece of land. This is true across China, even within existing protected areas. For example, in Anhua, protected areas are filled with homes

and farms. There is also a water reservoir which provides fish farms for subsistence fisherman. This makes ERL management more complex as a variety of existing land uses are being placed under protected area management. The combination of land rules and uses calls for an analysis of both literal and figurative layering. While this dissertation has mostly focused on the former, the latter deserves more attention as implementation moves forward.

III. Implications for Practice

There are various practical implications that emerge from this research.

1. The ERL needs to be localized and embedded within an existing land use planning process. Jiaxing's inclusion of the ERL in its environmental function zoning plan provided a way for the ERL to be addressed in the context of other environmental land use decisions. Shanghai has taken this a step forward and timed its ERL planning with a revision of its master plan. As long as all these planning processes are siloed, implementation of the ERL will remain more difficult than it needs to be.

2. While there are national financial outlays that accompany the ERL requirements -- in order to incentivize less developed localities -- the funding was not sufficient to encourage expansion of protected areas in much of the country. This is due to land serving as the primary source of revenue for localities combined with fiscal decentralization. The revenues received from the sale of land use rights have become the most important source of extra-budgetary income for local governments (Man 2011). At the same time, local governments are responsible for over 70% of the cost of public services while only keeping 40% of the taxation revenue (Saich 2015). This provides strong perverse incentives against land conservation. The central government needs to improve the balance between central and local taxation and expenditures

and decouple land as the primary source of local tax revenue. These are powerful institutional levers for more sustainable and resilient land use choices.

3. Currently, most of the ERL designations have provided stricter protection for existing protected areas. Given that previous protected areas designations have thus far not lead to protection, this is good news. It, however, raises an important concern. It does not address the root cause of ecosystem services degradation and loss of ecosystem quality. While the creators of the ERL have discussed climate change and the types of issues that the ERL addresses are influenced by climate change, there is no analysis of climate risks in the ERL mapping process. This is a major drawback of the current ERL maps. It will also likely hinder the ERL from achieving its overall goals. To address issues like coastal erosion requires understanding how sea levels are changing and future coastal flood risks are affected by climate change. China has the scientific information to be able to do this and understands the economic costs of inaction. The ERL has the capacity to unite biodiversity and climate goals in order to meet Sustainable Development Goals and the objectives of the Paris Agreement. The next Convention on Biological Diversity meeting is in Kunming in 2020. The Chinese government wants to produce a Kunming Agreement that is as ambitious as the Paris Accords. The successful implementation of the ERL could help China make the case for leadership on global environmental governance.

4. There are clear trade-offs between national and local ecological security and types of ecosystem services. The ERL, however, has determined that national security should have priority. While China may have enough water for the country, it is not very helpful if water supplies are not in the right places when they are needed. Socio-ecological systems require the attention of local decisionmakers. The primary ecosystem service in one area may not even be on the national list. There are also trade-offs among ecosystem services. In rural areas, there needs to be an accounting of the tradeoffs between saving

farmland as compared to preserving forests, and consideration of their social and ecological implications. It may be that focusing on one service over another will lead to more environmental harm.

5. As the ERL is being set, protection is being added in places with less development. While the areas that have the highest ecosystem services are undeveloped areas, this is also cementing existing regional development inequalities. This will need to be addressed as the ERL moves forward. China's development has come at a huge cost to poor rural people, environmental protection should not as well. This will require more financial and technical support to rural areas. This could provide a means to address the various social and economic impacts that are beyond local capacity to manage and compensate losers.

6. It is clear that scientists have a large role to play in environmental planning. As the ERL continues to be re-made, more scientific specializations should be included. There should be anthropologists, economists, hydrologists and climate modelers involved in improving the ERL and ecosystem models in the next stage.

7. There ought to be expanded opportunities for public participation and environmental education about the ERL. In Shanghai, the ERL mapping process included a public survey of the types of ecosystem services that were most highly valued. Jiaxing has been recognized for its public participation in environmental governance (van der Maesen 2015). As the ERL is improved over time, opportunities for public comment and consultation can certainly be expanded.

8. For the ERL to be successful will require cooperation across scales, government departments and jurisdictions. As the ERL moves forward, parties should use consensus building approaches, with an effort to find common interests among the various parts of the government to support implementation.

This includes creating packages or bunding existing policy priorities to enable ERL implementation to address salient issues in each locality and across jurisdictions.

IV. Continual Change

During the end of my fieldwork, a restructuring of environmental governance took place in China. The Ministry of Environmental Protection (MEP) became the Ministry of Ecology and Environment (MEE). The Ministry of Land and Resources (MLR) became the Ministry of Natural Resources (MNR). In fall 2018, it was announced that the MNR would be in charge of ERL management while MEE would do monitoring and oversight. The restructured MNR also combined all protected area management under its mandate in an attempt to eliminate the institutional overlap within protected area management.

These shifts moved the management of the ERL to the institution that does all spatial planning. This will theoretically streamline land use planning and allow the ERL to be integrated into land use plans across multiple scales. It will also place this activity in a much more politically influential ministry with more resources and technical land use expertise. MNR has implemented the prime farmland policy, some say to a large success, so this may bode well.

This shift in responsibility likely means that all the ERL maps will be redone, possibly using different criteria. MNR, however, to date has not been a major player in the ERL process. The impacts that it has already had on the maps are cause for concern.[7] MNR's role is to optimize land uses. It sees the role of protection as a means to support development. This could reduce the ability of the ERL to reach

[7] For example, MNR, which also control mining rights, has altered ERL rules to its advantage. While mining is prohibited in ERL areas, it still possible to look for areas to mine. This loophole could lead to changes in ERL areas.

biodiversity targets and address ecological degradation. MNR also does not have the same ecological scientific capacity that is already available in MEE.

V. Final Thoughts

The ERL is an ambitious project without precedent in China. The leadership is attempting a sustainable transformation by increasing China's protected areas from 15% of its land (but more realistically closer to 5%) to 35% of its land. This is a giant leap, especially for a country with a large population and the highest percentage of global manufacturing in the world.

The ERL faces significant scientific and governance challenges going forward. It is unlikely to achieve its goals under its current structure. The MEE is aware of this. This dissertation has shown the messy beginning of the process. The ERL is not supposed to be fully implemented until 2030, and some say that this may be too tight a deadline. It is thus just a first step. But, ideationally, it is a very bold and meaningful move. It prioritizes conservation for the first time.

China's rapid transformation has repeatedly surprised the world. China has experienced several massive transitions, including numerous reforms in the post-Mao period. According to the prevailing narrative, in 1978 Deng Xiaoping launched market reforms, beginning the restructuring of state and society. This led to a transformation from state socialism to market socialism, from a command economy to a market economy and from an agrarian society to an industrialized and urban society.

These reforms have been gradual, evolutionary and path dependent (Naughton 1996; Solinger 1991). The ERL is another instance of gradual institutional change. It does not represent an instant sustainable

transformation. On the other hand, it can provide time and opportunity for learning, addressing local social and economic impacts and adapting to climate change. There is still time for improvement. Streeck and Thelen (2005) argue that incremental processes of change appear to cause gradual institutional transformations that can add up to major historical discontinuities. The ERL may over time, along with other reforms, lead to a sustainable transformation to an ecological civilization.

The entire world is facing unprecedented, increasingly unpredictable and irreversible changes to environmental and social systems (Barnosky et al. 2012). It will require bold ideas and a process of adaptation and experimentation to respond effectively. China is testing a way forward. We should all hope for its success.

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Appendices

Interviews by type

Type	Number
Central government officials	5
Local government officials	33
Chinese government researcher	18
Chinese academic	15
Foreign academic	13
International organization - Chinese staff	27
International organization - International staff	9
Domestic non-state organization	5
Foreign government official	2
Media representative	2
Local resident	9
Firm representative	2
Total	140

Interviews by Case

Location	**Interviews**
Anhua County, Hunan	- Development and Reform Commission - Natural Resource Bureau - Ecology and Environment Bureau - Housing and Urban Development Bureau - Forestry Bureau - Township official - Hunan Provincial Land Planning Research Center
Jiaxing, Zhejiang	- Development and Reform Commission - Natural Resource Bureau (county) - Retired Natural Resource Bureau (city) official - Ecology and Environment Bureau - Water Resource Bureau
Background case: Yantai, Shandong	- Natural Resource Bureau - Ecology and Environment Bureau

Conferences and Workshops

Name of Event	Dates	Location
UNFCCC COP 23	12/5-12/12/15	Paris
Implementation of SDGs to achieve a harmony future for humanity and nature – Stakeholder Roundtable (WWF and Chinese Academy of Environmental Planning)	6/26/2016	Beijing
East-West Sustainability Summit (China Global Philanthropy Initiative)	8/30-8/31/2016	Hawaii
China's Climate Change Governance (Peking University)	10/20/17	Beijing
9th Annual Health, Environment and Development Conference (FORHEAD)	11/9-11/10/17	Beijing
International Symposium on Wetland Protected Areas (State Forestry Administration, UNDP-GEF ect.)	12/4/17-12/6/17	Haikou
Anhua County Land Use Planning Workshop (China Land Survey and Planning Research Institute)	12/14/17	Anhua
Spatial Planning Workshop (Hunan Provincial Land Planning Research Institute)	12/15/17	Changsha
Hunan Post-trip Workshop (China Land Survey and Planning Research Institute)	12/18/17	Beijing
East-West Philanthropists Summit IV: United Action for a Sustainable Planet (China Global Philanthropy Initiative)	1/10/18-1/12/18	Hawaii
Ministry of Land and Resources - Key Issues in Land and Spatial Planning Seminar (China Ministry of Land and Resources)	4/13/18	Beijing
Ecosystem Services Workshop (Nanjing Institute of Geography and Limnology, Chinese Academy of Science)	4/25/18	Nanjing
Spatial Planning Workshop (China Land Survey and Planning Research Institute)	6/22/18	Beijing
Yangtze River Workshop (Ministry of Natural Resources, China Land Institute Planning Branch)	6/22/18	Beijing
Ningxia Sustainability Summit (Baofeng Foundation)	8/17-8/19/18	Yinchuan

ERL Policy History Timeline	
2002	First ERL is tested in Anji County, Zhejiang
2005	Guangdong Province develops the first provincial ERL policy
2006	In the 11th five-year plan, China set the agricultural protection red line at 120 million ha for 2010 and then extended to 2020. This was the first use of a red line for protected areas.
2008	MEP and the Chinese Academy of Sciences jointly launched the "National Ecological Function Zoning"
2010	State Council approved the "National Plan for Major Function-Oriented Zones (MFOZs)
2011	State Council issued the "Opinions on Strengthening Key Environmental Protection Work", and for the first time proposed "delineating the ecological red line," putting the ERL on the national agenda.
2011	Third Plenary Session of the 18th CCP Central Committee explicitly proposed the establishment of an ecological red line in the "Decision of the CCP Central Committee on Several Important Issues concerning the Overall Deepening of Reform"
2012	National Ecosystem Survey and Assessment begins (2012-2014)
March 2012	National Ecological Red Line Demarcation Technology Symposium was held to a plan for the ERL. At the meeting, MEP set up a technical group led by Nanjing Institute of Environmental Science, Chinese Academy of Environmental Sciences and Chinese Academy of Sciences.
December 2012	MEP set Inner Mongolia and Jiangxi as ERL pilot provinces. (Hubei and Guangxi were added later.)
2013	In 2013, Shanghai established the first Environmental Protection and Construction Coordination Committee in China. This inter-departmental body integrates administrative, legal and policy resources, and is responsible for coordination, communication, inspection and evaluation of environmental protection works. It provides a platform to promote a series of actions, including the 'Three-year Environmental Protection Plan', the national and local 'Clean Air Action Plan' and the still to be issued 'Clean Water Action Plan' and 'Clean Soil Action Plan', urban environmental function zoning, and establishment of an eco-redline system. (CCICED 2014)
January 2013	MEP, the NDRC and the Ministry of Finance jointly issued "Opinions on Strengthening the Environmental Protection and Management of Key Ecological Functions in China" which included defining the ERL. It requires MEP with relevant departments to issue ERL technical guidelines.
January 2013	MEP organized the preparation of the "12th Five-Year Plan for National Ecological Protection." It proposed including drawing ERLs and developing technical guidelines and regulations for ERL areas.
May 2013	General Secretary Xi Jinping presided over the sixth collective learning session of

	the Politburo, proposing delineating and strictly observing the ERL.
August 2013	Jiangsu Ecological Protection Red Line Plan was completed
November 2013	"Decision of the CCP Central Committee on Several Major Issues concerning the Overall Deepening of Reform" mentioned, it would further expand the ecological red line to areas of ecological environment and natural resources. This is the first time that the ecological red line has appeared in the programmatic document of the CCP Central Committee.
2014	ERL was written into the newly revised Environmental Protection Law, which formally established its legal status
January 2014	MEP issued the "National Ecological Conservation Redline-Guidelines for Delineation of Ecological Functions Baseline (Trial),"
March 2014	Special Policy Study group formed, "Institutional Innovation of Eco-Environmental Redlining" and began to study practical cases in Jiangsu, Shenzhen, Beijing, and the Bohai Sea
December 2014	China Council for International Cooperation on Environment and Development released "Institutional Innovation of Eco-Environmental Redlining"
2015	Revision of National Ecological Function Zoning
May 2015	MEP formally issued the Technical Guide for Demarcating ERLs
September 2015	State Council releases report, "Integrated Reform Plan for Promoting Ecological Progress"
2016	MEP held training courses on identifying ERL areas
February 2017	General Office of the CCP Central Committee and the General Office of the State Council jointly issued the "Several Opinions on Delineating and Strictly Protecting the Red Line of Ecological Protection"
2017	National Key Function Zoning Plan revised
May 2017	MEP and NDRC formally issued the Technical Guide for Demarcating Ecological Protection Red Lines
July 2017	Inter-Ministerial Coordination Leading Group for Ecological Protection Red Line was established to coordinate the various tasks of the ecological protection red line and coordinating and solving major problems.
December 2017	Beijing-Tianjin-Hebei region and Yangtze River economic belt (11 provinces) and Ningxia plans finished (15 total)
July 2018	Plans released to the public
September 2018	The ERL plan for other 16 provinces were reviewed by the provincial government and sent to the Ministry of Ecology and Environment (formerly MEP) for review
By December 2020	The ERL system including a new monitoring system is set to be completed