Ecological Compensation in China

Trends and opportunities for incentive-based policies towards a greener China

GWSP GLOBAL WATER SECURITY & SANITATION PARTNERSHIP
THE WORLD BANK IBRD • IDA | WORLD BANK GROUP
DRC 国务院发展研究中心 Development Research Center of the State Council

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Acknowledgments

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Any errors or omissions are the responsibility of the authors.

Graphic design by Sarah Hollis.

Acronyms

CCFP	Conversion of Cropland to Forest Program
CNY	Chinese Yuan
COD	Chemical Oxygen Demand
CPGP	Conversion of Pasture to Grassland Program
FECF	Forest Ecological Benefit Compensation Fund
FYP	Five-Year Plan
GDP	Gross Domestic Product
KEFZ	Key Ecological Function Zone
MEE	Ministry of Ecology and Environment
MNR	Ministry of Natural Resources
MOF	Ministry of Finance
MWR	Ministry of Water Resources
NDRC	National Development and Reform Commission
PES	Payments for Ecosystem Services
RBECP	River Basin Eco-Compensation Program (Jiangxi)
SFA	State Forest Administration
SFGA	State Forest and Grasslands Administration
TN	Total Nitrogen
TP	Total Phosphorus
US$	United States Dollar
YREB	Yangtze River Economic Belt

Photo: Marcus Wishart. World Bank.

Executive Summary

China is a global leader in the use of ecological compensation ("eco-compensation")—fiscal transfers for environmental and natural resources management.

China is restructuring and rationalizing its system of environmental and natural resource management. Eco-compensation is central to this process, with its evolution and growth over the past three decades reflecting the government's increasing desire for environmental management reforms that can support a greener, high-quality growth model. While this process is challenging—involving numerous national and subnational agencies, stakeholders, and interests, with intersecting and sometimes overlapping programs and policies—there are significant opportunities to build on existing successes and incorporate domestic and international lessons learned.

China's rapid economic ascendance over the past four decades brought large economic gains, but at high environmental costs. Market reforms from 1978 onward fueled a roughly thirtyfold increase in per capita output and lifted 850 million people out of poverty. Yet rapid growth—and many of the policy reforms that supported it—has led to equally rapid increases in pressure on the environment and natural resources, and an implied environmental cost associated with the rapid depletion of natural capital averaged 3.6 percent of gross domestic product (GDP) annually between 1978 and 2018.

These costs were seen in the degradation of rural landscapes, water systems, natural habitats, and ecosystems. While impacts in recent years have slowed or reversed, around 40–50 percent of China's total land area (3–4 million km^2) remains adversely affected by overgrazing, deforestation, desertification, and salinization (Deng and Li 2016). This has reduced agricultural productivity, degraded water quality, impaired the resiliency and functionality of major river systems such as the Yangtze and Yellow, and contributed to natural disasters—including major flooding in the late 1990s that was exacerbated by siltation buildup and deforestation, and regional dust storms arising from denuded landscapes.

In response, the national government embarked on large public investments from the late 1990s onward to restore degraded ecosystems and river basins. The government invested a cumulative US$378.5 billion (in 2015 US$) in land and watershed management interventions, representing over 0.3 percent of GDP annually (Bryan et al. 2018). These interventions—which focused on soil and water conservation in the Yellow and Yangtze basins, forest conservation in the northeast and southwest, mitigation of desertification in north-central China, and agricultural productivity in the center and south—have covered 623.9 million hectares of land and involved over 500 million people. Environmental objectives are paired with poverty reduction and national food security goals. These efforts represent the largest such programs in the world, and while the challenges remain substantial, China has done more in absolute terms than any other country to reverse land and water degradation.[1]

These investments constitute substantial fiscal transfers from the national government to subnational levels of government (and in some cases, onward to individual landholders). China is one of the most fiscally decentralized countries in the world, with 85 percent of government spending occurring at subnational levels (Wingender 2018). Such national-to-local transfers are one of the national government's most important tools for motivating and aligning actions across levels of government and across jurisdictional boundaries. They are particularly important in the context of land and water management issues with large spatial spillovers, such as river basin management, and integral to China's fiscally decentralized governance system.

1 By comparison, the largest equivalent program in the US—the US Conservation Reserve Program—covers around 12 million hectares with a total expenditure of US$46.2 billion from 1987–2016.

Eco-compensation is becoming an increasingly important part of the country's environmental and natural resources governance framework, even while the term continues to evolve in meaning.

Eco-compensation is not a single program or policy mechanism; it is a conceptual approach to environmental management rooted in the use of fiscal transfers and market mechanisms to reduce negative environmental externalities. It is grounded in the use of payments to reapportion the costs and benefits of environmental protection between beneficiaries and suppliers of ecosystem services. Over the past decade, the term has broadened substantially to include direct government payments to individuals and communities for the provision of ecosystem services; compensation to households, communities, or governments for regulatory takings or environmental damages; environmental markets and trading mechanisms; and frameworks for cooperation and fiscal transfers between jurisdictions of the same level, among others.

The national government has signaled a clear commitment to expanding the use of eco-compensation to address environmental challenges. Eco-compensation features prominently in the 14th Five-Year Plan, which calls for an increase in transfer payments for ecologically sensitive areas and river basins. A National Regulation on Eco-compensation (draft) was published by the National Development and Reform Commission (NDRC) in December 2020, providing a definition of eco-compensation in broad terms,[2] allocating high-level responsibilities across ministries, and instituting an inter-ministerial council to guide eco-compensation's further development. As funding to eco-compensation programs grows, so does the need to ensure that programs are effectively, efficiently, and equitably delivering on their potential.

Eco-compensation is also likely to play a key role in China's efforts to meet global environmental and climate commitments. In September 2020, President Xi Jinping announced China's commitment to peaking its carbon dioxide (CO_2) emissions by 2030 and achieving carbon neutrality by 2060. China's target and associated nationally determined contribution under the United Nations Framework Convention on Climate Change will likely require substantial contributions from improvements in agriculture practices, forestry, and land use change. Such "nature-based" strategies to climate emissions reductions would complement mitigation efforts in the energy and transport sectors, reduce overall economic costs of decarbonization, and if designed appropriately, provide co-benefits such as biodiversity. Future international commitments, such as the proposed 30 x 30[3] initiative or others for biodiversity conservation, would also require contributions from land use sectors. Eco-compensation, as China's primary tool for incentivizing environmental management and land use change, will be central to these and related efforts.

This report traces the rise of eco-compensation, explores its current use, quantifies trends, and provides recommendations to strengthen impacts.

Eco-compensation is poorly understood outside of China; even within China, the disparate nature of data and the diversity of programs means that key trends and lessons are easily overlooked. Drawing on a unique dataset of eco-compensation programs from records across government, academia, and the news media, this report tracks the rise of programs in terms of number, expenditure, governance structure, and function across provinces in China (box ES.1). Key emerging trends include:

- **A range of program types have begun to solidify under national government guidance.** Eco-compensation programs include those focused on water management, ecological protection, and reforestation and rural land use change, among other natural resource issues. These categories contain a wide diversity in de facto design and implementation approaches, given China's highly decentralized framework for environmental and

2 The draft National Regulation defines eco-compensation as financial transfers payments or market transactions that provide appropriate compensation for costs incurred for ecological protection. This is applied broadly, to include fiscal transfers between governments, incentives to individuals, compensation for regulatory takings, environmental markets, green financing, procurement, and certification mechanisms.

3 The 30 x 30 initiative is a commitment to protect at least 30 percent of the world's land and ocean by 2030. It was proposed by a group of "high ambition" countries in January 2021 and will be discussed at the 15th Conference of Parties to the Convention on Biological Diversity, in Kunming, China, October 2021.

Box ES.1:
Report Objectives

This report aims to explore the broad and evolving concept of eco-compensation in China. Specific objectives include:

1. Defining the concept of eco-compensation as it is currently understood and applied in China;
2. Tracing the rise of eco-compensation, exploring its current use, and quantifying trends in its evolution;
3. Deriving lessons from select programs with a focus on the Yangtze and Yellow River basins; and
4. Documenting challenges to improved eco-compensation in China, and offering framework recommendations to address these challenges.

Source: Authors.

The report documents China's success in harnessing such mechanisms for both domestic and international audiences, and proposes framework policy recommendations for policy makers and stakeholders.

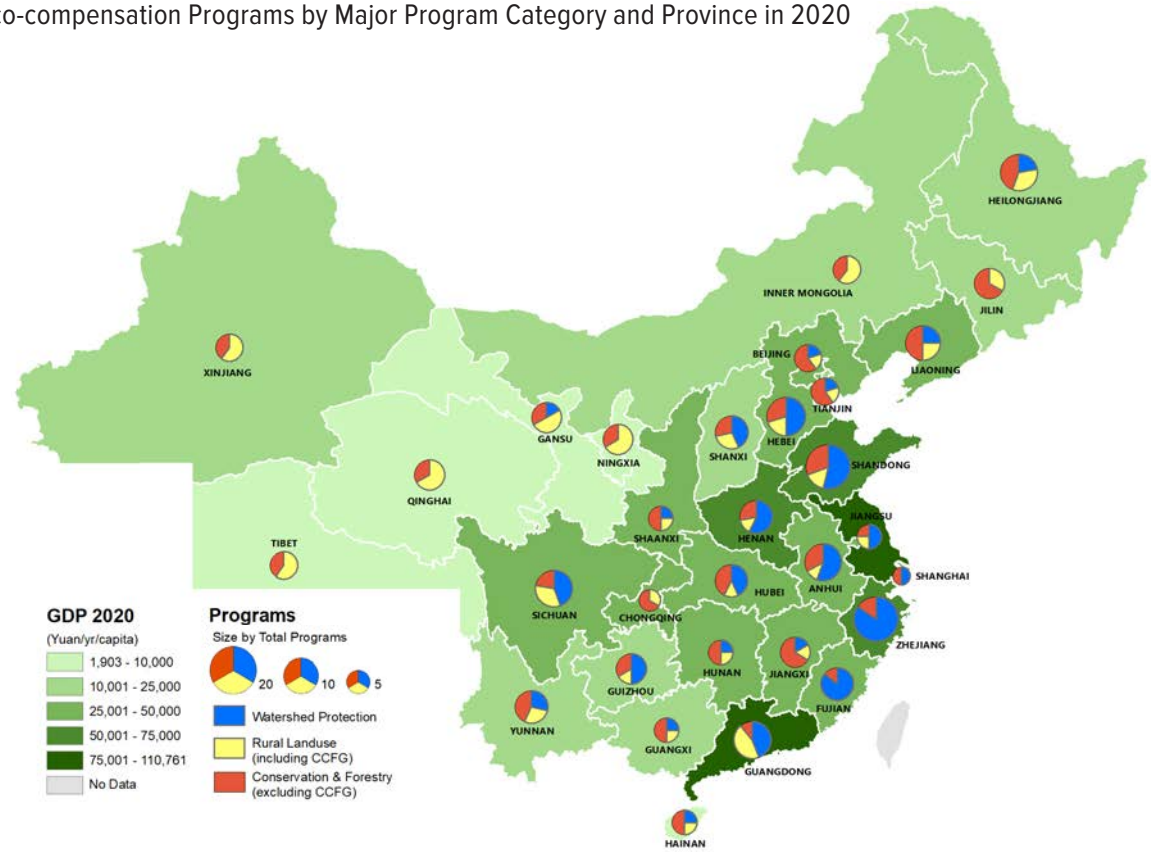
The breadth of the eco-compensation concept means that this report does not make recommendations for specific programs, but instead informs broader policy considerations of relevance to a range of programs. Land and water management are the primary topic areas of focus. Given the prominent role of government in China's most influential programs, this report places relatively greater emphasis on public fiscal transfers relative to environmental markets.

fiscal policy (i.e., the national government provides funding and broad guidelines, and provides subnational governments with the latitude to interpret and adapt them). Programs are widely distributed, both due to the spatial scope of large national programs and due to ongoing and increasing experimentation by provinces (map ES.1).

- **While watershed co-benefits have always been an important goal of eco-compensation, new programs are increasingly directed explicitly toward water quality and quantity management challenges.** Such water-related programs increased from 2 in 1999 to an estimated 67 in 2020 (figure ES.1). These include (1) cross-border agreements between provinces within river basins (interprovincial "horizontal" programs), (2) cross-border agreements between upper and lower watershed municipalities (intra-provincial horizontal programs), and (3) water source protection programs based on funding pools supported by downstream beneficiary contributions (localized water funds). It is important to note that the number of programs is only one metric of eco-compensation's prominence and use (expenditure, for instance, remains concentrated within national programs focused on key ecological zones, reforestation, and land use change), yet it is an important indicator of institutional experimentation, innovation, and current policy focus.[4]
- **A majority of the newer water-related programs target water quality, with performance-based rewards and penalty payments linked to water quality outcomes.** Often under these programs, water quality improvement beyond a baseline entails a payment from the lower to upper watershed county to defray costs, while worsening water quality entails the opposite, constituting a penalty to compensate for damages downstream. These often involve up-front financial contributions by the participating counties/districts into a program fund, out of which rewards are paid for performance (Peng and Xiao 2019).
- **The national government has been strongly promoting the development of this type of program to strengthen**

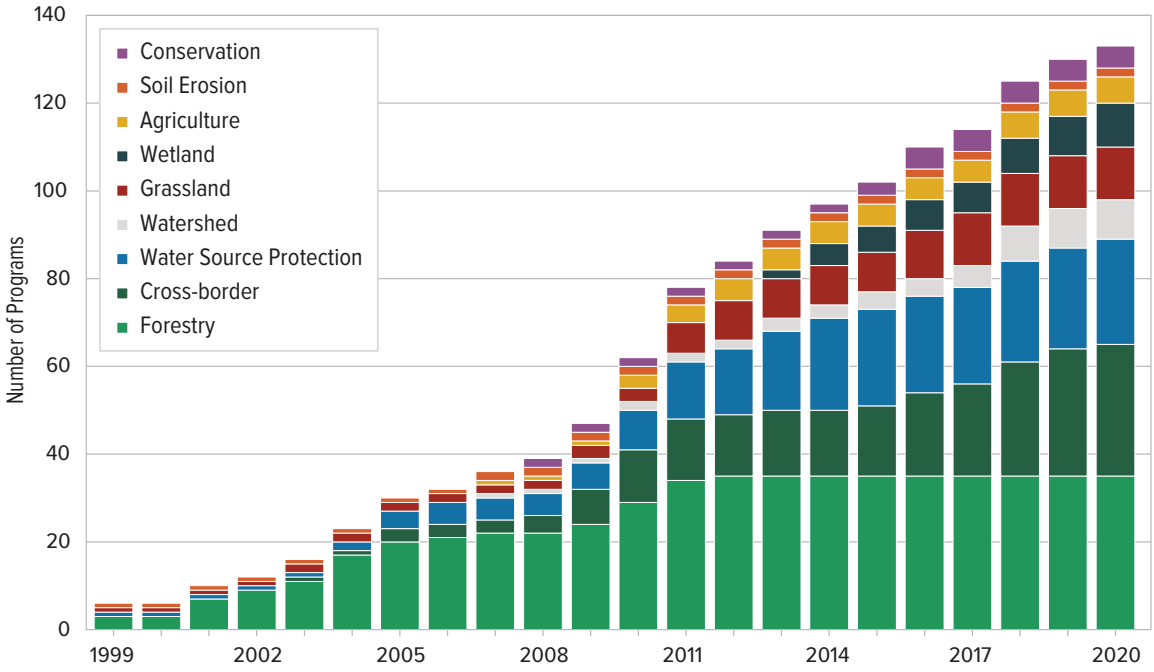
4 The number of programs is indicative of trends but should not be considered definitive given difficulties in determining the "boundaries" of some programs (i.e., some programs are subprograms within, or are supported financially by other programs, while others undergo reforms or name changes). The data collection process used for this report is described in chapter 3.

MAP ES.1: Eco-compensation Programs by Major Program Category and Province in 2020



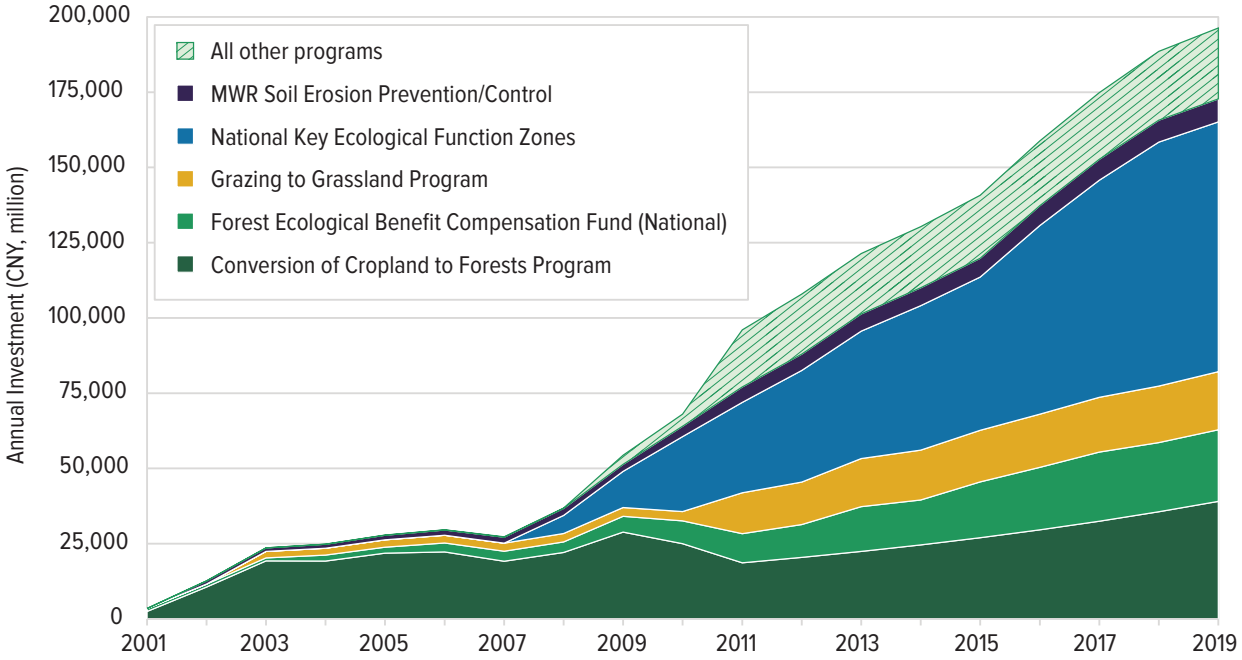
Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.
Note: The number of programs should be considered indicative rather than definitive given challenges in determining the precise "boundaries" of some programs (see box 3.1).

FIGURE ES.1: Growth in Eco-compensation Programs by Major Program Category



Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.
Note: The number of programs should be considered indicative rather than definitive given challenges in determining the precise "boundaries" of some programs (box 3.1).

FIGURE ES.2: Annual Investments by China's Eco-compensation Programs



Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.

watershed management at more localized scales.[5] This includes joint management and coordination capacity. A key value of these schemes, beyond the direct financial incentive to align actions with policy goals, is to promote knowledge transfer, shared monitoring systems, agreement on data, and basin management coordination across local jurisdictions.

- **The mainstay of eco-compensation in China, in terms of total funding and impact, remains the large-scale land management and forestry programs introduced in response to the severe droughts and floods of the late 1990s (figure ES.2).** Many of these programs involve direct, performance-based contracts with individual rural households as key stewards of ecosystem services, with funding passed through provinces.[6] For example, the Conversion of Cropland to Forest Program (CCFP)—the largest eco-compensation program in the world by area—has planted trees and increased vegetative cover on 17.5 million hectares (ha), reaching a total of 41 million households with a national government cumulative expenditure of Chinese yuan (CNY) 511.2 billion (US$78.7 billion) since its launch in 1999. The program is being extended with increased subsidies to households and added rural welfare guarantees.
- **Yet these large land management and forestry programs are also diversifying, as provinces introduce downscaled versions operating in parallel (often with national government funding), tailored to local conditions.** Forestry programs, for example (which support restoration or conservation of forestlands of higher ecological value), grew in number from 4 large-scale programs in 1999 to 35 large- and small-scale programs by 2020. Wetlands and grasslands eco-compensation programs have also been developing quickly, starting from zero in 1999, and growing to around 12 and 13, respectively, in 2020.
- **Another important trend is the increasing use of eco-compensation to support China's spatial planning systems.** The most prominent of these is the national

5 For example, see MOF. 2016. *Guiding Opinions on Accelerating the Establishment of a Compensation Mechanism for Horizontal Ecological Protection of Upper and Lower Watershed Areas. Beijing, China.*

6 These programs are thus closest to the payments for ecosystem services (PES) concept widely used internationally.

function-based land zoning system, which delineates zones where development should be either concentrated, expanded (in the future), or restricted or banned for environmental purposes. Transfer payments from the national government to counties, districts, and cities are used to ease the burden of restrictions, and have steadily increased from CNY 6 billion (US$937 million) in 2008 to CNY 83 billion (US$13 billion) in 2019. Payments are based on a composite of environmental indicators, including water quality, air quality, and forest area, and weighted by county area, population, and the type of key ecological function zone. China's Ecological Redlines Policy—spatial zoning by provinces at a more refined scale (currently in development) and based on a "no net loss" principle—is also envisaged to draw on eco-compensation mechanisms when fully functional.

- **Across these program types and trends, many eco-compensation programs depend on input-based proxies of achievement, rather than outcomes, for payments.** The two main classes of indicators used to evaluate performance are on-site land use investments (94.3 percent of programs used these) and management activities (69.1 percent). Outcome-based environmental quality and quantity indicators are used by 26.8 and 26.0 percent of programs, respectively.[7] Quality indicators are more heavily used by water-focused programs, although water source protection programs still often focus on traditional input-based land investment proxies. In some contexts, this is inevitable: for example, within individual landholder targeting programs, the actions of a specific landholder cannot be seen in water quality outcomes. In other contexts, greater use of payments conditioned on outcomes could help drive improved results.
- **Many programs have done very well to achieve outcomes at scale.** The national framework programs focused on reforestation and rural land use cover large areas with hundreds of millions of rural participants. A qualitative evaluation of these programs, based on a three-part evaluation framework (see sections 1 and 3.4), indicates that they have been effective at building scaled but shallow management frameworks that can now be refined and built upon with gradual adjustments to program configurations and targets.
- **There remain significant opportunities for improvements in efficiency and equity.** Diversification and leveraging of funding sources is generally low, payments are not always fully responsive to outcomes, and room exists for better capturing and leveraging synergies in ecological services provision. Across program types, greater efficiency (i.e., greater environmental outcomes per unit of spending) may be possible through strengthened monitoring and enforcement, tighter spatial targeting, use of reverse auctions and market-based mechanisms, and better alignment with landscape-level or basin-level objectives. Many programs also have room for greater use of co-management mechanisms between governments and communities. These opportunities are elaborated in a series of framework recommendations presented below, and in detail in chapter 5.

The government has signaled that an important focal area for eco-compensation will be the Yangtze and Yellow River basins.

The Yangtze and Yellow River basins are home to the majority of the Chinese economy and population.[8] Growing environmental impacts have led to national government prioritization of improved land and water management within these basins. Eco-compensation has been used extensively over the past three decades within these basins (for example, the CCFP was first piloted in the upper watershed provinces of both the Yellow and Yangtze Rivers). The national government has called for new eco-compensation programs and policies to address these basins' ongoing issues, including in the 14th Five-Year Plan (FYP); however, programs are yet to be defined or designed, providing opportunities for learning based on previous experience. Provinces are implementing and

7 Programs can use multiple indicator types, and so totals sum to greater than 100 percent.

8 If the Yangtze River basin was a country, it would have the world's third largest GDP.

experimenting with eco-compensation mechanisms in response to the national government's call to action.

The institutional landscape for river basin management is developing, albeit with some degree of fragmentation. New Watershed Ecological and Environmental Supervision and Management Bureaus have been established with responsibility for water pollution monitoring and enforcement; these will function in parallel to the existing river basin commissions under the Ministry of Water Resources (MWR), but are under the Ministry of Ecology and Environment (MEE). The government's objectives for the Yangtze River basin's protection were codified in the Yangtze River Protection Law, which was issued in December 2020 and represents the first legislation for a specific river basin in China. The national and provincial governments have been increasing investment in line with these priorities.

Within this landscape, new horizontal eco-compensation mechanisms—both interprovincial and within-province cross-border watershed eco-compensation—are envisioned. To catalyze horizontal program development, the *Yangtze River Ecological Belt (YREB) Ecological Protection Rewards Policy* in 2018 committed CNY 18 billion (US$2.76 billion) from the National Water Pollution Prevention and Control Special Fund to incentivize their establishment. Funding for the Yangtze portions of existing national programs has also increased: from 2017 to 2020, transfers under National Key Ecological Function Zone eco-compensation to the 11 provinces in the YREB increased from CNY 23.99 billion to CNY 32.51 billion, with funding concentrated toward the relatively less-developed upper reach provinces. As a result of these incentives and others, all provinces in the YREB have developed at least some form of a cross-border horizontal eco-compensation scheme for the river systems within their borders.

Lessons are emerging from the growing number of programs within these river basins, with implications for ongoing design and implementation efforts.

There is considerable experimentation in the water management–related eco-compensation underway, providing lessons for new programs. This report presents short case studies of water management–related programs in the Yangtze and Yellow River basins (map ES.2). Drawing on their experience, the report highlights opportunities for strengthening outcomes as these programs scale, or as they are replicated in other locations.

There are opportunities to better align subnational government efforts through the setting of basin-level objectives and the development of interprovincial coordination mechanisms. Basin objectives would be well served by basin-wide hydrological and water quality modelling, and codified in basin environmental and water management plans. Hot spot analyses could be used to identify most cost-effective intervention locations, which could be further incentivized using matching funds from the national government. Basin management authorities could be further supported in convening and coordinating between sectors and jurisdictions.

There are opportunities to increase the use of water quality trading for lower cost pollution control. Despite three decades of piloting, as well as recognition in high-level policy documents, water quality trading has not scaled in line with its potential. There is a need for national-level laws and regulations that define emission trading practices, and the rights and obligations of emissions permit holders, to take advantage of this potential. There is also a need to resolve conflicts in the regulatory regime and harmonize regulations across subnational jurisdictions that share watersheds. Scale and impact will be further supported by more predictable program administration and transaction transparency (see section 4.5).

More broadly, eco-compensation programs of varied types can benefit from reforms in at least five areas.

China's achievements with eco-compensation are undoubtedly impressive; refinements to existing programs, based on lessons to date, could deliver a new generation of further improved outcomes. This report draws on findings from the three-part evaluation of existing programs—based on indicators of efficiency, effectiveness, and equity outcomes (see section 3.4) —to identify five target areas for reform (figure ES.3).

MAP ES.2: Eco-compensation Program Case Studies Examined in This Report

Photo: Tiger Leaping Gorge, Yunnan Province, China. Xiawei Liao. World Bank.

AREA ONE: STRENGTHEN MONITORING AND ENFORCEMENT CAPACITY

Flexible, incentive-based eco-compensation systems require high capacity in monitoring and enforcement. This could be supported by a stronger national government role at the whole-of-basin level through actions, including strengthening of the river basin commissions, more tightly integrating management and planning responsibilities within ministries, and further developing platforms for coordination across ministries.

Monitoring data could be further standardized and broadened. Further expansion could include a wider array of indicators capturing watershed ecosystem health, functionality, and resiliency, and would complement recent improvements in water quality data. To ensure credibility and well-aligned incentives, agencies responsible for environmental monitoring should be independent from agencies responsible for achieving ecological and environmental targets.

Monitoring and enforcement could also be supported through emerging technologies. While technology is no substitute for sound policy design, recent innovations simplify the process of monitoring. These include blockchain for automated and secure environmental payments, earth observation satellites and drones for cost-effectiveness, and spatially and temporally comprehensive water quality monitoring (Harshadeep and Young 2020).

AREA TWO: ADDRESS GAPS IN TECHNICAL AND SCIENTIFIC CAPACITY AT LOCAL GOVERNMENT LEVELS

Needs within monitoring and enforcement functions highlight the broader importance of addressing scientific and technical capacity gaps at provincial and sub-provincial government levels. As key actors in operationalizing eco-compensation on the ground, such gaps constrain the ability of these actors to design and implement programs. Such constraints are particularly pronounced for poorer inland and western regions, which are also the key repositories of much of China's critical biodiversity and important headwaters for the Yellow and Yangtze Rivers.

Special-purpose grants could support training of provincial government staff—with a priority focus on knowledge areas of high need—along with the provision of technical

support where local expertise is lacking. Priority areas could include (among others): nonpoint source pollution control, market design (for water pollution emissions trading), and consultation methods for participatory program design. Capacity-building and standard setting around economic analyses (for example, standardizing and regularizing the use of benefit-cost analyses, including ecosystem services valuation) would also be valuable. Not all elements of these capacities are required at every level—specialized economic evaluation, for instance, is likely best concentrated in ministries or research institutes (or left to third-party service providers) and provided to subnational governments as needed. However, the ability to utilize and interpret such technical functions remains crucial at the subnational level.

Further development of forums for cross-learning between local government decision-makers and stakeholders would also be valuable. Gaps in some local government capacities are exacerbated by challenges in knowledge sharing of China's varied eco-compensation experiences. National government guidelines, opinions, and policy documents have, to date, primarily provided broad frameworks and principles for the development of eco-compensation programs, leaving the heavy lifting in operationalizing concepts to provincial and sub-provincial governments. The 2020 draft National Eco-compensation Regulation calls for such platforms at the central level (through a conference of ministries); river basin commissions could also be formally mandated to support these efforts.

AREA THREE: GREATER ADOPTION OF HOLISTIC LANDSCAPE-LEVEL OR BASIN-LEVEL PLANNING

Limitations in holistic landscape- or basin-level planning constrains provincial and sub-provincial governments in developing programs aligned with higher-level policy goals. This is especially true regarding the contributions of localized programs to basin-wide management goals, such as flood mitigation, environmental flows, and stable long-term water quality. A basin-wide management framework could be used to help guide disparate provincial-level programs, starting with the development of a comprehensive basin-level plan that incorporates all sectors and activities. The framework would need to consider the status and trends of major land and water use activities in the basin to inform government priorities around which eco-compensation programs to develop (or support with national government funding) and where interventions should be made.

A public expenditure review could be used to ensure better alignment between current fiscal flows and landscape- or basin-wide planning objectives. The magnitude of financing under eco-compensation programs is large and disparate, and targets a wide array of objectives. A systematic analysis would aim to account for such flows at the national or basin level, assessing what outcomes those flows are achieving, and establishing the degree to which gaps or overlaps exist in funding flows in relation to top-level planning objectives. Such a process would employ methods well-established internationally and could identify opportunities for scale-up or redirection of misaligned spending.

This would be well complemented by a comprehensive regulatory review, which would focus on identifying preexisting regulatory incentives and disincentives that may be conflicting. This would help strengthen programs by identifying where eco-compensation can be most effectively positioned within the current regulatory framework, and what reforms in other sectors (e.g., removing environmentally harmful agricultural subsidies) could best complement the programs. It could also aide in the removal of contradictory policies. For example, water quality trading has been hampered in some situations by dueling regulations: traditional mandates that conflict with trading's flexible approach should be reconciled.

AREA FOUR: IMPROVE INTERAGENCY AND INTER-REGIONAL PLATFORMS TO SUPPORT ECO-COMPENSATION ACROSS SUBNATIONAL BOUNDARIES

Platforms for joint decision-making and planning at the basin level would help ensure coordination of actions and resolve disputes across administrative boundaries. The recent establishment of the Watershed Ecological and Environmental Monitoring Bureaus under the MEE shows a national government commitment to building such platforms. Long term, these commissions either need to be sufficiently strengthened, or be a higher-level unified management framework with functions and responsibilities

Photo: Rice terraces and farming village in Longsheng, Guangxi province, China. iStock.

that encompass a more comprehensive range of land use and economic planning and enforcement responsibilities. Explicit channels for interagency and interregional knowledge sharing could also be created, such as departments or units within ministries solely dedicated to intra-government coordination and information sharing (with incentives for official's tied to these data sharing goals). Development of further mechanisms and protocols for conflict resolution among the regional governments and other stakeholders would also be valuable (and could potentially be housed within the strengthened basin-level authorities).

AREA FIVE: ADOPTION OF ADAPTIVE AND PARTICIPATORY DESIGN AND IMPLEMENTATION APPROACHES

Building flexibility and adaptivity into monitoring and management frameworks will be critical for addressing uncertainty and improving outcomes over time. This includes a strengthened capacity of provincial governments to refine approaches to address changing conditions, and the ability to better engage local communities as key agents of program implementation through co-management. Such capacity will be critical for effectively addressing China's largest source of surface water pollution, rural nonpoint source pollution.

Greater adoption of competitive and market-based mechanisms, such as tradeable emissions permits and reverse auctions, could support flexibility and adaptation. Such mechanisms will give programs the ability to rapidly adjust subsidy or payment rates to reflect changing relative prices in the economy due to changing socioeconomic and environmental conditions. Incorporating local knowledge into program designs may also help identify lower-cost options by understanding the needs, constraints, and interests of local actors.

Adaptive and participatory management would be well served by improved program tracking and periodic evaluation. Monitoring of varied socioeconomic and environmental dimensions—e.g., ecological outcomes; leakage to other areas; program impacts on income, structure

FIGURE ES.3: A Summary of Recommended Measures for Improved Eco-compensation Programs, with Envisioned Outcomes

KEY TARGET AREAS

RECOMMENDED MEASURES	ENVISIONED OUTCOMES
A. STRENGTHENING MONITORING AND ENFORCEMENT CAPACITY	
A.1. **STRENGTHEN** basin-level management platforms and authorities at the national level. A.2. **STANDARDIZE** and broaden the monitoring data collected and published. A.3. **ENSURE** that monitoring and implementation functions are separate.	Effectiveness → Quantification of ecosystem services flows and land use impacts on them improved. → Better attribution of the impacts of different interventions given different contexts and baselines improved. → Targeting of investments improved. Efficiency → Capacity to evaluate the cost-effectiveness of different approaches strengthened. → "Price discovery" mechanisms facilitated through verifiability of ecological outcomes. → Conservation finance flows catalyzed via real profit opportunities linked to attributable ecological outcomes. Equity → Greater adoption of market-based mechanisms ensures that schemes benefit participants, and costs and benefits of ecological restoration, protection, and management are more equitably shared among the key stakeholders.
B. ADDRESSING GAPS IN TECHNICAL AND SCIENTIFIC CAPACITY AT LOCAL GOVERNMENT LEVELS	
B.1. **TRAIN** provincial government personnel in knowledge areas important for eco-compensation program development and implementation. *(See A.1)* B.2. **PROVIDE** technical support to provinces where gaps in expertise exist. *(See A.2)* B.3. **DEVELOP** and strengthen knowledge-sharing platforms. B.4. **PROVIDE** stronger guidance on program design options.	Effectiveness → Capacity to deliver ecological management outcomes strengthened. → Rate of innovation in eco-compensation increased. → Scaling up of effective approaches facilitated. → Development of an environmental services sector catalyzed. Efficiency → Capacity to more efficiently use available resources to achieve outcomes strengthened. → Capacity to conduct cost-benefit analyses of potential and current programs improved. → Capacity to development and utilize market-based program design components improved. Equity → Stakeholder needs and constraints better incorporated into planning and design.
C. DEVELOPING TOP-LEVEL HOLISTIC PLANNING FRAMEWORKS TO INFORM PROGRAM TARGETS AND METRICS	
C.1. **CREATE** a comprehensive basin-level plan. *(See A.1)* C.2. **CONDUCT** a public expenditure review. C.3. **REVIEW** the regulatory framework comprehensively.	Effectiveness → Targeting of investments within a larger landscape improved. → Landscape- and basin-level outcomes improved through stronger linkages with local eco-compensation program design and indicators. → Improved eco-compensation program design to accord with the regulatory landscape. Efficiency → Regional targeting of investments to capture comparative advantages and synergies in ecological services provision improved. Equity → Ability to identify locales where ecological and rural welfare co-benefits could best be achieved with program interventions improved.
D. DEVELOPMENT OF MORE EFFECTIVE CROSS-SECTORAL, INTERAGENCY, AND INTERREGIONAL GOVERNANCE PLATFORMS	
D.1. **ESTABLISH** platforms for joint decision-making on basin-level planning. *(See A.1)* D.2. **CREATE** explicit institutional channels for interagency and interregional knowledge sharing. *(See A.1)* D.3. **DEVELOP** mechanisms and protocols for conflict resolution. *(See A.1)*	Effectiveness → Scaling up of effective approaches facilitated. → Development of interprovincial programs quickened. → Landscape-level planning and management improved. → Rate of innovation in eco-compensation increased. Lessons learned better captured. Efficiency → Improved regional targeting to improve cost-effectiveness improved. Equity → Stakeholder needs and constraints incorporated into planning and design.
E. GREATER ADOPTION OF ADAPTIVE, PROCESS-BASED AND PARTICIPATORY MANAGEMENT, PROGRAM DESIGN, AND IMPLEMENTATION APPROACHES	
E.1. **BUILD** adaptivity into monitoring systems. *(See A.1 & A.2)* E.2. **EXPAND** the use of market-based mechanisms. *(See B.1 & B.2)* E.3. **EXPLORE** greater adoption of adaptive co-management mechanisms in program design and implementation. *(See B.1 & B.2)* E.4. **USE** lessons learned in co-management mechanism development to create guidelines and protocols. *(See B.1 & B.2)* E.5. **MINIMIZE** equity-efficiency trade-offs via stronger guarantees of voluntarism.	Effectiveness → Capacity to deliver ecological management outcomes strengthened. → Scaling up of effective approaches within rural landscapes improved. → Program ecological management outcomes made more stable and sustainable via local stakeholder buy-in. → Capacity to address uncertainty strengthened. Efficiency → Efficiency improved via identification of lower-cost approaches. Equity → Rural welfare outcomes strengthened and improved. → Capacity to build partnerships with local communities strengthened.

of livelihoods, and community equity; and household and community attitudes and awareness—could be made an explicit part of program development from early stages, with formal mechanisms for feeding results into periodic program reviews and community consultations. Program impact evaluation could be included in the training and technical support activities outlined in (2) above.

China's eco-compensation experience also offers broad insights that may be useful for other countries as they develop their own incentive-based environmental programs.

Despite the scale—and in many respects the impressive success—of China's eco-compensation developments, they are not well known and understood internationally. China's experience is unique, and important caveats exist to the transfer of specific lessons abroad.[9] Yet broad insights in the development of incentive-based programs and environmental management systems can be drawn. This report highlights four general lessons:

- **The value of allowing flexibility in how programs are developed: Allowing flexibility on the ground is as an important factor in the successful expansion of eco-compensation across China.** The national government provides funding and broad guidelines, and it provides subnational governments with the latitude to interpret and adapt within that framework. Flexibility is also facilitated through blended government finance opportunities, wherein local governments have some ability to mix and match different tranches of national government funds. Other countries may similarly be able to harness elements of such framework approaches.
- **The value of striving for scale in the early stages of program development: Many environmental interventions and investments struggle with the challenges of achieving impacts at scale.** Often approaches are carefully piloted and refined to address specific local conditions, but are not easily adapted to a broader range of contexts. China has also used pilots extensively (discussed throughout this report), but has also moved rapidly to achieve scale before subsequently refining interventions further within the context of a scaled framework. This is not to discount the value of piloting to refine mechanisms and address the specifics of local conditions, and the utility of pilots in China could be improved if paired with greater tracking and evaluating of program impacts and success factors. However, China's experience suggests that scaling while also using flexible approaches (see above) may offer a valuable middle ground.
- **The value of using programs as capacity-building processes: China's experience at the local level shows that program development serves as a critical capacity-building exercise, both for the implementation of the program being developed, as well as for broader environmental management functions.** This contrasts with discussions around setting "preconditions" for certain investments or interventions. China's experience suggests that in many cases eco-compensation can be developed in contexts where such preconditions are relatively weak, and the process of policy implementation and experimentation will serve to establish the preconditions themselves. This must be balanced with ambitions for rapid scaling (as above) which requires some baseline of capacity.
- **The value of monitoring, information sharing, and transparency: Gaps in monitoring, transparency, and data sharing have resulted in some missed opportunities in China to improve program outcomes, and to tap into a wider range of sources of finance for environmental management.** While China is prioritizing the strengthening of its environmental monitoring capacity, much work remains. Other countries can avoid these potential challenges by adopting rigorous monitoring and data transparency measures earlier.

9 For example, few countries have China's depth of finance available for investment, or its subnational government coverage and reach.

CHAPTER 1.
Introduction

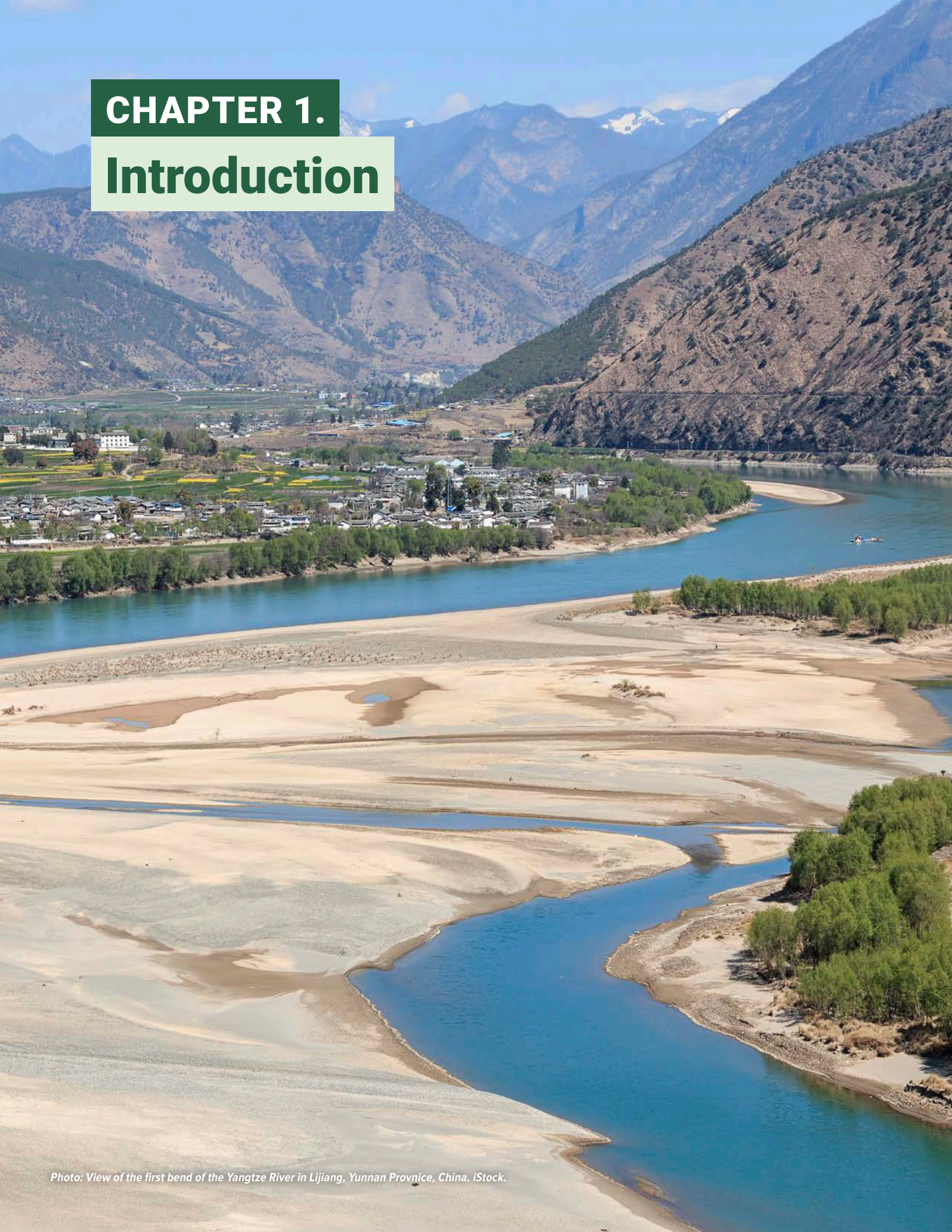


Photo: View of the first bend of the Yangtze River in Lijiang, Yunnan Provnice, China. iStock.

China is embarking on a difficult path that promises substantial rewards: restructuring and rationalizing its system of environmental management.

It is a system comprising numerous national and subnational agencies, stakeholders, and interests, with intersecting and sometimes overlapping policies and programs for land and water management. The system has evolved substantially over the past three decades and delivered important improvements in China's ecological and environmental conditions. There also remain gaps in scientific, technical, institutional, and financial capacity, especially at provincial and sub-provincial levels. Strengthening this system to achieve an improved level of environmental management remains an important ongoing endeavor.

The Chinese government recognizes the significant opportunities available in this process. China can jump ahead to a more innovative and effective management regime by building on its existing successes and incorporating lessons learned domestically and internationally. This includes expanding the policy toolkit to encompass a wider range of instruments via adopting and adapting incentive-based approaches to achieve outcomes more efficiently. It also includes mainstreaming natural capital and ecosystem services into overall economic planning, investments, and management.

"Ecological compensation"—one of the most important mechanisms in China for bridging national vision and local reality in environmental outcomes—is central to this process. The term "ecological compensation," or "eco-compensation," encompasses a broad range of policy mechanisms and instruments aspiring to introduce more flexible performance- and market-based components into environmental management. First used in the early 1990s, it was revived in the early 2000s and now often serves in government documents as a placeholder for "innovative environmental policy approaches." Its evolution reflects trends in the government's broader environmental management reforms that are critical for realizing China's desired shift to a greener, high-quality growth model.

China's rapid economic ascendance over the past four decades has brought huge economic and social rewards; however, it has also come at significant environmental costs. Market reforms from 1978 onward fueled a roughly thirty-fold increase in per capita output, driven initially by low wage labor and capital investment in resource-intensive sectors. As a result, China's share of the world economy increased from 1.5 percent in 1978 to 15.0 percent today, and more than 850 million people have been lifted out of poverty. This constitutes an impressive economic success story. However, extractive growth has also caused significant damage to the country's ecosystems and natural resources. World Bank estimates suggest these impacts have had an implied cost of 3.6 percent of gross domestic product (GDP) annually on average between 1978 and 2018.[10]

While such challenges linked to growth reflect global trends, their scale, complexity, and rate of change in China have been unprecedented, as has been the government's response. Multiple large-scale disasters in the late 1990s motivated development of programs to improve land, water, and forest management outcomes, and to increase the sustainability and productivity of agriculture. These programs have invested more than US$378.5 billion,[11] covered 623.9 million hectares of land, and involved over 500 million people, mostly since 1998 (Bryan et al. 2018). Drawing on a mixture of mandates, incentives, and direct government investments, they have made progress toward reducing soil and water degradation, increasing forest cover, and gradually nudging rural land use into a more sustainable pathway. China has done more in absolute terms than any other country to tackle these challenges.

Continued investment—and improvements to the institutions that channel such investment—is required to deal with the substantial challenges that remain, and to address an expanded scope of environmental issues. Despite the substantial improvements made to land and water management, China's environmental conditions continue to rank below countries of comparable income. In 2020, the Yale Environmental Performance Index ranked China 120 out of 180 countries based on its performance on multiple environmental dimensions. Notably, China's environmental performance ranked below that of other income-comparable, upper-middle-income countries, such as Turkey, Brazil, Mexico, and Russia. All countries with equivalent or higher per capita

10 World Bank Staff estimates based on National Bureau of Statistics data.

11 In 2015 US$.

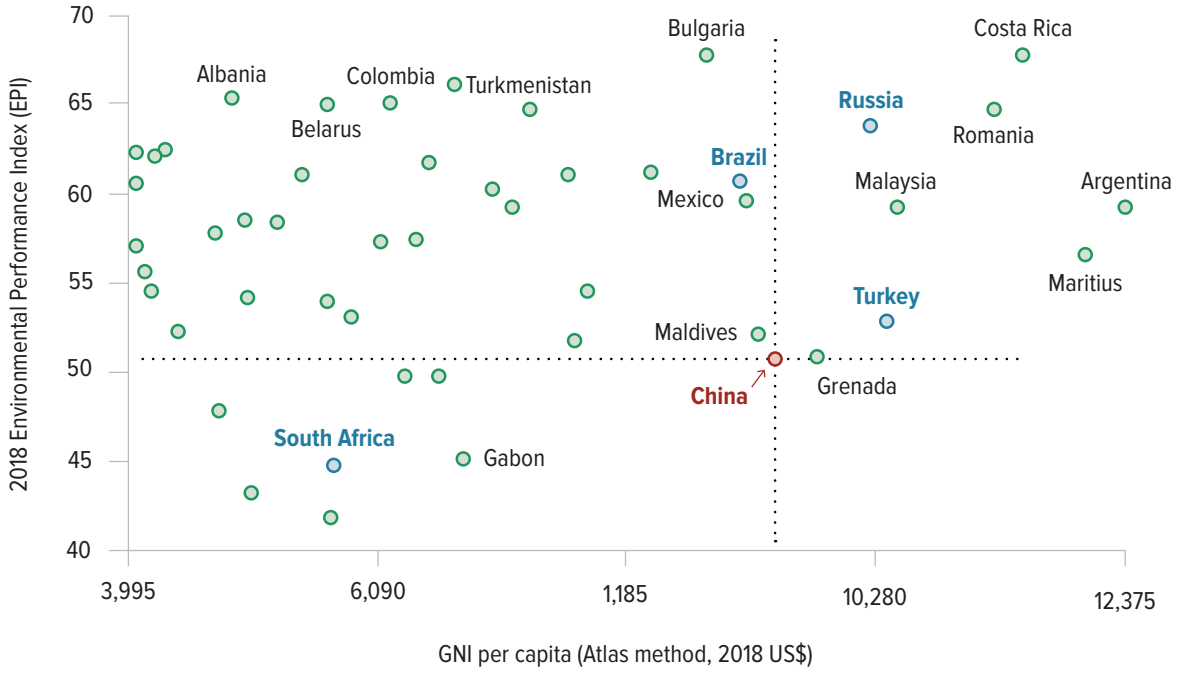
income exhibited higher environmental performance than China (figure 1.1).

Recognizing that environmental issues undermine long-term economic growth and human development, promoting more sustainable patterns of consumption and production has become a major priority. This is being pursued through productivity and innovation-driven development; rebalancing toward consumption and services; improving equitable access to basic public services; and reversing degradation through improved environmental management. National government funding of environmental protection and pollution control increased to US$35.7 billion in 2019, a fivefold increase from 2017 (Hu, Tan, and Xu 2019). China has started to slow greenhouse gas emissions growth, reduce air and water pollution, improve resource efficiency of the economy, and enhance land management.

"Ecological compensation," or "eco-compensation," is becoming an important part of this drive toward sustainability. First used to denote a fee levied to support China's former National Environmental Protection Agency, the term eco-compensation has broadened substantially. While still evolving in meaning, eco-compensation is grounded in the idea of environmental fiscal transfers, and of utilizing market-based, direct pay, and/or performance-based payments to equitably and efficiently apportion the costs and benefits of environmental protection and management between key beneficiaries and suppliers of ecosystem services. It encompasses payments for ecosystem services (PES)—a term used internationally to describe conditional and incentive-based environmental policies—but goes well beyond PES to include compensation for regulatory takings, direct government to government transfers, and frameworks for cooperation (box 1.1).

Eco-compensation's growing prominence and breadth of meaning represent both opportunities and risks. The national government is increasingly linking the term to a growing range of desired improvements in environmental outcomes, but has yet to map out a clear pathway for their realization. Provinces are implementing new eco-compensation mechanisms in response to the national government's call to action, with some degree of repackaging of preexisting

FIGURE 1.1: China's Environmental Performance: International Comparison



Source: World Bank and Development Research Center (forthcoming).
Note: Environmental outcomes are quantified by the Yale Environmental Performance Index (2020), a composite of metrics covering air, soil, water, biodiversity, fisheries, and carbon emissions, among others. Gross national income (GNI) is based on World Bank data.

Box 1.1:

Programs and Mechanisms Commonly Encompassed by the Term Eco-compensation

Eco-compensation covers a wide range of program mechanisms, actors, and scales, including:

- Direct government payments to individuals and communities for the provision of ecosystem services;
- Compensation to households, communities, or subnational governments for regulatory takings associated with environmental policies (e.g., due to the creation of protected areas or other development restrictions);
- Frameworks for cooperation and financial transfers between subnational governments to provide incentives for ecosystem service provision by apportioning responsibilities, rights, costs, and benefits;
- Fees, levies, or taxes on natural resources used to raise funding for (and to incentivize) sustainable use and management of those resources;
- Top-down financial transfers to subnational governments to fund and incentivize environmental management; and
- Top-down financial transfers to less developed western regions for compensation for past extractive and environmentally damaging resource use as part of the country's economic development, and to strengthen current environmental management capacity.

The varied forms of eco-compensation are based on the principle of internalizing environmental externalities, in which financial transfers ensure that the environmental costs and benefits of resource use reflect the costs and benefits to wider society. However, programs differ significantly on: (1) whether payments come from government or other actors, (2) whether environmental improvements are mandatory or voluntary, or (3) whether payments flow to individuals or jurisdictions (figure B1.1).

Few countries have the diversity of eco-compensation programs found in China, where almost all of the below categories are represented in one form or another.

FIGURE B1.1: Common types of Eco-compensation Programs and Examples from China and Internationally

STATE IS THE PAYER?	LEGALLY MANDATED ENVIRONMENTAL IMPROVEMENTS? *No*	*Yes*
No	**1a. User-financed voluntary PES schemes** (e.g., water funds) **1b. Voluntary carbon markets** (e.g., carbon offsets)	**3. Environmental compliance markets** (e.g., carbon trading markets, biodiversity offset programs)
Yes	**2a. Government-financed voluntary PES schemes** (e.g., US conservation reserve program) **2b. Ecological fiscal transfers to jurisdictions** (e.g., India's provincial payments system)	**4a. Compensation payments to individuals in restricted areas** (e.g., protected area payments) **4b. Foregone development compensation to jurisdictions in restricted areas** (e.g., National Key Ecological Function Zones)

Note: State refers to the overarching government that represents both those who receive benefits from, and those who face costs in creating environmental improvements. Type (a) refers to individual or firms as payment recipients; type (b) refers to jurisdictions such as provinces or counties.
Sources: Zhang et al. 2010; Lopez and Bennett 2018; Authors.

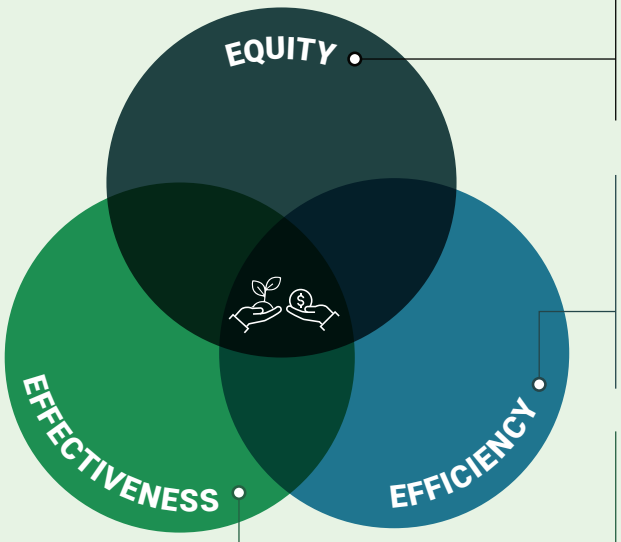
Box 1.2:

How Should Eco-compensation Programs Be Assessed?

The breadth of the eco-compensation concept means it is difficult to provide a single metric of assessment. However, there are clear principles that all programs can strive for to balance economic, environmental, and social goals. This report considers the following characteristics to be important in designing and evaluating programs: *efficiency* defined by the return on public or private spending, *equity* by social outcomes (including transparency and stakeholder participation), and *effectiveness* by the environmental impact the program has relative to the baseline and relative to the outcomes in the absence of the program (Figure B1.2).

No program can achieve all goals. There are trade-offs between these metrics (for instance, between targeting for high-impact locations, and targeting socioeconomic goals in addition to environmental goals). Programs should define goals up front, be explicit about trade-offs, and continually measure progress and adapt implementation and design to improve performance on the goals prioritized. This report draws on this framework to assess programs and make recommendations (see chapters 3 and 5).

FIGURE B1.2: A Conceptual Framework for Assessing Eco-compensation across Multiple Dimensions



Is the program fair, and supported by communities?

Is participation (within incentive programs) truly voluntary?

Is compensation (within mandatory programs) fair?

Is program design and implementation based on consultation?

Are program data (inputs and outcomes) publicly available?

Does the program achieve its goals in a cost-effective way?

Does public expenditure match public good outcomes?

Are private sector contributions leveraged, where possible?

Are potential synergies and tradeoffs between ecosystem services recognized?

Is funding secure for program with ongoing needs?

Does the program deliver meaningful environmental improvements?

Are achieved outcomes beyons what would happen without the program?

Are high-impact locations priorized, and detrimental spillovers avoided?

Are results credibly monitored and attributable to the program?

Is the program's scale (extent and time horizon) meaningful and appropriate?

Source: Authors.

activities taking place. Meanwhile, most national government eco-compensation consists of top-down payment programs targeting broad ecosystem types. Overall, what is taking shape is a system of geographically scaled but relatively shallow overlapping management frameworks, with varying levels of efficiency, effectiveness, and equity (box 1.2). The national government has signaled a clear commitment to improving environmental outcomes, and is increasing eco-compensation financing toward this goal. However, at present, growth in eco-compensation risks replicating existing inefficiencies. There is a need for strategic thinking on how eco-compensation policies and programs should be refined within China's complex and evolving environmental governance landscape to meet current challenges.

This report presents eco-compensation's current and envisioned role within China's evolving environmental governance landscape, and makes recommendations for improvement. The objective of this report is to identify how eco-compensation is taking shape, how it contributes to China's environmental management regime, and what opportunities exist for its refinement and improvement. The report places eco-compensation within the context of China's overall environmental management reforms, exploring how it has contributed to, and been facilitated by, those reforms. It provides recommendations for Chinese policy makers for further refinements to eco-compensation based on an assessment of existing programs and remaining institutional challenges. Throughout, the report highlights China's considerable success with eco-compensation. It takes a whole-of-China view, assessing national-level trends, complemented by short case studies. By necessity, the report provides framework recommendations and principles for improvement, rather than recommendations directed toward specific programs.

The report includes a special focus on the Yangtze and Yellow River basins. These geographic regions are home to some of China's most important water-related and ecological natural resources, and are home to a majority of the Chinese economy and population (if the Yangtze River basin was a country, it would have the world's third largest GDP). They are also extremely complex hydro-ecological and economic systems, with competing users across sectors, jurisdictions, and ecosystem types. Growing environmental impacts have led to the national government prioritizing improved land and water management within these basins. Eco-compensation has been used extensively over the past three decades in these basins; new instruments are now envisaged, but are yet to be defined or designed, providing opportunities for learning from experience.

The remainder of the report is organized as follows. Chapter 2 presents the rise and evolution of eco-compensation, linking its development to the broader environmental management reforms to which it has contributed. Chapter 3 then presents distinct types of eco-compensation as well as an assessment of trends, based on a database of programs developed for this report. Chapter 4 explores how eco-compensation is being used to address water management challenges of the Yangtze River and Yellow River basins. Chapter 5 provides framework recommendations to improve eco-compensation outcomes and help realize China's ambitious environmental goals.

CHAPTER 2.

Eco-compensation within China's Evolving Ecological and Environmental Governance Framework

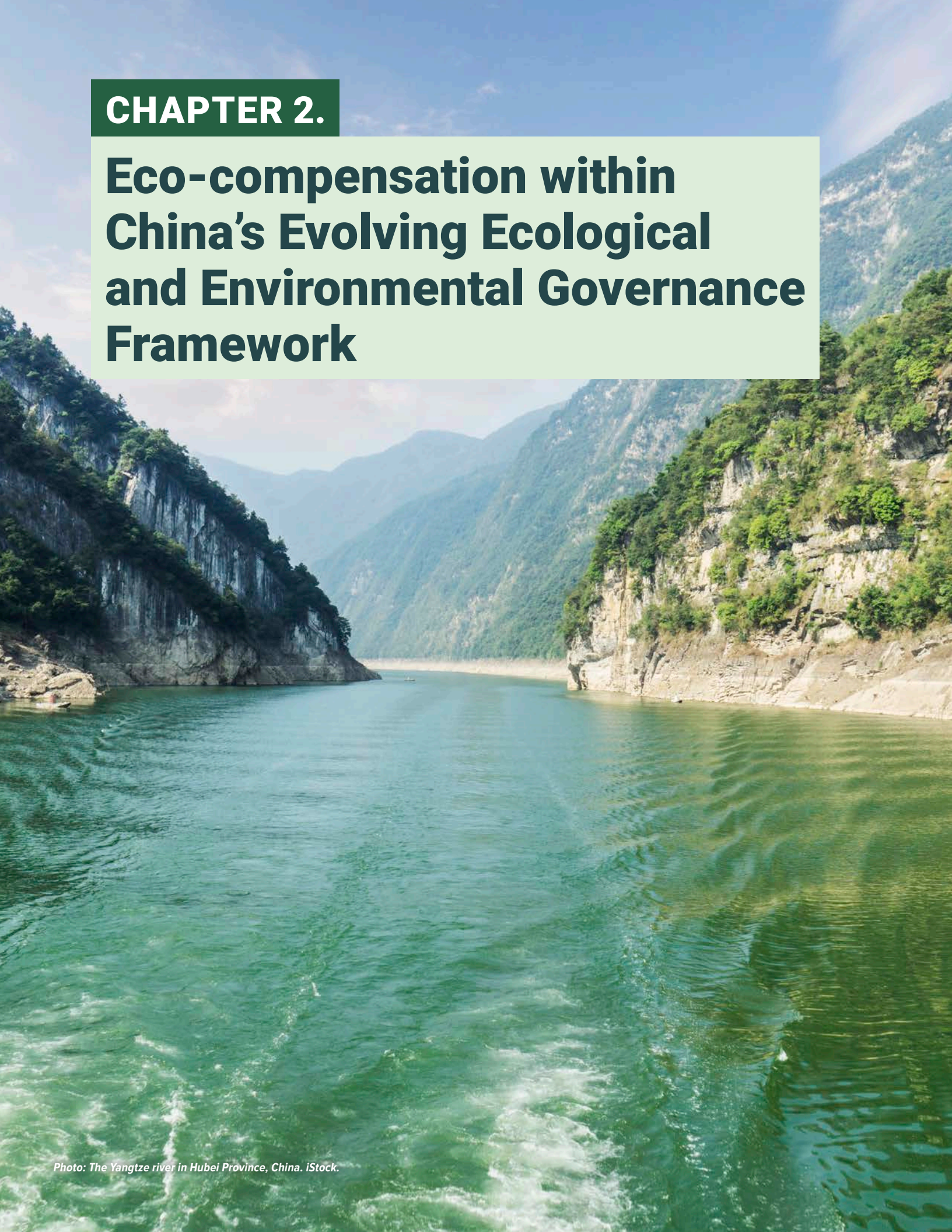


Photo: The Yangtze river in Hubei Province, China. iStock.

Eco-compensation has become a key component of China's overall drive toward sustainability.

It has become both an increasingly broad concept encompassing a wide range of performance-based policy instruments and approaches, and an important coordination tool within the Chinese government's fiscal and organizational structure. This chapter presents the evolution of eco-compensation, demonstrating its role within China's environmental management regime and fiscal system.

2.1 THE STARTING POINT: DROUGHTS AND FLOODS

The term "ecological compensation" first appeared in 1993, when the then National Environmental Protection Agency (NEPA) began collecting a *Pilot Ecological Environment Compensation Fee*. This fee was used by the agency to raise revenues to finance environmental rehabilitation and protection, while around the same time, the national government was laying broader foundations for eco-compensation. In 1992, the State Council announced[12] a "forest price system and a forest ecological benefit compensation system for paid use of forest resources" (Zhang and Crooks 2012). This led to the inclusion in the 1998 revision of the *Forest Law*, of a plan to "establish a forest ecological benefit compensation fund for the construction, tending, protection, and management of forest resources and trees for ecologically beneficial shelterbelts and special-purpose forests" (CCICED 2008).

Disaster accelerated the process of turning these ambitions into reality. Severe drought in the Yellow River basin and flooding in the upper Yangtze River basin and northeast China in 1997–1998 motivated the launch of a portfolio of large-scale forest sector programs. The Yellow River witnessed a historic dry out in 1997, failing to reach the sea for 267 days. The summer of the following year witnessed catastrophic flooding along the Yangtze River, and along the Songhua and Nen Rivers in Northeast China that claimed more than 4,000 lives, caused an estimated CNY 255.1 billion (US$37.2 billion) in direct economic losses and damage, and affected 22.3 million hectares (ha) of cropland in 29 provinces (Xu and Cao 2001; Xu et al. 2010).

Of the programs developed in response to these disasters (the "Six Key National Forestry Programs"), the Conversion of Cropland to Forests Program (CCFP) was the most innovative (Liu 2002; Hyde, Belcher, and Xu 2003).[13] The CCFP directly engaged rural households as stewards of ecosystem services, providing subsidy payments to retire and afforest their sloping or marginal cropland, and to manage the planted trees to ensure survival, with the level and duration of subsidies depending on the region and type of plantation.[14] The CCFP expanded quickly, starting with around 300,000 hectares of enrolled cropland across three pilot provinces in 1999, and growing to 7.2 million hectares by the end of 2003, at which time it was being implemented in more than 25 provinces (Uchida, Xu, and Rozelle 2005; Xu et al. 2010). This flagship program provided crucial policy learning for a range of subsequent programs and the development of eco-compensation in China more generally.

While the CCFP regrew forests, the Forest Ecological Benefit Compensation Fund (FECF) protected existing forests. The FECF targeted standing forest area that was deemed to provide important ecological goods and services ("public benefit forests"). The idea for a such a program had long been discussed by policy makers.[15] Under the FECF, payments are made to households who are the land users for a "public benefit forest area," primarily in eastern and

12 Notice on the Essential Points of the 1992 Economic System Reform, National Issue [1992] No. 12; Notice on Further Strengthening Afforestation and Greening Work [1993] No. 15.

13 These programs were motivated by a growing understanding that the severity of these disasters was significantly magnified by degradation of riparian and upper watershed forests and ecosystems due to agricultural extensification and timber overharvesting. The programs focused in large part on shifting the forest sector away from extractive timber production to a more balanced management and utilization of forest resources based on the full range of ecological services they provide.

14 The initial subsidy scheme paid part of these subsidies in grain. This was subsequently shifted to cash-based subsidies.

15 While the legal foundations for FECF were set down in the revised Forest Law (1998), it was in 2000 that the State Council agreed that the money for compensation be directly allocated from the fiscal budget, putting in place a formal source of funding (Zuo et al. 2005). In January of the same year, the Forest Law Implementation Regulations were put in place, with Article 15 of Section 3 stating that those who manage and protect public benefit forests have the right to receive compensation (State Council 2000).

southern China.[16] Over 124 million ha of forest area in China has been delineated as key public benefit forest areas, and generally include areas suffering from severe soil erosion or desertification (47 percent of total area), areas along riverbanks (24 percent), and areas in the watersheds (primarily upper) of the Yellow and Yangtze Rivers (75 percent) (SFA 2008, 2012).

The Ministry of Finance allocated CNY 1 billion (US$150 million) to launch the pilot phase of the FECF program in 2001, covering 13.33 million hectares across 685 counties and 24 national-level reserves. Local governments in Guangdong, Fujian, Zhejiang, and other provinces also budgeted for similar funds and began implementing pilots (Zuo et al. 2005). The national FECF was formally launched in 2004, and by the end of the decade had scaled to 30 provinces with almost 70 million ha enrolled and annual payments of CNY 7.59 billion (US$1.12 billion). Annual subsidies are paid to the owners of targeted forestland to compensate for the rezoning to a key public benefit forest area, which bans the use of the trees on that land for timber, fuelwood, or non-timber forest products.[17] Importantly, funding for this program was often interwoven into a range of other eco-compensation programs, demonstrating a key characteristic of national framework-type eco-compensation in China: a tendency to facilitate and financially support supplementary local programs tailored to local conditions, and in doing so, drive innovation. This report returns to the FECF and CCFP in section 3.1.c.

2.2 LOCAL INNOVATION AND NATIONAL UPTAKE

The CCFP and FECF served as important catalysts for broader development of eco-compensation. The scale of the CCFP—one of the most widespread rural programs in China at the time (among all programs, not only those focused on the environment)[18]—generated significant momentum and local government capacity-building. The programs helped motivate a variety of local, provincial, and national environmental policy innovations, often but not always under the term eco-compensation. These included numerous programs targeting watershed ecological services, such as experiments in compensated water use rights transfers, and fiscal transfer programs aimed at financing watershed protection and forest conservation (Bennett 2009).

In 2005 the State Council issued, for the first time, principles for developing eco-compensation mechanisms,[19] and the 11th Five-Year Plan (FYP) (2006–2010) subsequently called for accelerated eco-compensation mechanism development. Eco-compensation has been prominent in all subsequent FYPs and incorporated into a range of high-level policy documents. This included the *2007 State Council Work Outline*, which called for "… deepening product pricing and emissions fee reforms for key natural resources, perfecting a resource taxation system, and improving a paid mineral resource use system; accelerating the development of eco-compensation mechanisms," and the 2008 revision of the *Water Pollution Prevention and Control Law*, which enables the use of financial transfers and payments to underwrite watershed protection in drinking water source areas. The national government's promotion of eco-compensation resulted in significant provincial government efforts in developing eco-compensation policies and programs (figure 2.1).

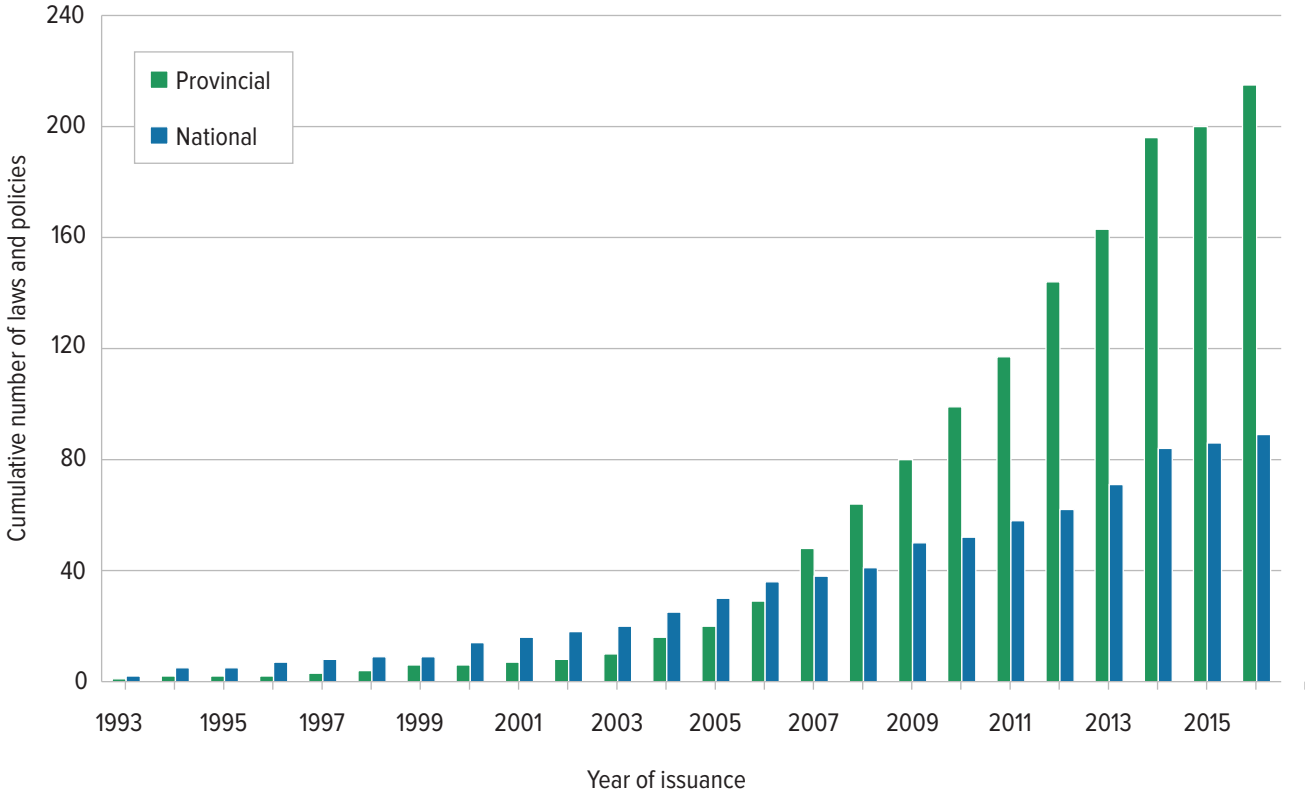
16 This forest-type classification was developed in 1996 as part of China's reform of its classified management of forestry. As part of this, two main forest classifications were developed: "commercial forests" (where harvesting is permitted) and "public benefit forests" (those deemed to provide important ecological services, such as sapling and seed provision, watershed protection, biodiversity, and carbon sequestration, with harvesting not permitted) (Hyde et al. 2003; Xu, White, and Lele 2010).

17 Use rights owners include communities or households in collective forest areas, or state forestry enterprises in state-owned forest areas.

18 Zhang et al. (2006) finds in a survey of investment projects during 1998–2003 in 2,459 sample villages across six provinces that the CCFP was the third most common project being implemented at the village level, behind roads and bridges, and irrigation investments.

19 Document No. 39: *State Council Decision Regarding Using the Scientific Development View to Strengthen Environmental Protection* stated that the government ". . . should improve eco-compensation policy, and develop eco-compensation mechanisms as quickly as possible" (State Council 2005).

FIGURE 2.1: The Issuance of Laws and Policies Directly Concerning Eco-compensation



Source: Compiled by Authors with data from the China Eco-compensation Policy Research Center, China Agriculture University.

2.3 EQUITY CONSIDERATIONS: LOOKING TO THE WESTERN REGIONS

The idea that richer coastal "beneficiaries" of ecosystem services should provide compensation to poorer inland "providers" is an important theme in the rise of eco-compensation. Western Region provinces[20] have long lagged behind China's more prosperous coastal areas, are important headwaters areas for the Yellow and the Yangtze Rivers, and are repositories for China's richest and most internationally significant biodiversity. For this reason, the then Western Region Development Department of NDRC[21] was tasked with coordinating the CCFP as well as the related Conversion of Pastures to Grasslands Program (CPGP), as part of its mandate over broader economic development of lagging regions.[22] The original three CCFP pilot provinces—Sichuan, Gansu, and Shaanxi—are in key upper watershed areas for the Yellow and Yangtze Rivers, while the CPGP is an important contributor to protection of the source region of these rivers (and the Mekong River). Governments have increasingly focused on incorporating poverty alleviation goals and indicators into eco-compensation programs, especially for key ecological function zones, many of which are nationally designated poverty counties in the Western Region.

20 The Western Region in China is comprised of Chongqing, Gansu, Guangxi, Guizhou, Inner Mongolia, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Xinjiang, and Yunnan.

21 In 2019 the Western Region Development Department of the NDRC became the Regional Opening Department responsible for China's "Belt and Road" initiative (Jing 2019). The Regional Revitalization Department inherited the role of coordinating eco-compensation policy.

22 The Western Region Development Strategy was initiated with guidelines in 1999 and the establishment of a State Council leading group in 2000. The strategy focused on infrastructure development and improved transport links with the eastern and coastal provinces, incentives for foreign direct investment, and ecological protection (Jun et al. 2014).

2.4 THE ECO-COMPENSATION CONCEPT BROADENS

The State Council soon called for mainstreaming of eco-compensation approaches in environmental management. This is seen in the *Opinions of the General Office of the State Council on Improving Ecological Protection Compensation Mechanisms* (State Council 2016), and the *Action Plan for Establishing Market-oriented and Diversified Ecological Compensation Mechanisms* (NDRC 2018). In both the Opinions and Action Plan, the national government called for incorporating and improving eco-compensation mechanisms in preexisting programs targeting specific land types/ecosystems—forests, grasslands, wetlands, deserts, oceans, and cultivated land—as well as to support key ecological function zones and ecological redline areas.

In recent years the concept has significantly broadened as part of the national government's desire for ecological and environmental "institutional innovation." Desired outcomes include interagency and interregional coordination mechanisms, a formalized system for calculating eco-compensation subsidy standards, "horizontal eco-compensation" programs (i.e., transfers between the same level of government), compensation other than fiscal transfers (such as providing downstream development rights), and environmental trading platforms—including for water use rights, water pollution emissions, and carbon emissions. Other objectives now commonly referred to as eco-compensation include green product standards, green financial standards, and preferential green public procurement. In the context of this conceptual expansion, a national eco-compensation policy framework was needed. Its development continues, with a draft National Regulation for Eco-compensation (NDRC 2020) currently open for public comment (box 2.1).

As a result, it has become increasingly challenging to pin down eco-compensation's exact meaning. The draft National Regulation continues to define eco-compensation only loosely. However, throughout this conceptual broadening, four key goals for eco-compensation remain clear. Eco-compensation is expected to (1) drive experimentation with and adoption of incentive-based policy instruments; (2) create interagency, intersectoral, and interregional management frameworks; (3) diversify funding sources for environmental management; and (4) directly engage a wide range of stakeholders. The extent to which these and other goals are being achieved is examined in chapter 3.

2.5 A GUIDING VISION: ECOLOGICAL CIVILIZATION

The "ecological civilization" concept (*shengtai wenming* 生态文明) is the guiding vision for China's sustainable development. Ecological civilization is an ideological framework for the country's transition to a lower-impact, resource efficient economy. The concept goes beyond the traditional definitions of sustainable development—built around environmental, social, and economic elements—to incorporate political and cultural dimensions, and is sometimes called "sustainable development with Chinese characteristics" (box 2.2). The concept was enshrined in China's constitution in 2018 (Hansen et al. 2018).

Ecological civilization embodies the goal of reframing and reorientating China's economic development to incorporate the values of ecosystem services; this is also central to the concept of eco-compensation. This alignment is seen in the phrase "Lucid waters and lush mountains are invaluable assets" (绿水青山就是金山银山), first stated by President Xi Jinping in 2016 in recognition of the importance of natural capital and the value of ecosystem services.[23] This is now a regularly quoted expression in official government documents and public speeches, referred to as the "two mountains concept." Conceptually, eco-civilization is thus aligned with market- and incentive-based approaches to environmental management. Eco-compensation has been evolving side by side with the concept of ecological civilization, and is an increasingly important tool to operationalize this vision (figure 2.2).

23 Xi, Jinping. 2016. "A New Starting Point for China's Development: A Blueprint for Global Growth." Keynote Speech. The phrase is a play on a classic Chinese idiom for beautiful natural scenery: "Lush Mountains and Lucid Rivers" (青山绿水).

Box 2.1:

A National Regulation for Eco-compensation

A draft National Regulation for *"Compensation for Ecological Protection"* was issued in December 2020 for public comment, representing the first national-level regulation on the topic (NDRC 2020)**.** The regulation defines eco-compensation broadly as financial transfer payments or market transactions that compensate for costs incurred for ecological protection. It nominates priority areas for the use of eco-compensation, namely public benefit forests, grasslands, wetlands, rivers, and lakes; restoration of desertified areas; compensation for fishing bans; promotion of sustainable agriculture practices; and support for the protection of national key ecological function zones and nature reserves.

The draft regulation delegates monitoring and evaluation responsibilities across branches of government. Under the draft regulation, national government ministries are expected to monitor and publicize results on indicators contained within interprovincial agreements, while the equivalent requirement is made of provincial governments for agreements by sub-provincial governments within their jurisdiction. The regulation makes broad calls for increased transparency, including the public release of information. Specific requirements and guidelines for data standards, along with platforms to facilitate publication, would be useful complements.

The draft regulation institutes an interministerial joint conference for guiding the development of eco-compensation. The conference is expected to evaluate the implementation of eco-compensation regulations by subnational governments, synthesize local experience, and provide guidance for further policy development. If successful in implementation, this body would represent a substantive contribution toward more adaptive policy development by capturing lessons across programs and provinces, and through time.

The regulation also calls for the acceleration of mechanisms to protect the Yellow and Yangtze River basins (explored further in section 4.4). These may be facilitated by rewards and co-financing from the national government to provinces that form such agreements. Notably, it supports the development of trading mechanisms for water allocation and pollution control. However, these remain broad statements of intent; further regulations clarifying property rights and trade will be needed to support operationalization of these principles.

Source: Authors.

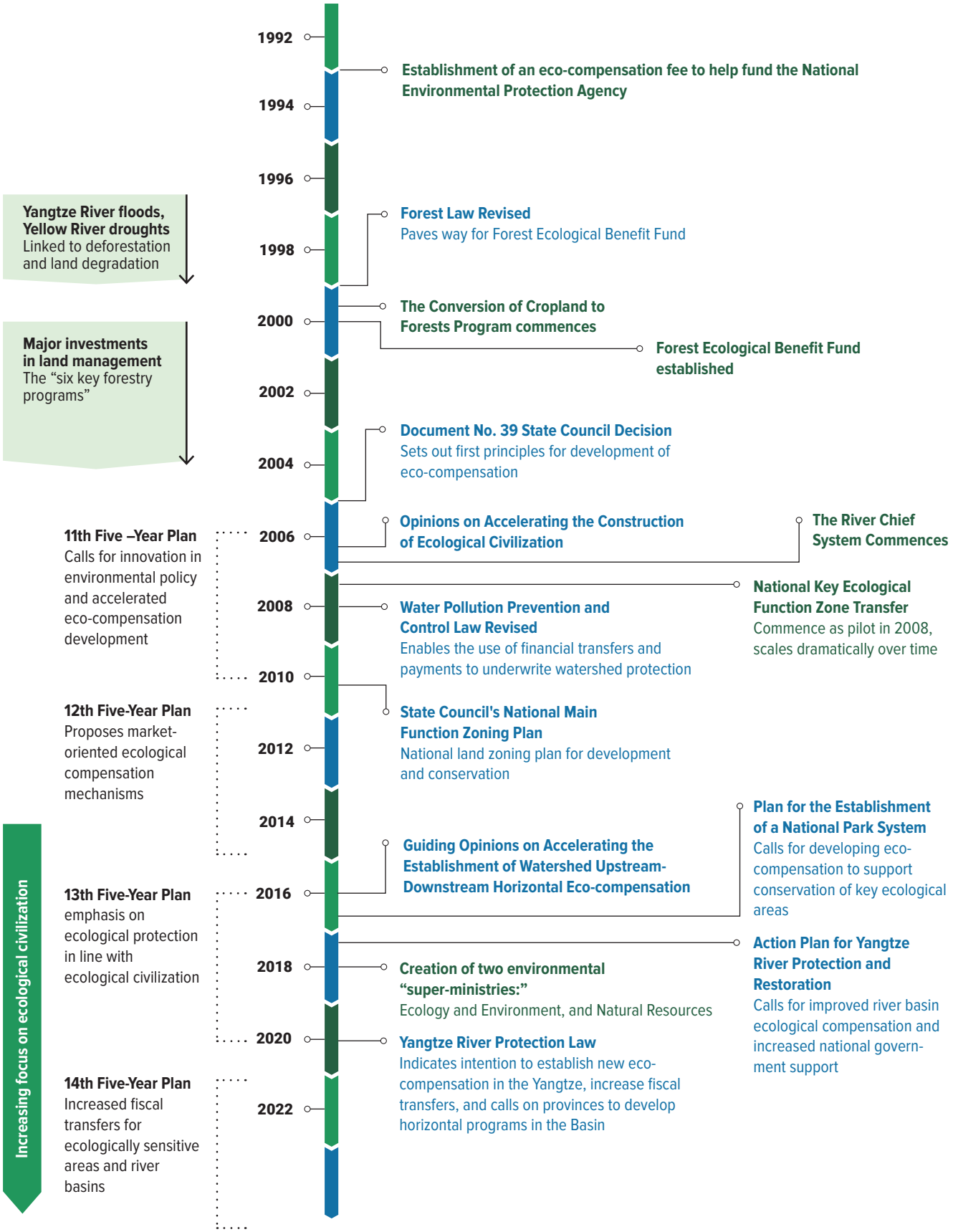
Box 2.2:

Elements of the Ecological Civilization Concept

Ecological environment	Physical protection and restoration of the environment
Ecological economy	A resource efficient economy that incorporates the value of ecosystem services
Ecological society	A society with heightened environmental awareness and social participation
Ecological politics	A political system that rewards ecological performance and establishes political accountability for environmental impacts
Ecological culture	A culture that values the environment

Source: World Bank and DRC (forthcoming).

FIGURE 2.2: Key Policy Milestones in Eco-compensation Policy Development



2.6 THE INSTITUTIONAL LANDSCAPE UNDERPINNING ECO-COMPENSATION

Throughout China's economic development, eco-compensation has also become an important component of environmental and fiscal governance. China's environmental management system began taking shape in the 1970s and was formalized in the *Environmental Protection Law* of 1989 (Zhou 2020). It is supervised by the National People's Congress and has been managed by the national environmental protection authorities—now the Ministry of Ecology and Environment (MEE) and the Ministry of Natural Resources (MNR)—with the onus of implementation on provincial and sub-provincial governments and agencies (Zhou 2020; Cai, Li, and Shen 2015; PRC 2014).

The Chinese government is structured with overlapping vertical and horizontal lines of management and oversight, traditionally termed the tiao-kuai (条块) system (Lieberthal 1997). This consists of the horizontal "blocks" (*kuai*) of governmental levels (i.e., national, provincial, municipal, county, and township) overlaid by the vertical "lines" (*tiao*) of the top-down hierarchical relationships within agencies (box 2.3). As a result, for a given subnational agency, both its regional level of government and its superior counterpart agency exert management and oversight authority (Zhou 2020; Deng 2016).

This overlapping system has traditionally resulted in ecological and environmental management conflicts. Local protectionism in the "blocks" has often overridden the hierarchical "lines" of the superior agency, impeding implementation of the national environmental policy (Eaton and Kostka 2014; Mertha 2009). Environmental management responsibilities have also been fragmented and spread across multiple ministries, and the funding for environmental management has long been folded into other funding streams within the fiscal system.

To resolve these conflicts, the national government has been introducing measures to strengthen environmental governance. These are (1) streamlining institutions; (2) strengthening fiscal support and funding channels; (3) developing spatial planning frameworks; and (4) clarifying and strengthening property rights. These have served to make eco-compensation a more prominent part of the fiscal and institutional structure of management, both explicitly and by addressing key issues needed for eco-compensation to be effective. Eco-compensation has, in reality, been evolving alongside these management reforms with ongoing cross-fertilization: eco-compensation is both influenced by and influencing these reforms (table 2.1).

1. Strengthening and Streamlining Institutions

The national government has been significantly strengthening ecological and environmental management authority and oversight. This has included both a consolidation of environmental responsibilities at the national level, as well as strengthening vertical management and oversight and de-linking environmental agencies from their respective regional governmental levels, with varying levels of success (Zhou 2020; Shen and Jiang 2020).

Consolidation of ecological and environmental management responsibilities into China's two "super-ministries" has been the most comprehensive institutional reform for environmental management in the past 40 years. In broad terms, the MNR now serves as the overall environmental planner and natural resource owner and manager, while MEE is the country's top regulator of pollution. This consolidation of responsibilities—which extends to subnational government levels—has significantly clarified the institutional landscape within which eco-compensation programs can operate. For example, water pollution management responsibilities have been consolidated within MEE, meaning that eco-compensation programs targeting water can function through this single ministry and its subnational counterparts.

Vertical management reforms have also consolidated management and monitoring in upper governmental levels (national and provincial). These reforms aim to remove potential conflicts of interest at local government levels, while increasing the directness of oversight; MEE can now directly intervene in subnational government environmental management emergencies and issues. The consolidation of these lines of authority have strengthened the ability of national and provincial governments to monitor

Box 2.3:

The Role of Eco-compensation in China's Environmental Governance and Fiscal System

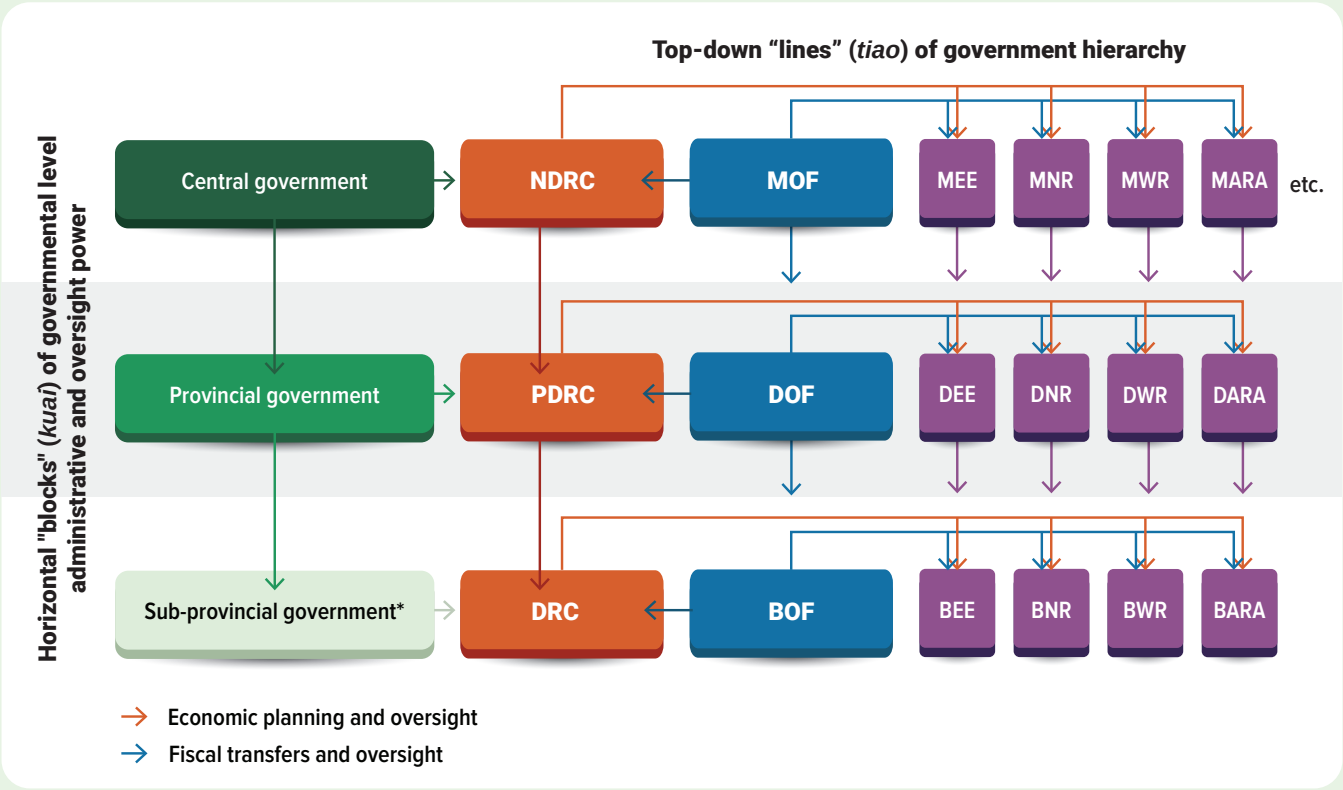
As a fiscal and cross-governance coordination tool, eco-compensation is itself part of the organizational structure of the Chinese government. China is one of the most fiscally decentralized countries in the world, with 85 percent of government spending occurring at subnational levels (Wingender 2018).[a] Sub-provincial governments are the key implementers of national government policy (Shen and Jiang 2020; Zhou 2020). Generally, the national government provides funding and broad policy guidelines, and provides subnational governments with the latitude to interpret and adapt them. Fiscal transfers remain the dominant source of revenues of subnational governmental levels and are made vertically to the next subordinate level of government, so that the national government makes transfers to provincial governments, provincial governments to municipal or county governments, and so on.

In this context it is not surprising that eco-compensation is widely used for meeting environmental management goals. With provincial (or sub-provincial) governments responsible for implementing higher-level objectives, there is a need for mechanisms that can provide coordination across boundaries, motivate and incentivize subnational governments to implement a national government vision, and provide financial resources for implementation. Eco-compensation is well suited to meeting these needs, and is often described as a platform for coordination as much as a fiscal transfer mechanism.

[a]This increases to 89 percent when including local government financing.

Source: Authors.

FIGURE B2.3: Chinese Government Fiscal and Organizational Structure, with an Emphasis on Environmental Management



Abbreviations: NDRC = National Development and Reform Commission; MOF = Ministry of Finance; MEE = Ministry of Environment and Ecology; MNR = Ministry of Natural Resources; MWR = Ministry of Water Resources; MARA = Ministry of Agriculture and Rural Affairs. Subnational agencies simply sustitute the M for a D = Department or B = Bureau with the exception that PDRC = Provincial Development and Reform Commission and DRC = Development and Reform Commission (at the relevant level of government).
Note: Management and fiscal transfers generally go to municipalities then counties, but some provinces have direct province-county management and funding linkages. See Appendix A for more information on the fiscal and organizational structure of environmental governance.
Source: Adapted from Deng et al (2016), Shah and Shen (2006), Zhou (2020).

TABLE 2.1: Environmental Management Reforms and Interactions with Eco-compensation

(i) STRENGTHENING & STREAMLINING INSTITUTIONS	(ii) STRENGTHENING FISCAL SUPPORT & FUNDING CHANNELS	(iii) DEVELOPING SPATIAL PLANNING FRAMEWORKS	(iv) CLARIFYING & STRENGTHENING PROPERTY RIGHTS
1. What are the key components of these reforms?			
• Consolidation of responsibilities into MEE and MNR; • Clarification and strengthening of agency and regional government roles and responsibilities; • Strengthening of vertical management and oversight; • More direct mechanisms for monitoring and enforcement.	• Continual increase in environmental funding at all levels of government; • Increasing use of national grants (special use funds) to incentivize capacity-building and reform.	• Creation and deepening of a function-based land use zoning system; • Creation and deepening of "ecological redlines" demarking conservation priority areas; • Environmental indicators increasingly central for government official performance evaluations.	• Clarification of natural resource property rights; • Development of a system for private sector contracting and use of natural resources; • Catalyzation of a third-party environmental services sector. • Promotion of markets to determine prices; • Removal, when necessary, of countervailing laws and regulations.
2. How do these reforms influence eco-compensation?			
• Clearer roles and responsibilities strengthen the use of eco-compensation as an incentive mechanism; • Consolidation of responsibilities removes barriers to effective functioning of eco-compensation.	• Eco-compensation is becoming a key channel through which increased funding flows; • Eco-compensation is being used as a target for national grants, through the encouragement of pilot development.	• Ecological targets are ostensibly to be informed by these spatial planning frameworks; • Local officials are incentivized to create effective programs to achieve targets.	• Clearer delineation of property rights creates opportunities for the creation of meaningful eco-compensation arrangements (i.e., with rights holders); • Removal of regulatory conflicts will improve the functioning of eco-compensation instruments.
3. How is eco-compensation facilitating these reforms?			
• Program development encouraged as a means to facilitate strengthening of management oversight; • Program development encouraged as a means to facilitate clarification of roles and responsibilities.	• Eco-compensation serving as a platform to catalyze and leverage increased funding; • Eco-compensation serving as a mechanism to explicitly link beneficiaries with suppliers and clarify costs and benefits.	• Eco-compensation serving as the primary means to support "key ecological function zones" delineated by this system; • Ecological redline areas are to be supported by eco-compensation.	• Development of programs encouraged as a means to clarify property rights and the contracting of these; • Via program development governments are encouraged to better let market forces determine prices and quantities.

Source: Authors.

the performance of sub-provincial eco-compensation programs. National government policy documents also suggest that eco-compensation should be used to support the needed capacity-building to realize these reforms.

2. Strengthening Fiscal Support and Funding Channels

Along with overall prioritization of the environment and ecology, the government has been continuously strengthening funding and fiscal support for environmental protection and ecological conservation. This was facilitated early on by reforms to government revenue and expenditure classifications to make environmental protection a distinct fiscal budget item. Annual expenditures for environmental protection have significantly increased, from CNY 99.58 billion in 2007 to CNY 853.81 billion in 2018. This constitutes an increase in the environmental expenditures' proportion of total national fiscal expenditures from 2.0 percent in 2007 to 3.9 percent in 2018, and from 0.4 percent of GDP in 2007 to 0.9 percent in 2018 (Xu and Wang 2020).[24] With these increases, eco-compensation has become an important and increasingly formalized channel for environmental funding flows, as well as a mechanism for catalyzing increased provincial and local government funding contributions.

3. Developing Spatial Planning Frameworks

The national government began setting an improved spatial planning framework in 2010. Two key elements are (1) a national function-based zoning system to better integrate economic planning with conservation;[25] and (2) an ecological "redline" policy to set limits on how much development activities can encroach on key ecosystems, generally in line with the principle of "no net loss."[26] Eco-compensation is now explicitly being used to support the "key ecological function zones" delineated in the first component (explored in section 3.1.b), and national government documents encourage provincial-level eco-compensation mechanisms, particularly "horizontal" eco-compensation mechanisms (i.e., between government entities at the same administrative level), to be developed to support the management and enforcement of these redline areas (though such programs are yet to be operationalized). These reforms have also helped to make environmental indicators an increasingly important part of the performance criteria used for evaluating provincial and sub-provincial government officials, with this in turn further incentivizing governments to prioritize developing effective eco-compensation programs.

4. Clarifying and Strengthening Property Rights for Natural Resources

A final key reform effort is the clarification and strengthening of property rights over natural resources. While the state remains the owner of natural resources in China, property rights have in practice been ambiguous across many contexts, leading to management failures. To address this, reforms aim to accelerate the development of formalized systems for private sector contracting of use rights, including for extractive uses and for third-party ecological restoration and management tasks, with market forces to determine prices and allocations.[27] The clarification of property rights is an important underpinning for the development of eco-compensation and environmental markets.

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24 By comparison, expenditures on environmental protection for EU-27 countries were on average 0.8 percent of GDP in 2019, ranging between 0.2 percent to 1.4 percent (Eurostat 2021).

25 The National Main Function Area Plan was issued in 2010 (State Council 2010). The system divides China into four function-based zone types: preferential development zones, key development zones, restricted development zones, and banned development zones. Development is banned or restricted under the last two categories, which are also classified as "key ecological function zones," deemed to provide nationally important ecological functions and services. Banned development zones are the administrative regions that encompass China's preexisting protected areas, nature reserves, and national parks. Restricted development zones allow for some production of agricultural goods and services but not urban development.

26 The development of ecological "redlines"—lower limits for ecological land types—has been in process in China since at least 2004, and was given legal status in 2014 (PRC 2014). In 2017, the national government called on provinces to develop the legal and regulatory foundations for an enforced system of ecological redlines, and set timelines for completion of this demarcation (Beijing-Tianjin-Hebei and Yangtze River Economic Belt regions by the end of 2017, and remaining jurisdictions by the end of 2020; the latter target date has been delayed). See Article 29 of the Environmental Protection Law (2014). Several Opinions Regarding the Delineation and Strict Protection of Ecological Redlines (GOCCCPC 2017)

27 See *Guiding Opinions on Promoting Reform of the Natural Resources Asset Property Rights System* (GOCCCPC and GOSC 2019), detailing tasks and targets for improving the clarification, registration, rationalization, and enforcement of natural resources ownership and management.

CHAPTER 3.

Eco-compensation Types, Trends, and Outcomes

Photo: Marcus Wishart. World Bank.

As described in the previous chapters, eco-compensation has been an important component of China's drive toward sustainability and is integral to ongoing ecological and environmental management reforms.

The report now takes a more focused look at the programs themselves: i.e. what types of eco-compensation are being developed, for what issues, and where? What role do different levels of government play, and how are programs performing? These underpin the assessment of prospects and needs for eco-compensation, which the report turns to in chapters 4 (application and prospects for river basin management) and 5 (recommendations).

Although developing a complete picture of eco-compensation's status, trends, and performance is challenging given the range of programs and data constraints, broad conclusions can be drawn. Centralized data were unavailable for this study given the diversity of programs, the role of subnational governments in implementation and monitoring, and limited reporting of program outcomes (a key point returned to in chapter 5, recommendations). In this context, the study develops a comprehensive dataset of programs by drawing on available secondary sources, including publicly available online government sources, news sources, and academic journals, with a systematized search process (box 3.1). In aggregate, these data indicate important statuses and trends in program development. The report augments these data with qualitative insights on a selection of key programs, based on government and academic literature, highlighting program performance in terms of effectiveness, efficiency, and equity considerations (see box 1.2 in chapter 1).

3.1 ECO-COMPENSATION TYPE BY RESOURCE MANAGEMENT ISSUE

A range of program "types" have begun to solidify under national government guidance. Broadly speaking, these types conform with ecological targets, though sub-types in some cases are related to the envisioned governance structure or mechanisms utilized. These are (1) eco-compensation for watershed management, (2) eco-compensation for ecological protection, and (3) eco-compensation for reforestation and land use change. These categories contain a wide diversity in de facto design and implementation approaches, and can often have a degree of overlap. There are, of course, many ways to categorize eco-compensation, and the following subsection provides an alternate view based on the roles and relationships between levels of government. This section presents these categorizations in turn.

Data collected for this report show the composition and growth of eco-compensation over time. In total, 150 programs[28] were identified in 2020, an increase from 8 eco-compensation programs in 1999. Of these programs, water-related programs have seen the most growth, from 2 in 1999 to 67 in 2020. Forestry programs—primarily comprising funding for provincial ecological public benefit forests—have also grown significantly, from 4 in 1999 (albeit large-scale, including the Conversion of Cropland to Forest Program [CCFP]), to 35 in 2020. Wetlands and grasslands eco-compensation programs progressed from 0 in 1999 to 12 and 13, respectively, in 2020 (figure 3.1).

Program growth is seen in almost all provinces with a concentration in the east (map 3.1.). Water management–related programs (described in detail in the next section) are more common in the southeast and within the Yangtze River Economic Belt (YREB), consistent with government prioritization of green development and improved water management (the focus of chapter 4), and explicit calls for provincial and sub-provincial programs in this region. The growth in program numbers between 2005 and 2020 is greatest in the relatively wealthier coastal provinces, but is occurring in almost all provinces.

3.1.a Watershed management and water source protection programs

Water management issues have long been an important driver of the development of eco-compensation programs, with a common focus on important watershed co-benefits (e.g., soil erosion prevention and control, seasonal flow

28 The number of programs is indicative of trends but should not be considered a definitive account, given difficulties in determining the "boundaries" of some programs. See box 3.1.

Box 3.1:
Developing the Eco-compensation Dataset

A unique dataset of current programs was developed using available secondary sources for this study. Building on earlier data collected and published by Forest Trends,[a] collection of data followed four steps:

1. Systematic online keyword search
Keyword searches were set up using Google Alerts to identify English and Chinese language news articles, academic publications, and government website documents and reports that contained "ecological compensation" or related terms, including "ecological protection," "ecological red lines," "cross-border watershed," and "water source protection." These automatic alert searches were run for eight months.

2. Program list development and secondary source research
Results were grouped by program and researched to extract key characteristics. Additional online sources were searched using program-specific keywords to calibrate/triangulate and deepen available information. These included, where possible, expenditure, location, time frame, government roles, monitoring, and land area coverage. Data from previous research efforts were added to the dataset, with entries on earlier categorized programs updated to reflect new developments.

3. Development and revision of program categorical data
Program data were revised to best leverage the commonalities of information provided across sources, creating a range of categorical variables of program characteristics with data extending across all programs.

4. Filling of key gaps in data
The final step included filling of data gaps using informed judgment for the categorical data or interpolation/extrapolation for the quantitative variables.

Programs were included in the dataset based on several criteria. Only programs reasonably identifiable as "eco-compensation" were included. Given the focus of this work, only those programs targeting watershed ecological services either directly or as key co-benefits (i.e., via conservation, rural land use interventions, or mining area ecological restoration) were included. For example, while several eco-compensation programs targeting air pollution management were identified, these were not included in the final dataset.

The number of programs should be considered indicative rather than definitive. There are difficulties in determining the "boundaries" of some programs: some are sub-programs within, or are supported financially by other programs, while others undergo reforms or name changes. The dataset allows for exploration of key trends rather than precise accounting.

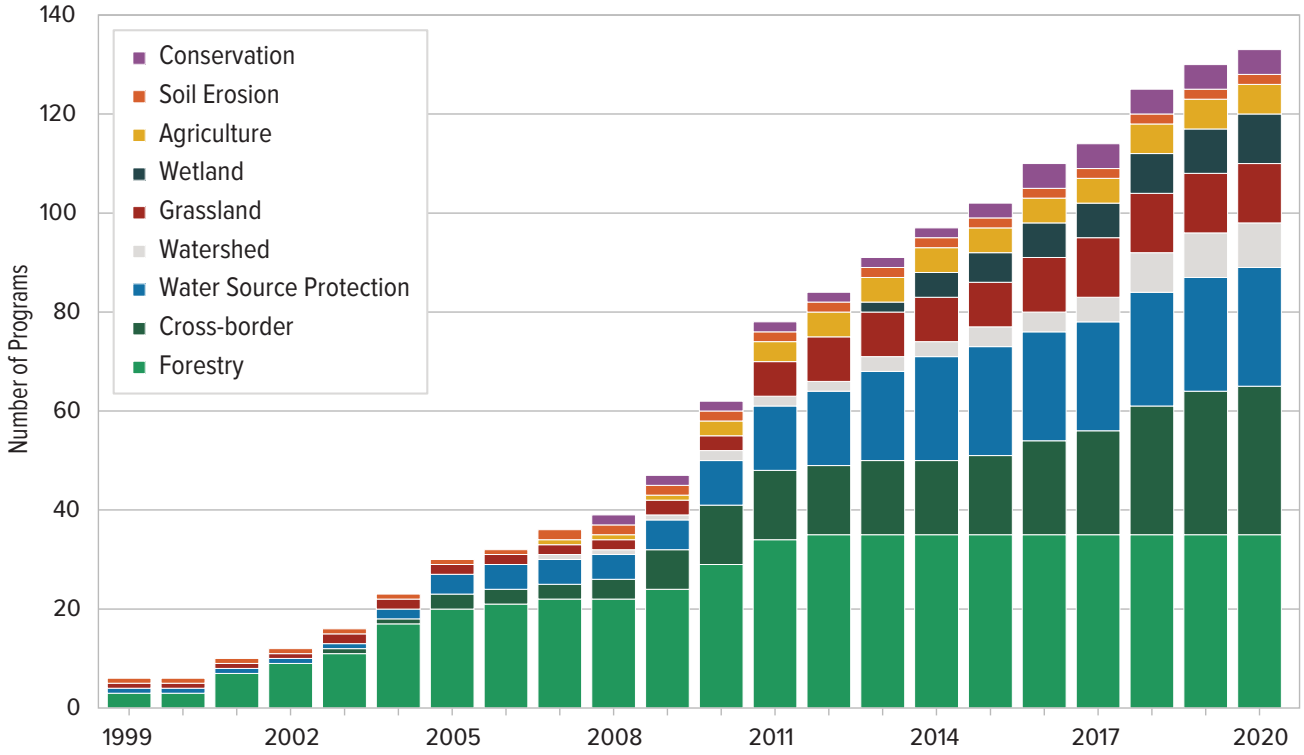
Source: Authors.
[a]These data focused on market-based programs for ecosystem services in China until 2014 (see Bennett 2009; Stanton et al. 2010; Bennett, Carroll, and Hamilton 2013; Bennett and Carroll 2014).

regulation, flood mitigation). However, programs explicitly targeting watershed and water quality management issues and institutions have grown significantly over the past decade. These include cross-border agreements between provinces within river basins, agreements between provinces and county governments, and localized eco-compensation funds for water source protection. This category of eco-compensation has been important for introducing innovations in watershed and river governance in China.

1. INTRA-PROVINCIAL CROSS-BORDER "HORIZONTAL" WATERSHED ECO-COMPENSATION

"Horizontal" or "cross-border" eco-compensation programs consist of contractual arrangements between upper and lower watershed administrative districts. These generally target water quality, with rewards and penalty payments made between adjacent administrative districts, the direction and size of which are dependent on water quality outcomes. Water quality improvement beyond a baseline entails a payment from the lower to upper watershed county to defray costs, while worsening water quality entails the opposite. These payments often involve up-front financial contributions by the participating counties/districts into a program fund, out of which the rewards are paid for performance, as determined by cross-border water quality measurements (Peng and Xiaoyao 2019). Significant variation exists across provincial programs, including in program structure, direction of payments, size

FIGURE 3.1: Growth in Eco-compensation Programs by Major Program Category



Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.
Note: The number of programs should be considered indicative rather than definitive given challenges in determining the precise "boundaries" of some programs (see box 3.1).

of penalties and rewards, and the metrics and formulas used for performance evaluations.

The national government has been strongly promoting the development of these programs as a means to strengthen watershed management at more localized scales.[29] The Ministry of Finance (MOF) has directed provinces and sub-provincial administrative areas to develop these programs across (1) all administrative districts covering within-province watersheds, and (2) provinces with cross-provincial watersheds that have drinking water functions and important ecological service values. In response, all YREB provinces have established cross-border horizontal eco-compensation schemes for water systems within their borders (box 3.2).

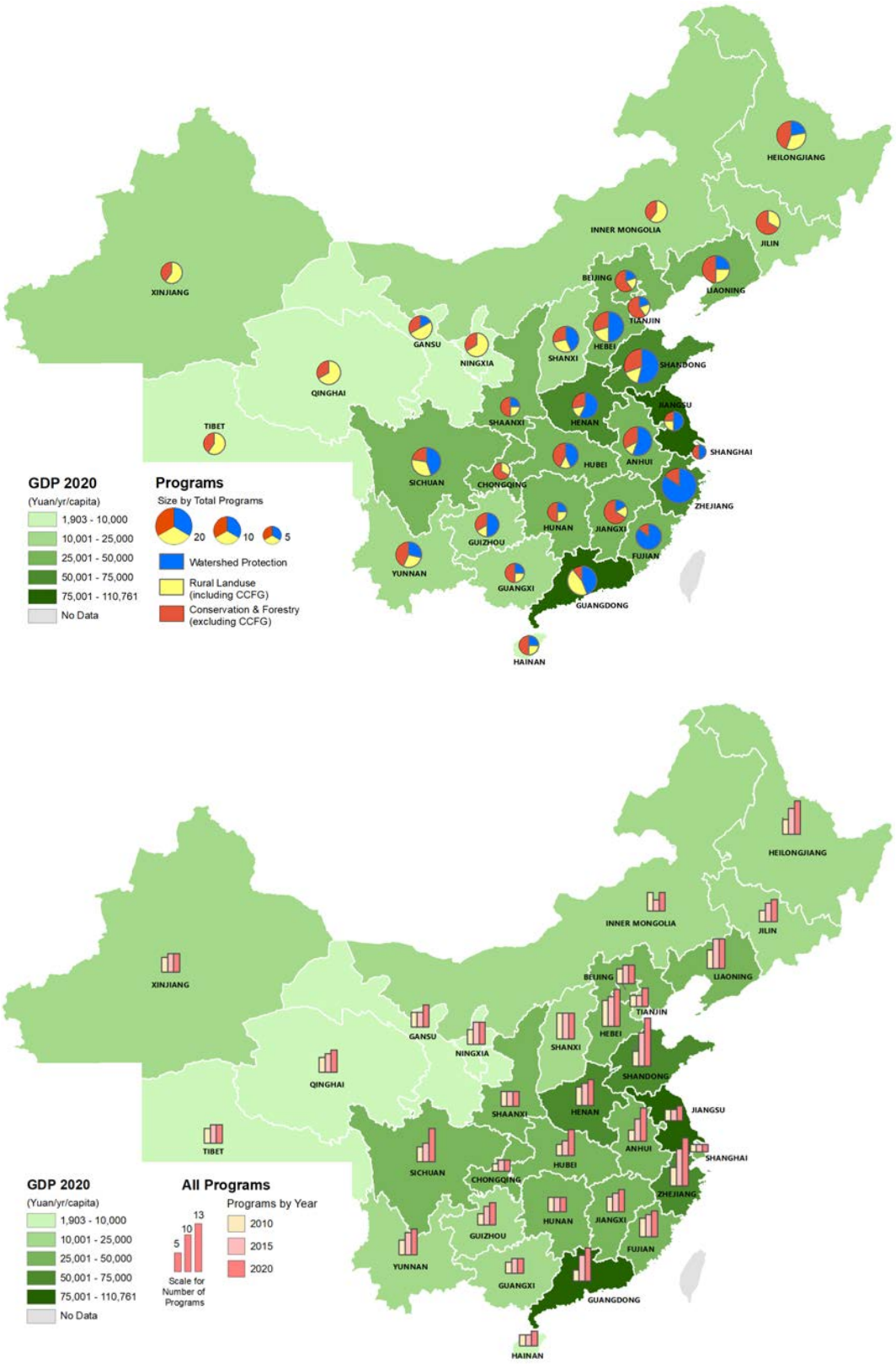
2. INTERPROVINCIAL CROSS-BORDER "HORIZONTAL" WATERSHED ECO-COMPENSATION

The national government has also been promoting the development of interprovincial horizontal eco-compensation, again focusing on key tributaries of the Yangtze River. These programs embody the same principle as those described for intra-provincial horizontal programs, though are instead between provinces and so typically involve a stronger national government role. In most cases, cross-border pollution or water quantity flows trigger a set payment based on an agreed target. The national government has been incentivizing these programs by providing essential start-up financial support and funding (in the form of co-contributions to interprovincial payments) for programs that are considered most important in terms of ecological function.[30] The Xin'an River-Qiandao Lake Eco-compensation Program between Anhui and Zhejiang

29 See: MOF. (2016). *Guiding Opinions on Accelerating the Establishment of a Compensation Mechanism for Horizontal Ecological Protection of Upper and Lower Watershed Areas.*

30 Article 9 of MOF (2019) Water Pollution Prevention and Control Funds Management Measures.

MAP 3.1: Eco-compensation by Major Program Category in 2020 (top) and Growth in Number 2005–2020 (bottom)



Source: Custom data collected by authors from systematic review of available news, academic and provincial government sources.
Note: The number of programs should be considered indicative rather than definitive given challenges in determining the precise "boundaries" of some programs (see box 3.1).

Box 3.2:

Examples of Horizontal Intra-provincial Eco-compensation: Jiangxi and Sichuan Provinces

Jiangxi Province developed a horizontal river basin eco-compensation program for the river systems within its borders in 2019. The program targets water quality and has to date resulted in 81 horizontal eco-compensation agreements signed by 79 counties that share common river courses. In total CNY 325 million (US$50 million) has been allocated from provincial and national government sources to incentivize the establishment of these agreements, while the counties involved have committed an additional CNY 313 million (US$48 million). In addition to linking watershed targets to penalties and rewards, the resulting agreements have helped to engender joint management and decision-making across county boundaries.

Sichuan Province established a horizontal eco-compensation mechanism for the Tuo River watershed in 2010, involving 10 municipalities. Unlike other horizontal examples, this program does not involve direct rewards and penalty payments between the participating municipalities, but instead features indirect payments via a system of provincial-to-municipality annual allocations. These are drawn from a pooled fund to which the municipalities and the province contribute. Contributions are based on a formula that includes water quality and water use efficiency improvements, in comparison to the average for the group, conditioned on the land area and population of the municipality in question. More detail on this program is presented in chapter 4.

Sources: 2019 Jiangxi Intra-provincial River Basin Horizontal Eco-compensation Implementation Plan; Authors.

provinces is an early example of this type of program (box 3.3).

These programs are important platforms for the provinces' joint management of shared watersheds, and have further helped catalyze and reinforce intra-provincial watershed programs. Provinces engaged in interprovincial programs face an incentive to improve their portion of the cross-border watershed; an intra-provincial program is one option for doing so, essentially nesting an intra-provincial program within the interprovincial program. As an example, Anhui Province, a party to the Xin'an River scheme between Anhui and Zhejiang, has 29 cross-border joint prevention and control agreements between municipalities and counties, which helps the province achieve its interprovincial agreement target.

The value of these schemes again goes beyond the direct incentives provided to also include knowledge transfer and management coordination. For example, Anhui, Jiangsu, Zhejiang, and Shanghai have collaborated since 2018 via joint monitoring of water metrics and co-hosting of learning events between their ecological environment departments. Participation in the Xin'an River eco-compensation program has spurred the participating provinces—Anhui and Zhejiang—and their neighbors, to both strengthen their capacity for management of their own watersheds, as well as to coordinate with other provinces on the management of shared watersheds.[31]

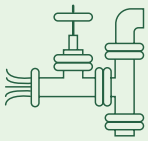
3. WATER-SOURCE PROTECTION ECO-COMPENSATION

The national government has been urging provinces to address drinking water management issues, leading to growth in water-source protection eco-compensation. Drinking water sources, such as reservoirs and lakes, are required to achieve at least a Class II or Class III water quality based on the *Surface Water Environmental Quality*

31 For example, Anhui Province now has 29 cross-border joint prevention and control agreements between municipalities and counties, 12 of which are interprovincial agreements signed with Zhejiang and Jiangsu. Anhui and Jiangsu, and Zhejiang and Shanghai have also collaborated on multiple rounds of joint supervision and cross-learning on water sources in the region and emergency linkages. Since September 2018, the ecological environment departments of these four provinces/municipalities have also organized joint supervision and learning activities (Xinhua News Agency 2019).

Box 3.3:

The Xin'an River Cross-provincial Eco-compensation Scheme



Anhui and Zhejiang provinces launched one of China's first interprovincial eco-compensation schemes in 2012. This targets water quality in the Xin'an River, the main tributary to Qiandao (i.e., "thousand islands") Lake reservoir, a key regional water source. Deteriorating water quality in the lake pushed the national government to launch negotiations between upstream Anhui and downstream Zhejiang beginning in 2004, leading to the creation of the program.[a]

The national government invested CNY 2.05 billion, and Zhejiang and Anhui each invested CNY 750 million during the two pilot phases (2012–2014 and 2015–2017). These funds were used for program start-up, watershed management, and pollution prevention, including sewage and solid waste management and treatment, ecological protection and restoration, and industry structural adjustment.

This has stabilized the water quality of Qiandao Lake—which now ranks in the top tier of 61 key national lakes—and has catalyzed improvements in the larger watershed area and significant transformation of upstream activities.[c] Next steps include tapping into a wider range of funding sources (including private sector finance), developing more efficient approaches to reduce rural nonpoint source pollution, and developing sustainable alternate eco-industries and livelihoods, including organic tea production and cultural/eco-tourism.

The Xin'an River scheme has served as an example for subsequent programs. These include programs on the Dong River (between Guangdong and Jiangxi provinces), the Chishui River (between Sichuan, Yunnan, and Guizhou provinces), the Chu River (between Anhui and Jiangsu provinces) (see box 3.4), the Lushui River (between Jiangxi and Henan provinces) and the Youshui River (between Hunan and Chongqing provinces).

Sources: Lopez and Bennett 2018; Xinhua News Agency 2018b; Authors.
[a]The 290 km Xin'an River—of which 54 percent of its watershed area and 77 percent of its population resides in upstream Anhui Province—contributes 68 percent of Qiandao Lake's water inflow. Qiandao Lake experienced deteriorating water quality and eutrophication during the late 1990s and early 2000s with recurring algal blooms.
[b]With 2008–2010 averages as the benchmark, a composite index combines the average concentration values of four water quality indices—permanganate index, ammonia nitrogen, total phosphorus, and total nitrogen—for a given year. An index value below/equal to/above the benchmark means the Zhejiang pays/keeps/receives CNY 100 million to/from Anhui for the given year, with this increased to CNY 200 million during the second pilot phase.
[c]Upstream Huangshan Municipality in Anhui Province has retired and afforested 24,000 hectares (ha) of farmland, has shut down more than 220 polluting companies, relocated more than 90 companies, and is promoting rural tourism (with the participation of more than 100,000 farmers).

Box 3.4:

Examples of Horizontal Interprovincial Eco-compensation: Chishui River and Chu River

An interprovincial program that has benefited from national government support is that for the Chishui River, a primary tributary of the Yangtze that is shared between Yunnan, Guizhou, and Sichuan provinces. These three provinces are co-signatories to the *Chishui River Basin Horizontal Ecological Protection Compensation Agreement*, in which they jointly contribute CNY 200 million (US$30.7 million) each year to a Chishui River horizontal watershed eco-compensation fund (Yunnan pays CNY 20 million, Guizhou CNY 100 million, and Sichuan CNY 80 million). From this fund, payments for ecological restoration and management are allocated at a set ratio (Yunnan receives CNY 60 million, Guizhou CNY 80 million, and Sichuan CNY 60 million).

Anhui and Jiangsu provinces have signed an agreement for the Chu River, another important tributary of the Yangtze River. The two provinces implement a two-way compensation system based on the principle of "whomever exceeds standards will compensate, whomever meets standards shall benefit." The agreement uses annual water quality category targets jointly agreed to by the Ministry of Ecology and Environment (MEE) and the two provincial governments. Jiangsu compensates Anhui CNY 40 million if the annual water quality reaches Class II or better, and CNY 20 million if it reaches Class III. Conversely, Anhui will compensate Jiangsu CNY 20 million if water quality falls to Class IV, and CNY 30 million if it is Class V or worse.

Source: Authors.

Standards.[32] The growing challenges of rural nonpoint source pollution in upper watersheds has pushed provinces and municipalities to develop localized eco-compensation focused on these areas. An important distinction between this type of eco-compensation program and cross-border watershed programs is that these often involve the creation of an eco-compensation fund supported by downstream beneficiary contributions in the form of water fee surcharges and downstream district government fiscal earmarks, usually based on the previous year's government revenue growth and some weighting by district size (for example, the share of the downstream watershed area covered by the district). Often such funds also fold in some portion of provincial and national government funding streams, or align interventions supported by other funding streams toward a common goal. Examples include using the CCFP funding to target reforestation of important riparian areas.

Given that most upper watershed areas in China contain a complex patchwork of rural land users and stakeholders, such programs involve a wide range of interventions. This can include agricultural best management practices, installing or upgrading rural sewage and solid waste treatment facilities, environmental remediation activities such as the closing of mining and industry facilities, the treatment of soil pollution and tailings, reforestation, and riparian zone investments such as artificial wetland construction. Like intra-provincial eco-compensation programs, water source protection eco-compensation involves contracts with upper watershed district governments, and links rewards and penalties to water quality outcomes. While not originally labeled as such, water source protection programs are now commonly described as "eco-compensation," with the number of programs growing rapidly.

32 MEE classifies water quality into six classes, depending on the concentration of the worst individual pollutant in the water sample. These classes are: Class I—suitable for drinking without treatment; Class II—suitable for use as a Class A water source for centralized drinking water supply, sanctuaries for rare species of fish, and spawning grounds for fish and crustaceans; Class III—suitable for use as a Class II water source for centralized drinking water supply, sanctuaries for common species of fish, and for swimming; Class IV—suitable for use as a general industrial water supply and for recreational use involving no direct human contact with the water; Class V—only suitable for agricultural water supply and general landscaping use; and Class V+—unsuitable for any use.

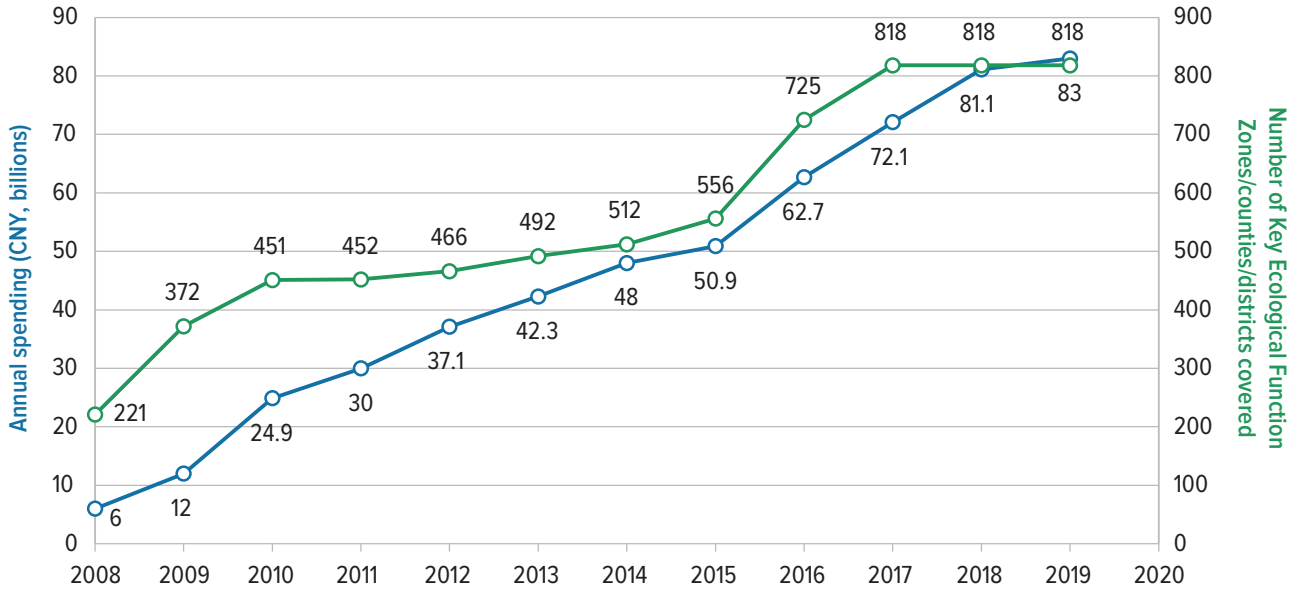
These programs have shown considerable success due to their supplier-user links. Experience to date suggests that these programs help clarify roles and responsibilities, and help to begin the process of identifying key stressors of watershed ecosystem services through more integrated, cross-sectoral, and cross-agency communication, planning, and management frameworks. They have also, through their focus on local sources of financing, helped to build the "business case" for nature-based watershed investments. Close links between beneficiaries and suppliers have supported these programs' impacts, with beneficiaries (generally downstream municipalities) directly concerned with protecting key drinking water supplies. Beneficiaries are concentrated, have the pooled economic resources to be able to effectively target sustainable financing to protect their drinking water supplies, and are incentivized to resolve interagency and intersectoral conflicts.

3.1.b Ecological Protection and Conservation

Eco-compensation is used to support ecological protection and conservation, and spatial zoning by compensating jurisdictions and households affected by development restrictions and by funding investments in protection. The government is expanding spatial planning systems—key ecological function zones, and ecological redlines—with eco-compensation as a mechanism of support. Ecological redlines identify important ecological systems based on biodiversity, susceptibility to erosion, and susceptibility to natural disasters (such as sandstorms and floods), and designate them for protection by limiting development. Key ecological function zones play a similar role, but at a larger spatial scale. The national system of functional zoning, launched in 2010, designates land according to (1) areas where development should be concentrated; (2) areas for future development; and (3) Key Ecological Function Zones (KEFZs), which include areas where development should be limited and China's protected areas where development is prohibited. These KEFZs consist of 818 counties, cities, and districts, comprising over 50 percent of China's total land area (NDRC 2016).

Transfer payments from the national government to counties, districts, and cities covered by the program

FIGURE 3.2: Coverage and Fund Flows for National Key Ecological Function Zone Eco-compensation



Source: Compiled by authors with data from Table 4 in Ma et al. 2020; Xinhua News Agency 2014, 2018a; MOF 2019.

have been increasing steadily (figure 3.2). For the KEFZs, payments compensate for development restrictions and incentivize improved management. Payments are based on a composite of environmental indicators, including water quality, air quality, and forest area, and are weighted by county area, population, and the type of KEFZ,[33] with payments based on the change in indicator rather than the absolute value. Payment guidelines provide some flexibility for the provinces to adjust to local circumstances and provide additional funds within this framework. Since many of the zones are also national poverty counties, poverty alleviation indicators are currently being considered for inclusion in the allocation of funds.

Other eco-compensation programs target critical ecosystems and biodiversity at localized scales, including support for protected areas. Provincial and local programs are used to cover costs imposed on landholders in conservation areas of high value, such as the migratory bird habitat around Poyang Lake, Jiangxi Province (see box 4.2 in chapter 4). Eco-compensation is expected to support an expanded national parks system, part of an expansion of conservation areas, and a standardization of management processes. Like KEFZ payments, these aim to balance community and conservation objectives given the restrictions park designation entails (i.e., compensation for regulatory takings).[34, 35]

3.1.c Forestry and land use change

A third category of eco-compensation program targets forest activities and rural land practices, combining elements of both ecological protection and watershed management. These programs include some of the largest national programs, but their funding is also often used to support other regional and provincial eco-compensation schemes. China's longstanding large-scale forestry and

33 MOF. 2017. Measures for *National Government Transfer Payments to Local Key Ecological Function Zones.*

34 From modest beginnings, China's protected areas have expanded to today covering over 17 percent of China's landmass, consistent with Aichi Target 11 for terrestrial areas (Zhang et al. 2017). The national government is currently reforming the protected area system under a unified management framework that will align decision-making with ecosystems and biomes rather than administrative zones (GOCCCPC 2017). Ten national park management pilots have been established from existing nature reserves to test these principles (Forest and Grassland Bureau 2019), with eco-compensation expected to support these changes.

35 One response has been the direct provision of conservation-oriented jobs: CNY 14 billion (US$2.16 billion) was provided in subsidies for ecological park rangers as a means of supporting local livelihoods between 2016–18. More than 500,000 ecological forest rangers across 22 provinces, mainly from poorer communities in these nature resources, are receiving this support (SFGA, MNR 2019).

grassland programs, most prominently the CCFP and the Forest Ecological Benefit Compensation Program (FECF), and soil erosion prevention and control programs fall into this category, and target improved watershed functionality via improved rural land management practices and land use change. Unlike the former two categories, most programs in these categories provide payments directly to households.

The CCFP is the largest and most influential eco-compensation program within this category. Involving direct, performance-based contracts with individual rural households as recognized stewards of ecosystem services, the CCFP was a catalyst of current trends in eco-compensation (see section 2.1). This direct-to-households approach has since been incorporated into a wide range of rural land use programs in China. The CCFP is the largest eco-compensation program in the world in terms of geographic coverage and expenditure, having retired and afforested 13.27 million hectares (ha) of marginal and sloping cropland, and planted forests and vegetative cover on 17.5 million ha since 1999.[36] To date, the national government has spent CNY 511.2 billion (US$78.7 billion) on CCFP (see figure 3.5). The program is currently being extended for a new round with increased subsidies to households and added rural welfare guarantees.

The FECF is another important program in this category, and complementary to the CCFP. As discussed in section 2.1, this program targets the protection and rehabilitation of forest area deemed to provide important ecological goods and services, and thus are denoted as "public benefit forests." The FECF has also served as an important template for more recent developments in eco-compensation, since it has catalyzed the development of provincial-level analogues. Under either national or province FECFs, annual payments are made to households or local forestry agencies who are the land use rights holders for the public benefit forest area covered by either the national- or provincial-level programs.[37] In return, these areas are rezoned to ban use for timber, fuelwood, or non-timber forest products. The national-level annual subsidy rate has increased from CNY 5 per mu (US$ 11.6 per ha) in 2001 to currently upward of CNY 16 per mu (US$ 37 per ha). Provincial FECFs have also added provincial-level public benefit forest areas, with some providing subsidies at upward of CNY 70 per mu (US$ 162 per ha) (figure 3.3).

The national program has steadily expanded the subsidized national public benefit forest area from 100 million mu (6.67 million ha) in 2001 (the pilot phase), to 1.904 billion mu (126.9 million ha) by 2015 (figure 3.4). Along with this, provincial-level FECFs have increased from 6 in 2001 to 31 in 2020. These provincial programs either delineate and subsidize provincial-level public benefit forest area, top-up national subsidies for national-level public benefit forest area within the province, or often both (so that subsidy rates are equal across forest types).

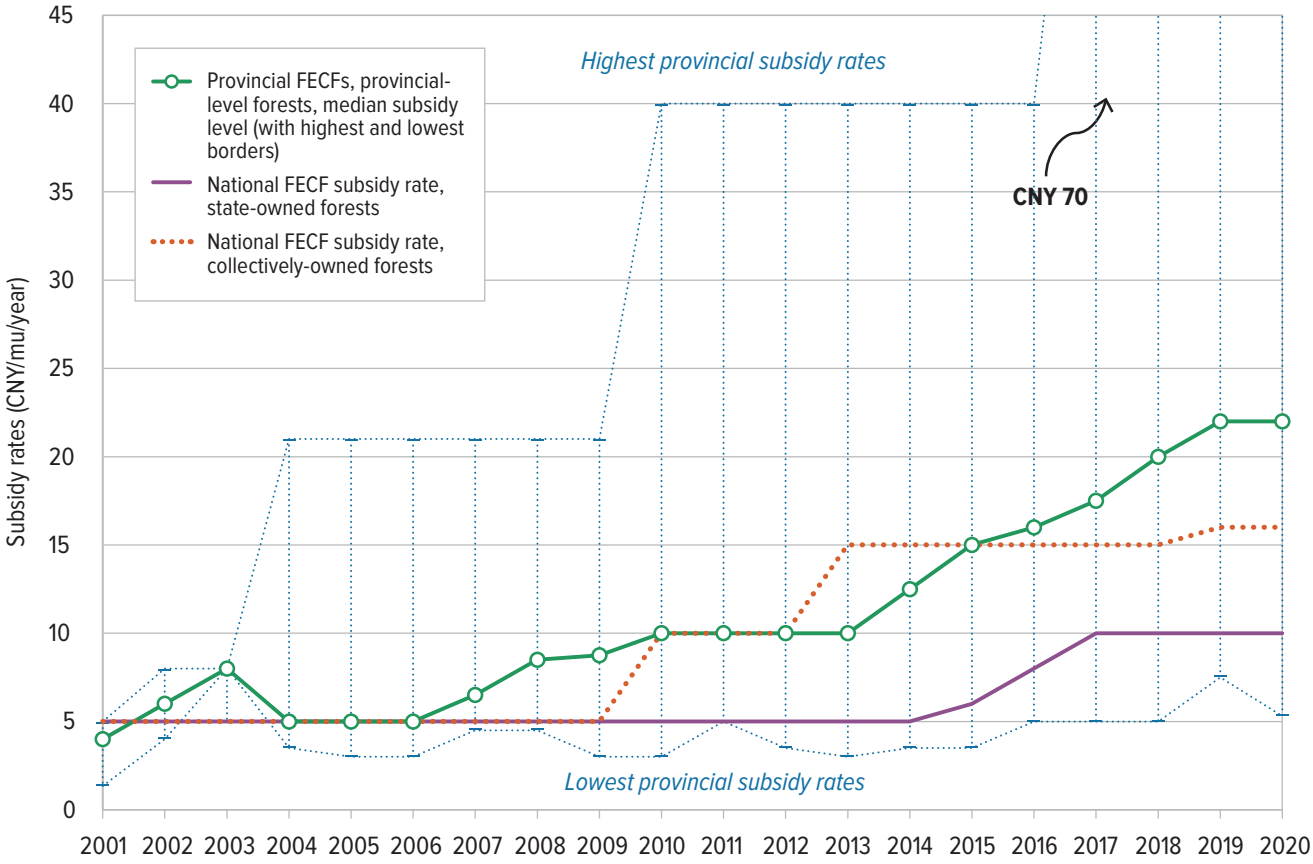
The Conversion of Pastures to Grasslands ("Grazing to Grasslands") Program (CPGP) is a similar households-oriented program targeting degraded and over-grazed grasslands.[38] This program was launched in 2003 as an offshoot of CCFP. Grasslands cover over 4 million square kilometers of China, accounting for over 40 percent of China's land area; of this,

36 CCFP has contributed more than one-third of the total area of planted forests in China. A total of 41 million households, or 158 million rural people, have participated in the program.

37 This forest type classification was developed in 1996. Two main forest classifications were developed: "commercial forests" and "public benefit forests." Commercial forests—consisting of "timber forests," "economic forests," (i.e., orchard crops) and "fuelwood forests"—are those allowed to be harvested for commercial use. Public benefit forests—consisting of "protection forests" and "special-use forests"—are those forest types deemed to provide important ecological services, such as sapling and seed provision, watershed protection, and biodiversity and carbon sequestration, and so are not allowed to be harvested (Hyde, Belcher, and Xu 2003; Xu, White, and Lele 2010). Guidelines for what constitutes a public benefit forest area have been laid out in the National-Level Public Benefit Forest Zoning Definition Measures, jointly issued by the State Forest Administration (SFA) and Ministry of Finance (MOF) in 2004 and updated in 2009 (SFA-MOF 2004, 2009).

38 Several other programs also fall under this category and use the same naming rubric as CCFP. These include the "Conversion of Paddy Rice to Dryland Agriculture" program, wherein Beijing has paid farmers in the Chaobai watershed in upstream Hebei Province to abandon water-intensive rice cultivation so as to improve water inflow to the Miyun Reservoir, as well as "Conversion of Cropland to Wetlands," "Conversion of Cropland to Lake," and "Conversion of Aquaculture to Lake" programs and policy interventions across China, which have generally involved subsidy-based voluntary or mandatory restoration of the functionality of specific riparian zone ecologies that have been encroached upon, often as a result of previous subsidy-based policies to encourage "productive development" of such areas for agriculture.

FIGURE 3.3: National and Provincial Forest Ecological Compensation Fund Subsidy Rates



Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.

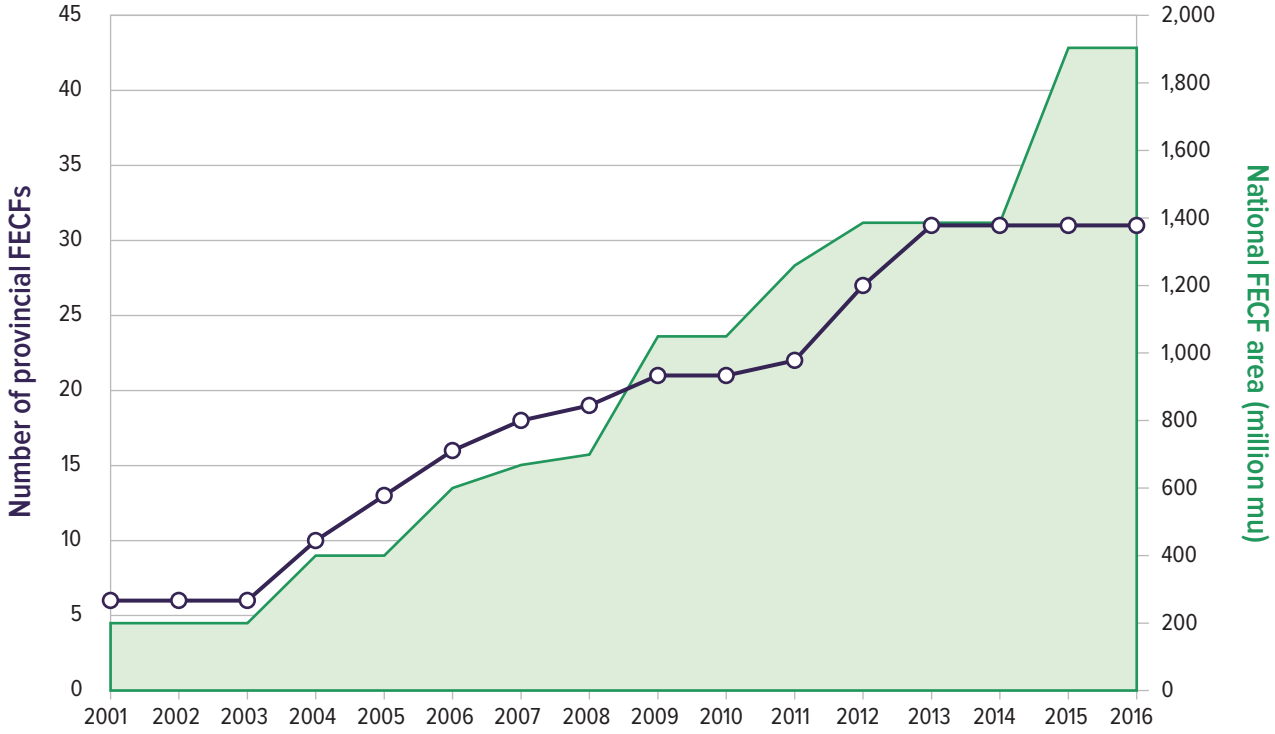
approximately 1.6 million square kilometers is degraded. The program provides direct subsidies to herdsmen to pen their flocks, reseed and restore degraded grassland areas, and provide household livelihood support, along with a range of subsidies to help husbandry households improve the efficiency and productivity of their activities. Cumulative investment reached CNY 30 billion (US$4.62 billion) by 2018.

While newer developments in eco-compensation receive much focus (including in this report), these rural land use eco-compensation programs remain central to China's eco-compensation efforts. These programs are some of the most important drivers of China's success in slowing land degradation and reversing deforestation and erosion trends over the past two decades (Bryan et al. 2018). While trends favor growing payments to key ecological function zones (figure 3.5) as well as a rise in number, if not in value, of watershed programs, these "original" land use programs continue to provide support to rural households, funds for improved land management, and capacity-building and familiarization with eco-compensation principles for local governments.

3.2 ECO-COMPENSATION TYPE BY GOVERNMENT ROLE

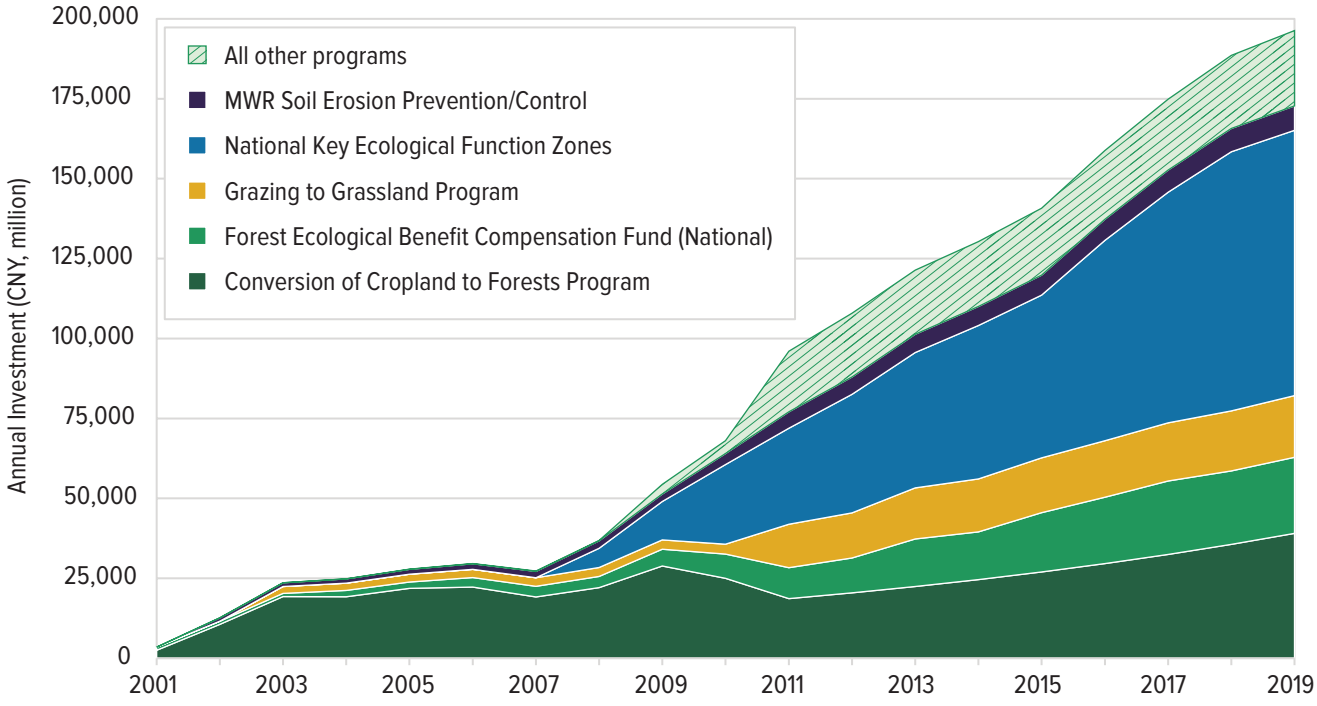
The role of eco-compensation as a fiscal transfer mechanism—specifically its function to incentivize and align the disparate interests within China's hierarchically layered government—can also be used as a meaningful basis of categorization. Along these lines, programs can be described in four major classes: (1) national framework

FIGURE 3.4: National FECF Area and Number of Provincial FECFs, 2001–2016



Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.
Note: 1 mu = 1/15 ha

FIGURE 3.5: Annual Investments of China's Eco-compensation Programs



Source: Custom data collected by authors from a systematic review of available news, and academic and provincial government sources.

programs; (2) interprovincial programs; (3) intra-provincial programs; and (4) provincial and sub-provincial hybrids. All have a role for the national government, often as a source of funding, or through actions to bring subnational governments together. Based on this study's data collection exercise (see box 3.1), intra-provincial programs are the most prominent (46.2 percent of programs), followed by subnational hybrids (30.3 percent), national framework programs (22.1 percent), and interprovincial programs (1.4 percent).

- **National framework programs:** These are programs created, configured, and funded by the national government. They often have the explicit expectation of provincial government matching funding as part of implementation, and provide provinces with flexibility in how they implement these programs within a broad framework set at the national level. Examples of these programs include the CCFP, the FECF, the CPGP, and the KEFZ programs. With the exception of the latter—which involves transfers to subnational governments (see section 3.1.b)—most national framework programs target rural households. They are often designed to encourage the creation of parallel provincial-level programs, as seen in the FECF, wherein provinces have created their own forest ecological benefit compensation funds and provincial-level key public benefit forest areas.
- **Nationally led/enabled interprovincial programs:** These are relatively new programs indicative of the national government's focus on addressing cross-provincial environmental issues. They are programs in which the national government facilitates, coordinates, and financially supports platforms for interprovincial cooperation and formal agreements. Within the framework of national government support, provinces shape the program's agreement itself. Water quality–focused programs are the most prominent examples (see section 3.1.a).
- **Nationally catalyzed intra-provincial programs:** These are programs developed directly by provinces in response to national government policy signals and include cross-county watershed eco-compensation and water source protection eco-compensation. The national government sets goals and general environmental indicators,[39] and provinces then develop approaches for meeting those goals independently. This program "type" encourages piloting through implicit rewards—additional national grants and recognition given to the more eager and nimble provinces that develop innovative approaches and with the best cases used as models elsewhere.
- **Provincial and sub-provincial hybrids:** This category carries the greatest degree of program diversity. These consist of provincial and sub-provincial eco-compensation programs directed at localized areas (e.g., rivers, watershed areas, or specific municipalities). These generally involve the weaving together of multiple funding sources and utilization of approaches. Funding from national framework programs are often drawn on by these, and they potentially contain the greatest wealth of information, innovative approaches, and lessons learned, and have high potential to feed into and influence national policy or practices elsewhere. However, they are also the least well documented, given decentralized administration and data limitations.

Empirical data highlight the focus of national framework programs on rural land use interventions: forestry, soil erosion prevention and control, and grassland protection and restoration (table 3.1). Programs that more explicitly and directly engage individual households and communities tend to be the large-scale national framework programs. Somewhat newer developments have been in water quality and watershed management, with these programs generally being either nationally catalyzed intra-provincial programs or subnational hybrids. This division is expected: when targeted activities have more concentrated, local impacts (e.g., for watershed and water quality services), local program design and implementation are likely better suited, relative to programs focused on more dispersed benefits (e.g., for carbon sequestration, biodiversity, anti-desertification, and larger-scale watershed impacts).

39 For example, as seen in the broad guidelines provided by the *Guiding Opinions on Accelerating the Establishment of Watershed Upstream-Downstream Horizontal Ecological Protection Compensation Mechanisms* (MOF 2016).

TABLE 3.1: Programs by Government Role and Resource Management Issue

			ALL PROGRAMS	BY GOVERNMENT ROLE: National Framework	Nationally-led interprovincial	Nationally Catalyzed intra-provincial	Sub-national Hybrid
			29.4%	4.4%	39.7%	26.5%	
BY OBJECTIVE	**Forestry**		25.0%	24.3%	0%	0.7%	0%
	Water	*Watershed*	8.8%	0%	0%	1.0%	7.4%
		Cross-border	24.3%	0%	4.4%	19.9%	0%
		Water Source Protection	17.6%	0%	0%	1.0%	16.9%
	Soil Erosion Prevention/Control		0.7%	0.7%	0%	0%	0%
	Wetland		8.1%	3.0%	0%	5.2%	0%
	Grassland		8.1%	0.7%	0%	6.6%	0.7%
	Agriculture		3.7%	0%	0%	3.7%	0%
	Conservation		3.7%	0.7%	0%	1.5%	1.5%

Source: Custom data collected by authors.

3.3 ECO-COMPENSATION EVALUATION INDICATORS

The indicators that programs use to condition payments are a key design characteristic with implications for program outcomes. Based on the empirical data, these include *financial indicators* (related to confirming the proper use of funds, timing, and disbursement of funding tranches) and *institutional milestones* (often regarding goals concerning targeted regional shifts in economic structure); input-based indicators—*on-site investments* (generally concerning land use interventions and other investments), *management activities* (inspections, training) and *livelihoods transformation activities* (involving community and household skill development for alternative livelihoods); and outcome-based indicators—*environmental quality indicators* (e.g., water quality, forest age, and/or species structure), *environmental quantity indicators* (e.g., number of saplings planted, area of land covered), *socioeconomic indicators* and *composite environmental indices* (e.g., weighted combinations of multiple indicators).

Based on the empirical data, most programs still rely primarily on input-based indicators—on-site investments and management activities—to evaluate program performance (table 3.2). Outcome-based indicators are generally used much less, though the newer water-related eco-compensation programs rely heavily on water quality indices. Composite indicators are also seeing greater adoption in newer programs, particularly conservation programs and some water source protection programs.

TABLE 3.2: Programs by Evaluation Indicator Type

PROGRAM TYPE			EVALUATION INDICATORS USED								
					INPUT-BASED			OUTCOME-BASED			
			Financial indicators	Institutional Milestones	On-site Investments	Management Activities	Livelihoods Transformation Activities	Environmental Quality Indicators	Environmental Quantity Indicators	Socioeconomic Indicators	Composite Environmental Indices
	All programs		62.7%	7.8%	60.8%	13.7%	5.9%	84.3%	54.9%	8.8%	8.8%
BY OBJECTIVE	**Forestry**		100%	0%	100%	0%	0%	100%	100%	0%	0%
	Water	*Watershed*	27.3%	0%	27.3%	18.2%	0%	91%	36.4%	0%	0%
		Cross-border	20%	8%	20%	16%	8%	80%	12%	8%	16%
		Water Source Protection	41.7%	8.3%	58.3%	50%	16.7%	83.3%	58.3%	16.7%	8.3%
	Soil Erosion Prevention/Control		100%	100%	0%	0%	0%	0%	100%	0%	0%
	Wetland		89%	44%	67%	0%	11%	78%	44%	33%	11%
	Grassland		67%	0%	100.0%	0%	0%	33.3%	33.3%	0%	0%
	Agriculture		100%	0%	60%	0%	0%	60%	20%	0%	0%
	Conservation		75%	0%	75%	50%	25%	75%	75%	50%	75%
BY GOVERNMENT ROLE	**National framework**		97%	5%	95%	0%	5%	97%	97%	8%	5%
	Nationally-led Interprovincial		40%	20%	40%	20%	20%	80%	20%	20%	0%
	Nationally Catalyzed Intraprovincial		42%	11%	34%	11%	3%	74%	21%	5%	11%
	Sub-national Hybrid		45%	5%	55%	41%	9%	82%	50%	14%	14%

Source: Custom data collected by authors.
Note: Programs can use multiple indicators, and so rows do not necessarily sum to 100 percent.

3.4 PROGRAM PERFORMANCE AND OUTCOMES

To complement the examination of eco-compensation status and trends, a qualitative assessment of performance by a selection of programs was developed. Assessing the successes and difficulties facing programs in China is challenging. First, in many cases, attribution is difficult due to programs' evolving nature within overall management reforms, which mean they arise in changing institutional environments that are themselves affecting program outcomes (as examined in section 2.6). Second, programs often aim to address a combination of factors behind ecological and environmental management shortfalls, particularly in the case of locally developed programs. Although the main objectives may be land and water improvements, these programs are also implicitly focused on catalyzing and facilitating local innovation, institutional change, and capacity-building. An assessment based on one set of outcomes may be missing signifiers of success in other important dimensions. Third, data on eco-compensation is limited—particularly social and environmental outcomes and payment flows—and highly dispersed across governments, even when made publicly available.

Nevertheless, considerable information is available; this report uses those sources available to make a broad assessment of programs and program types (tables 3.3–3.5). Conclusions are developed via a synthesis of a collection of available sources, including descriptive information from the eco-compensation dataset, combined with additional news articles, government reports, and academic literature. Programs and program types are considered through the lens of the three dimensions of the eco-compensation assessment presented earlier in this report: effectiveness, efficiency, and equity (box 3.5). This assessment is necessarily subjective, intended to indicate broad strengthens and weaknesses, and to motivate framework recommendations.

The results of the assessment provide important insights. These inform the framework recommendations (section 4.5) developed by this study to address the gaps identified here and in other sections. In aggregate, many programs score well on effectiveness, especially in achieving sufficient scale (Bryan et al. 2018). It is expected that ongoing strengthening of technical and monitoring capacity will further improve outcomes along this dimension. However, there are opportunities for improvement in efficiency, with scores that are middling across programs and indicators. Diversification and leveraging of funding sources is generally low, payments are not always fully responsive to outcomes, and room exists for better capturing and leveraging synergies in ecological services provision. Many programs also have room for improvement regarding equity. Co-management is relatively low across programs, with many primarily top-down in their design and implementation, as specifically discussed below.

Programs targeting watershed ecological services score highest in terms of effectiveness, while KEFZ eco-compensation scores the lowest. Watershed programs appear to help catalyze needed shifts in management frameworks by introducing conditionality, and better align and improve the sustainability of funding flows via a clearer framing of management in terms of beneficiaries and suppliers. Targets are being achieved beyond the status quo, and are attributable (Li et al. 2020; Li, Tong, and Wang 2020; Peng 2010).[40] Conversely, eco-compensation for KEFZs faces apparent gaps in the ability to monitor outcomes, as well as in attribution, additionality, and conditionality. While many KEFZs were selected based on their high conservation value, the degree to which these natural areas are under threat, and whether the threat level is being considered in selection, appears to vary significantly across zones.

Though forestry eco-compensation programs have generally achieved effectiveness, they still have room for improvement. The CCFP scores better on additionality than does the FECF; households with use rights over forests generally already face significant administrative barriers to timber harvesting, and so the rezoning of such land under FECF in many contexts has likely done little to change the status of threats. The broad literature on CCFP has also highlighted issues of conditionality, though this has been strengthened as the program has progressed. Often poorer households and regions have been targeted by the program to capture welfare co-benefits, though the need to ensure rural welfare outcomes has meant that conditionality regarding ecological outcomes was weakened during earlier program stages, i.e., households were generally not penalized for poor tree survival rates for fear of harming their livelihoods (Bennett 2008; Uchida et al. 2007; Gutierrez-Rodriquez et al. 2016). In addition, there remain opportunities for better bundling of ecological services. Xu (2011), for example, notes adverse impacts on biodiversity from forestry programs in China's southwest due to the introduction of fast-growing exotic tree species or the creation of rubber plantations.

Most of the programs examined have done very well to achieve scale. The CCFP, FECF, and CPGP cover large areas with hundreds of millions of rural participants. These programs have been effective at achieving scaled but shallow management interventions that can be built upon—by first prioritizing expansion and coverage, with gradual adjustments to program configurations and targets occurring after sufficient scale has been achieved. Water-related eco-compensation programs have also generally been

40 This is based on assessments of the "River Chief System," which facilitates cross-border eco-compensation programs.

Box 3.5:

The Assessment Approach and Evaluation Framework

Qualitative indicators were developed to align with the three dimensions of the assessment framework presented in chapter 1, effectiveness, efficiency, and equity (table B3.5). These were decomposed into component indicators, based on academic literature on payments for ecosystem services, conservation finance, and rural development. For each indicator, programs (or program categories) were given scores between 1 (poor) to 5 (excellent) based on qualitative information from the eco-compensation dataset, and government and academic literature.

Selected programs and program types were grouped by general length of time they have been in operation—categorized either as "mature programs," "medium-term programs," or "newly developed programs." This is to account for both the amount of time programs have had to improve implementation and outcomes, as well as for the availability of information to make well-grounded assessments. The programs included in this assessment were also selected based on the information available. Assessments for each program or program grouping were made using these indicators.

TABLE B3.5: Qualitative Indicators for Assessing Eco-compensation Programs

	INDICATOR	DESCRIPTION
EFFECTIVENESS	**Targets achieved?**	Are targeted outcomes being achieved?
	Attribution?	Can observed outcomes be attributed to program interventions?
	Additionality?	Are outcomes beyond what would have happened without program interventions?
	Conditionality?	Are program mechanisms sufficiently performance based?
	Leakage?	Are targeted outcomes being diluted by adverse program-induced impacts elsewhere?
	Sufficient scale?	Is sufficient scale to achieve meaningful impacts being reached?
	Sustainable funding?	Is program funding or budgetary planning sufficiently stable to ensure long-term outcomes?
	Innovative?	Is the program innovative in how it achieves its targeted outcomes?
	Adaptive?	Is the program sufficiently adaptive to address uncertainty and change, and to catalyze and capture learning-by-doing?
EFFICIENCY	**Cost-effective?**	Are lowest cost approaches and/or locations to deliver targeted outcomes being utilized where reasonable?
	Best approach?	Are program instruments the best means to deliver outcomes within the larger regulatory and socioeconomic landscape?
	Transactions costs?	Does program design minimize transactions costs, and are they sufficiently low?
	Synergies captured?	Are synergies in delivery of co-benefits being captured, and are trade-offs or conflicts in targeted outcomes being minimized?
	Leveraged funding?	Are different funding streams being effectively combined, aligned, and/or rationalized to deliver targeted outcomes?
EQUITY	**Voluntary?**	Is participation voluntary?
	Opportunity costs?	Does the program fully compensate providers for their opportunity costs of participation?
	Shared costs and benefits?	Does the program facilitate a more equitable sharing of the costs and benefits of sustainable ecological services provision?
	Livelihoods co-benefits?	Does the program deliver improved livelihoods or community welfare co-benefits?
	Co-management?	Are service providers being consulted and engaged in decision-making on design and implementation?
	Elite capture?	Does the program minimize risk that program benefits are unfairly captured by a subset of the potential pool of service providers?
	Due diligence?	Does program design minimize, where possible, risk of adversely impacting community equity?

Source: Authors.

TABLE 3.3: Qualitative Evaluation of Select Eco-compensation Programs: Mature Programs

		CCFP		FECF	
	INDICATORS	**Score+**	**Summary**	**Score+**	**Summary**
EFFECTIVENESS	**Targets achieved:**	4.5	Afforestation targets achieved.	3.5	The program has facilitated a transition of forest rights. Improved protection.
	Attribution:	4.5	Outcomes able to be linked to program interventions.	3	Afforestation results clear. Impacts on deforestation rates unclear.
	Additionality:	4.5	Outcomes achieved beyond status quo.	3	Some afforestation beyond status quo. Rates of harvesting likely unchanged.
	Conditionality:	4	Earlier ecological-rural welfare target conflicts have been resolved.	2.5	Likely low. This is more in the form of regulatory taking with compensation.
	Leakage:	3	Some work has suggested that leakage has occurred.	3	Likely some leakage has occurred, though to some degree by design.
	Scale:	5	Program has achieved scale.	5	Program has achieved scale.
	Sustainable funding:	3	Future funding is unclear, though the government continues its support.	3	Future funding is unclear, though the government continues its support.
	Innovative:	3	Program was innovative in its beginning, but little has changed since then.	3	Program was innovative in its beginning, but little has changed since.
	Adaptive:	3.5	Some flexibility in local implementation encouraged.	2.5	Compensation rates have increased, but little else has changed.
EFFICIENCY	**Cost-effective:**	3	Cost-effectiveness has slowly been improved.	3.5	Costs are low, likely due to low-subsidy, top-down structure.
	Best approach:	3	Reasonably "second-best" approach within context.	2	Other regulatory approaches could likely obtain better outcomes.
	Transaction costs:	3	In early years, high transaction costs. These have gradually been reduced.	3	In early years, high transaction costs. These have been reduced.
	Synergies:	3	Some captured, but land selection criteria vary widely across locales.	3.5	Co-benefits important in selection of public benefit forest area.
	Leveraged financing:	1	Dependent on government funding. Other sources (carbon, water) not tapped.	1	Dependent on government funding. Other sources (carbon, water) not tapped.
EQUITY	**Voluntary:**	4	Though some issues in early implementation, generally good.	2	This is primarily a top-down regulatory taking of forest rights.
	Opportunity costs:	4	Farmers are compensated above their opportunity costs.	1	Common point in the literature is that compensation is far too low.
	Shared Cs & Bs:	4	Program targets important environmental externalities.	2	Important environmental externalities targeted, but Cs & Bs not well shared.
	Livelihoods:	4	Livelihood outcomes have been an important focus of the program.	2	Little focus on rural welfare issues.
	Co-management:	2	Households have had little voice in program design and implementation.	2	Households have had little voice in program design and implementation.
	Elite capture:	4	Unlikely given China's equitable land distribution. Some early government capture.	3	Likely some degree of government capture (local forestry agencies) by design.
	Due diligence:	4	Equity in participation has been an important part of implementation.	1	Not at all considered in program implementation.

Source: Authors.
+ Based on a scale of 1 to 5, with 5 being the best.

TABLE 3.3: Qualitative Evaluation of Select Eco-compensation Programs: Mature Programs (continued)

	GRAZING TO GRASSLAND		
	INDICATORS	**Score+**	**Summary**
EFFECTIVENESS	**Targets achieved:**	3.5	Some degree of grassland recovery appears to have occurred.
	Attribution:	2.5	Based on many questionable assumptions on underlying causes of degradation.
	Additionality:	3	Outcomes generally beyond status quo.
	Conditionality:	3.5	Herdsmen required to change production activities.
	Leakage:	4.5	Unclear, but generally low potential for leakage to other grassland areas given comprehensive coverage.
	Scale:	5	Program has achieved scale.
	Sustainable funding:	3.5	Government appears to be committed to ongoing support, at least in the medium term.
	Innovative:	2.5	Use many of the approaches in previous programs targeting similar outcomes.
	Adaptive:	2.5	Primarily top-down in program design and implementation.
EFFICIENCY	**Cost-effective:**	2	Unlikely that the most cost-effective approach is being used.
	Best approach:	3	Likely that other regulatory interventions could be more effective.
	Transaction costs:	3.5	Transaction costs have been gradually reduced during implementation.
	Synergies:	3	Grassland area selections capture some synergies (e.g., important headwater areas)
	Leveraged financing:	1	Funding remians siloed and top down, with little interagency collaboration.
EQUITY	**Voluntary:**	3	Husbandry households likely have little to say in participation choice.
	Opportunity costs:	2.5	Mandated subsidy standards generally below opportunity costs.
	Shared Cs & Bs:	4	Targets an important environmental externality.
	Livelihoods:	3.5	Program prioritizes transitioning rural livelihoods.
	Co-management:	2	Households have little voice in program design and implementation.
	Elite capture:	4	Unclear, but unlikely given China's equitable land distribution. Possibly some local government capture.
	Due diligence:	2.5	Unclear, but livelihood transitions might be difficult for some households.

Source: Authors.
+ Based on a scale of 1 to 5, with 5 being the best.

TABLE 3.4: Qualitative Evaluation of Select Eco-compensation Programs: Medium-term Programs

		WATER SOURCE PROTECTION		KEY ECOLOGICAL FUNCTION ZONE ECO-COMPENSATION	
	INDICATORS	Score+	Summary	Score+	Summary
EFFECTIVENESS	**Targets achieved:**	4	Water quality targets are being achieved and improved.	3	Monitoring ability still developing. Outcomes targeted unclear.
	Attribution:	4	Program interventions are clearly the cause of improvements.	3	Ability to attribute outcomes still developing, but weak.
	Additionality:	4	Improvements beyond status quo are definitely being achieved.	3.5	Improvements in some, but other locations have uncertain threats.
	Conditionality:	3.5	Program structure suggests it, but likely varies across programs.	2	Once in the program, hard to make fiscal transfers truly conditional.
	Leakage:	3	Some potential leakage in the form of displaced industries and activities.	2	Possibility for leakage to other areas. This is to some degree by design.
	Sufficient scale:	5	Most are of local scale, but appropriately target relevant watershed areas.	3	Unclear, especially given lack of clarity on targeted outcomes.
	Sustainable funding:	4.5	They create direct links between beneficia-ries and providers.	4	The government is currently strongly committed to supporting this program.
	Innovative:	4	Improves management frameworks for water resources.	4	Cadre evaluation system places increasing weight on ecological indicators.
	Adaptive:	3.5	Management structures and funding appear to evolve.	3.5	Some flexibility in local implementation suggested.
EFFICIENCY	**Cost-effective:**	3	Unclear, but budgetary rigor supports efficienct use of monies.	2	Unlikely, since this targets composite environmental outcomes.
	Best approach:	3	Unclear, but budgetary rigor aligns with using best approaches.	2.5	Unlikely, in comparison to more targeted interventions.
	Transaction costs:	3	Unclear, but likely considered in working effectively with communities.	4	Relatively low since interface at the county government level.
	Synergies:	3	Unclear, but likely given comprehensiveness of interventions.	3.5	While in principal being leveraged, still under development.
	Leveraged financing:	4	Often tap into and combine or better align different funding streams.	1	Top-down funding suggests minimal access to other possible funding sources.
EQUITY	**Voluntary:**	3	Unclear, though effective collaboration with communities suggests it.	1.5	This program is a regional-level regulatory taking.
	Opportunity costs:	3	Unclear, though effective collaboration with communities suggests it.	2.5	Opportunity costs estimated at a regional level, not on a community basis.
	Shared Cs & Bs:	4	Improves the apportioning of watershed management Cs & Bs.	3	This program is a regulatory taking, though benefits sharing could improve.
	Livelihoods:	4	Rural livelihoods are often a priority to improve collaborative partnerships.	2	Little consideration of rural community welfare in program design.
	Co-management:	3	Some degree of input into desired design and interventions likely.	2.5	Appears to be primarily top-down, though with likely hidden variations.
	Elite capture:	4	Unlikely, given the need for comprehensive interventions.	3	Potential for some capture at relevant government levels.
	Due diligence:	3.5	Equity concerns in rural interventions make this likely.	1.5	Top-down general structure indicates that this was not considered.

Source: Authors.
+ Based on a scale of 1 to 5, with 5 being the best.

TABLE 3.5: Qualitative Evaluation of Select Eco-compensation Programs: Newer Programs

		INTER-PROVINCIAL CROSS-BORDER WATERSHED		INTRA-PROVINCIAL CROSS-BORDER WATERSHED ECO-COMPENSATION	
	INDICATORS	Score+	Summary	Score+	Summary
EFFECTIVENESS	**Targets achieved:**	4.5	Most of these programs have achieved improvements in water quality.	4.5	These programs have achieved improvements in water quality.
	Attribution:	5	Program interventions are clearly the cause of improvements.	5	Program interventions are clearly the cause of improvements.
	Additionality:	4.5	Programs are clearly improving outcomes beyond the status quo.	4.5	Programs are clearly improving outcomes beyond the status quo.
	Conditionality:	4.5	These programs strongly link payments to indicators.	4	Most programs link funding to the outcomes of indicators.
	Leakage:	3	Some degree of leakage, in terms of displaced industries, etc., likely.	3	Some degree of leakage, in terms of displaced industries, etc., likely.
	Sufficient scale:	4.5	These programs approapriately target relevant watersheds.	4.5	These programs appropriately target relevant watersheds.
	Sustainable funding:	4	Strong, since provinces vested in outcomes.	4	These projects tap into multiple funding sources.
	Innovative:	4	These have significantly advanced trans-provincial watershed management.	4.5	These programs have clarified roles and responsibilities.
	Adaptive:	4	These programs are continuing to evolve.	4	These programs are continuing to evolve.
EFFICIENCY	**Cost-effective:**	2.5	Initiation conditional on large national government start-up support.	2.5	Likely not the most efficient approach, though could improve.
	Best approach:	3.5	Likely necessary to "get the ball rolling." Later programs could be different.	3.5	Has catalyzed important institutional reforms, though improvements possible.
	Transaction costs:	3.5	Provincial-level interface likely reduces these, somewhat.	2	Potential for significant transactions costs.
	Synergies:	3	Unclear how well these are being levereged to achieve larger outcomes.	3.5	Likely variation across provinces. Could improve over time.
	Leveraged financing:	3.5	Combination of multiple funding sources, but primarily governmental.	3	Combination of multiple funding sources, but primarily governmental.
EQUITY	**Voluntary:**	3.5	These have generally involved detailed negotiations between provinces.	3.5	Generally good, though some reports of mandated participation.
	Opportunity costs:	3	Unclear in program designs, though likely some considerations made.	3	Unclear in program designs for the land users and other economic actors.
	Shared Cs & Bs:	2.5	More developed lower watersheds often get the better deal.	3.5	Improved, but lower watershed developed regions often get the better deal.
	Livelihoods:	2	Unclear, with potentially significant variation depending on interventions.	2.5	Possibly some considerations of this, but depends on interventions.
	Co-management:	3	Primarily top-down in design and implementation.	3	Primarily top-down in design and implementation.
	Elite capture:	3	Likely minimal, given the comprehensiveness of interventions.	3	Likely minimal, though possibly some government capture.
	Due diligence:	3	Unclear, especially for land users and other economic actors.	3	Unclear, especially for land users and other economic actors.

Source: Authors.
+ Based on a scale of 1 to 5, with 5 being the best.

Photo: Panoramic view of the Li River and Karst Mountains in Guilin, China. iStock.

good at intervening at the appropriate scales to achieve targeted outcomes.

In terms of equity, results are mixed. The CCFP, CPGP, and water source protection programs all score reasonably well, especially in terms of facilitating a more equitable sharing of the costs and benefits of ecological services provision, and in delivering rural livelihood and community welfare co-benefits. Common across these programs is the targeting of rural land use interventions. Water source protection programs, for example, commonly engage upper watershed rural communities. FECF deviates from this, since payment rates are consistently cited in the literature as too low to offset opportunity costs, and the program constitutes a regulatory taking.

It is unclear whether and to what degree interprovincial and intra-provincial watershed programs focus on equity dimensions in implementation. These programs involve collaborations between regional governmental levels, with implementation to address rural land use impacts likely implemented via traditional, top-down modes. For KEFZ eco-compensation, these programs constitute regulatory takings, with little consultation with the communities in newly designated zones. While the focus on rural welfare outcomes are being emphasized in policy documents, implementation may have space for improvement.

Most programs do well in helping to better apportion the costs and benefits of ecological services provision, but at the same time score poorly on co-management. Programs remain primarily top-down in design and implementation, with relatively little consultation and joint decision-making with targeted communities. Though scoring low in co-management, CCFP has improved somewhat over time to include more consultation with communities, with rural welfare outcomes prioritized to ensure buy-in (Gutierrez-Rodriquez et al. 2016). However, FECF has primarily been top-down in implementation. The literature on the Grazing to Grassland program has also indicated that while livelihood issues are likely an important focus, communities and individual households are rarely consulted on design and implementation (e.g., Yeh 2010).

All programs have significant room for improvement regarding efficiency. Low scores on co-management are linked to this since limited engagement with key stakeholders and communities represents missed opportunities to identify lower-cost approaches. The mature programs, despite their age, have generally not significantly evolved. Though these target a range of ecological services, land targeting is often motivated by many considerations independent of ecological services provision or the capturing of synergies in these (Gutierrez-Rodriquez et al. 2016; Yeh 2010; Cao 2017).

Most programs also perform poorly in terms of the degree to which they are able to effectively combine, align, and/or leverage funding sources. The exception are water source protection programs, which often involve interagency collaboration and joint support. Interprovincial and intra-provincial programs are given a middle score for this, but it is possible that finances for these are also pooled and reasonably well leveraged, at least by the upper watershed provinces, to ensure that outcomes are achieved. Conversely, the mature programs, as well as KEFZ eco-compensation, continue to depend heavily on national government funding, despite calls in various policy documents for greater funding diversification and utilization of market forces. In all cases, there appears to be very little private sector funding support for programs. In the case of forestry programs, other sources of finance for forests—such as for the watershed services they provide or for carbon sequestration—are in large part untapped.

Finally, monitoring capacity is an important factor underlying evaluations of both effectiveness and efficiency. Water quality monitoring has seen significant improvements in recent years, which has allowed for greater conditionality in water-related eco-compensation programs. Conversely, China still faces significant gaps in the more demanding requirements for assessing and monitoring the health and recovery of its wide diversity of regional ecosystems and eco-regions, including the estimation of both static and dynamic baselines, as well as ongoing issues with data quality (Brombal 2017). This has bearing for both its mature programs, as well as KEFZ eco-compensation, which target bundled services, including harder to assess ecological services and functions.

CHAPTER 4.

Eco-compensation for River Basin Management

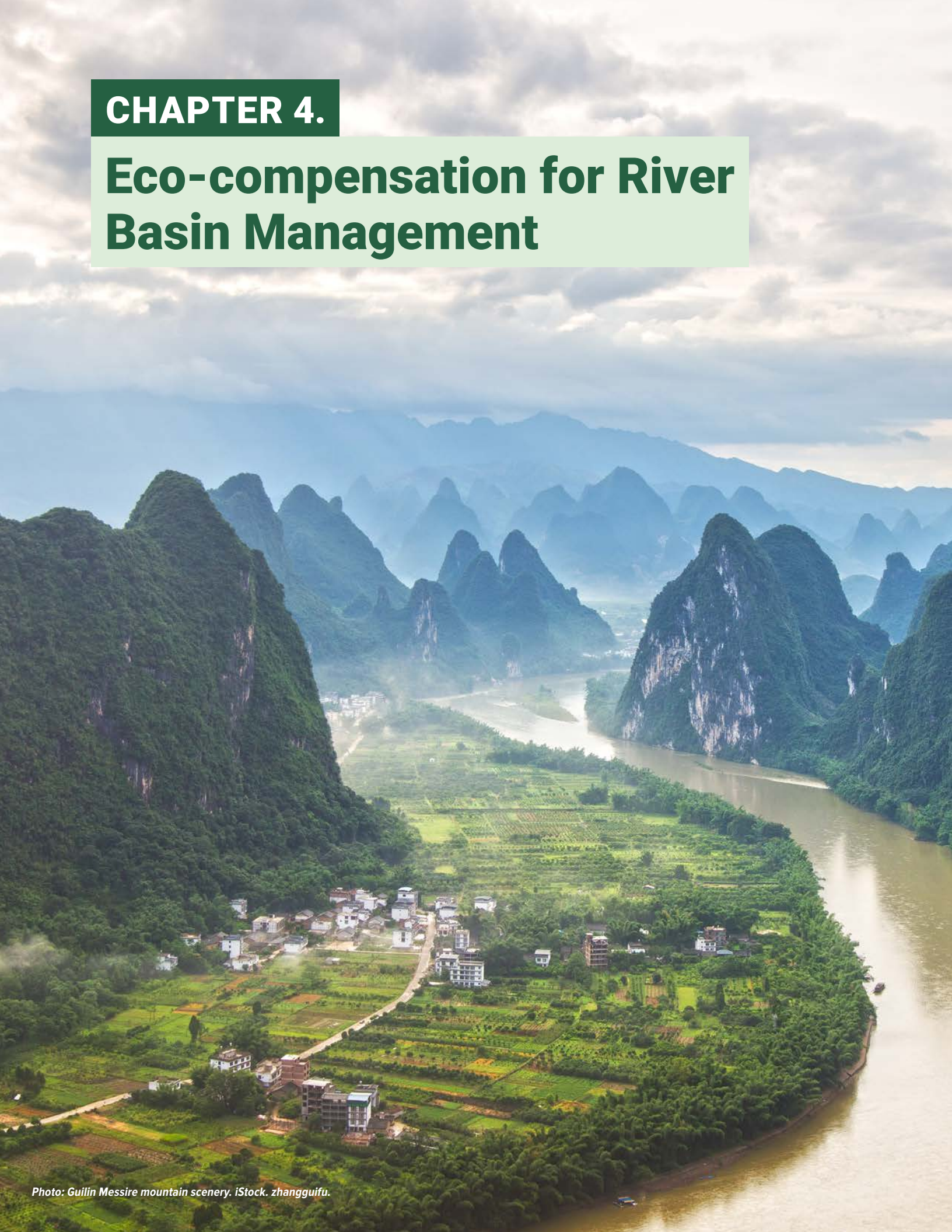


Photo: Guilin Messire mountain scenery. iStock. zhangguifu.

While this report has to this point considered eco-compensation and China's environmental management institutions across geographies, types, and performance issues broadly, it now turns to river basin management specifically, with a focus on the Yangtze and Yellow River basins.

Basin management has become a high priority for the national government and is a growth area for eco-compensation. With these two basins covering a combined 27 percent of China's landmass and encompassing a majority of China's economy, management of these basins will determine whether China achieves many of its environmental management goals. Eco-compensation has played an important role within these regions for decades, with floods and droughts in these regions motivating the development of the country's biggest programs, such as the Conversion of Cropland to Forest (CCFP) and the Forest Ecological Benefit Compensation Fund (FECF) (see section 3.1.c). There is growing interest in expanding eco-compensation, in a variety of forms, to address the basins' ongoing issues. This chapter provides an overview of the Yangtze and Yellow River basins, including challenges and government responses to those challenges, before considering the role of eco-compensation within this framework. Case studies are used to derive lessons and opportunities.

4.1 OVERVIEW OF THE YANGTZE AND YELLOW RIVER BASINS

The Yangtze River and its catchment plays a major role in the economic, historical, and cultural identity of China. Extending more than 6,300 km from the Qinghai-Tibetan Plateau to the East China Sea, the Yangtze and its catchment is a center of economic activity and a supplier of ecological services and natural resources. The importance of the basin is seen in the national government's growing focus on the "Yangtze River Economic Belt" (YREB), a grouping of 11 provinces and provincial-level municipalities along the basin.[41] The YREB contains over 42 percent of China's population and contributes around 45 percent of its gross domestic product (GDP).[42] With annual water resources of over 995 billion m^3, the Yangtze accounts for 35 percent of China's freshwater resources,[43] and is one of the world's most biologically diverse ecoregions (WWF 2020).

The Yellow River, while smaller in geographic and economic terms, is similarly central to Chinese history, culture, society, economy, and ecology. Considered the cradle of Chinese civilization, the river is known as "China's Sorrow" due to its flooding tendencies. As the river turns south from Inner Mongolia, it runs through the fertile but highly erodible soils of the Loess Plateau, resulting in sediment loads that are the largest of any major waterway in the world. At 5,464 km in length, the Yellow River is of similar length but much smaller in basin size and water resources volume than the Yangtze River, carrying 2 percent of China's water resources. The Yellow River basin is home to 15 percent of China's arable land and 12 percent of its population.

4.2 KEY CHALLENGES FOR THE YANGTZE AND YELLOW RIVER BASINS

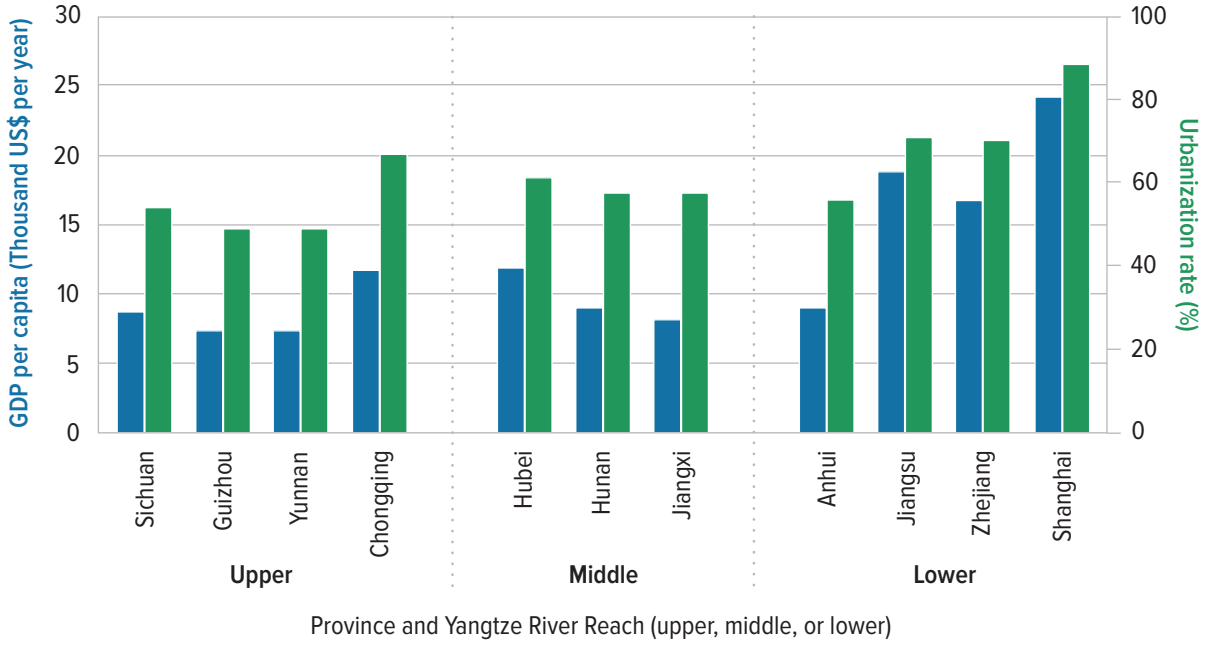
The Yangtze River basin faces intense pressures from human activities. Urban, agricultural, and industrial activities have encroached upon natural ecosystems. Land covered by roads and buildings in the overall Yangtze River basin roughly doubled between 2000 and 2017, increasing surface runoff and contributing to water pollution. Nonpoint source agricultural pollution has created further water pollution challenges. From 1982–2017, total wastewater discharges to the Yangtze increased from 12.7 billion m^3 to 31 billion m^3. Deficiencies in waste management systems, particularly in rural areas, and widespread use of plastic films in agriculture,

41 These are Anhui, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang, Chongqing, and Shanghai.

42 If it were a country, the YREB would be the third largest economy in the world after the US (US$22.32 trillion) and China itself (US$15.27 trillion) (IMF 2020).

43 The Yangtze provides more than 200 billion m3 of water to industries and populations, servicing around 580 million people in the basin and in north China. This includes 100–120 million people who are beneficiaries of the first phase of the South-to-North Water Transfer Project (WWF 2020).

FIGURE 4.1: Development level across the Yangtze River Economic Belt Region



contributed to high plastics loads in the basin's rivers.[44] An estimated 14 percent of lake area was lost between 1975 and 2015 due to agricultural extensification, conversion to aquaculture, and land development (WWF 2020; Cong et al. 2017). Climate change is set to exacerbate these pressures through increasingly variable regional water cycles (Wu 2016; Cao 2017).

The Yellow River faces similar pressures from human activities, compounded by water-related scarcity constraints. A water utilization rate of up to 80 percent, far exceeding the 40 percent ecological warning line of river basins in general, has intensified water use conflict. Insufficient water for the environment continues to impact the basin's ecosystems, resulting in the drying of lakes, tributaries, and estuary wetlands, and the degradation of grasslands (Xu and Wang 2020; Jin 2019). In addition to agricultural, municipal, and industrial discharges, the Yellow River basin has long been prone to heavy sediment loads due to erosion of the basin's fragile soils, leading to flood risks and water quality issues. More than 12 percent of the 137 water quality sections in the main stem of the Yellow River had a water quality of Class V (poor), significantly higher than the national average of 6.7 percent (Wang, Mao, and Xu 2020).

In both basins, poverty and regional income disparities compound the impact of resource scarcity and complicate environmental protection efforts. GDP per capita at the mouth of the Yellow River (Dongying City, Shangdong Province) is tenfold that of its source (Yushu Prefecture, Qinghai Province). The poverty gradient in the Yangtze is less severe in relative terms but shows a similar pattern, with GDP per capita three times higher in the basin's richest province (Shanghai, at the river mouth) than in its poorest (Guizhou, in the upper reaches) (figure 4.1).

4.2.a Institutional and management issues

Basin-level management in China is based on a system of river basin commissions. The commissions have existed since the 1950s, when the Yellow River Conservancy Commission (YRCC) was established, followed by the creation over the following decades of commissions for

44 The Yangtze is the world's leading plastics contributing river, estimated to contribute 0.31 to 0.48 million tons of the estimated 2.40 million tons deposited into oceans globally each year (Lebreton et al. 2017).

each of China's seven major watersheds.[45] Under the responsibility of the Ministry of Water Resources (MWR), the purpose of the basin commissions is to manage water resources utilization and development, water resources management and protection, soil and water conservation, and flood and drought risk management. Their role is primarily advisory, with no implementation or enforcement mandate over provinces.

The revised Water Law (2002) made the role of the river basin commissions more explicit, yet challenges remain. The MWR provides technical advice on implementation of water policies and laws to provincial water management bureaus. At the basin level, management of water quality (formerly managed by the Ministry of Environmental Protection [MEP], now by the Ministry of Ecology and Environment [MEE]) has remained separate from that of water quantity (managed by MWR), maintaining a barrier between these related policy domains. The commissions do not manage subbasin activities, which are the purview of local governments. While consistent with a localized governance framework, this structure conflicts at times with basin-wide management goals and ecological dynamics. Land use activities that have important watershed impacts are also outside of the management purview of the commissions (Hu, Tan, and Xu 2019).

The Yellow River exemplifies these challenges, with ongoing water allocation issues between provinces. A key management objective for the Yellow River since the early 1980s has been to limit water extraction to sustainable levels, manifesting in a water resource allocation plan in 1987, to formal permits enforcing these quotas in 1999, to extended management control over tributaries since 2006 (Moore 2013; Ringler et al. 2010). Despite these changes, overextraction persists, with provinces sometimes circumventing water quotas by extracting from tributaries—where water quantity allocations are not clearly defined—before they reach the main stem and become part of water allocation limits (Moore 2013; Deng 2020).

45 These are the Song-Liao (Songhua and Liao River basins in northeast China), the Hai River (and Luan River), the Yellow River, the Huai River, the Yangtze River, the Pearl (Zhu) River, and the Tai Lake basins.

4.3 RECENT REFORMS IN RIVER BASIN MANAGEMENT

As part of the national government's concerted effort toward environmental management reforms (see section 1.1), river basin management is improving. One element of this effort focuses on expanding the river basin commissions. Rather than restructuring and deepening preexisting institutions, seven new Watershed Ecological and Environmental Supervision and Management Bureaus—parallel to the MWR commissions but under MEE—have been created to manage water pollution and coordinate ecological and environmental planning and management at the basin level. Again, these serve primarily an advisory role, with the onus of implementation and management on provincial governments.

Two policies—the *Three Redlines* and the *Water Ten Policies*—represent important further efforts by the national government toward addressing unsustainable water use and water quality issues. The "three red lines" policy[46] (*santiao hongxian* 三条红线), was issued in 2012 and set national limits of aggregate consumption, and required water use efficiency levels and water quality levels.[47] The "water ten" policy (*shui shitiao* 水十条), requires improved control of pollution discharge, improved resource use efficiency and recycling, stronger enforcement of laws, greater use of market mechanisms, and greater public participation.[48]

46 See State Council. (2012).

47 Specifically by 2030: (1) national water use is to not exceed 700 billion m^3 per year (approximately 75 percent of the country's total exploitable freshwater resources), (2) water use efficiency should increase so that industrial value-added per unit water use reaches or exceeds US$38 per m^3 (CNY 250/m^3) and agricultural irrigation efficiency surpasses 60 percent, and (3) water quality compliance rates exceed 95 percent (State Council 2012; Wang 2018).

48 More formally known as the State Council's *Water Pollution Prevention and Control Action Plan*, the water ten policy is one of the most comprehensive water policies issued by the national government. The plan covers four broad actions (Hu and Tan 2018): (1) control pollution discharge, promote economic and industrial transformation, and improve resource use efficiency and recycling; (2) promote scientific and technological progress, promote greater adoption of market mechanisms, and improve enforcement of laws and regulations; (3) strengthen management and ensure water environmental safety; and (4) clarify roles and responsibilities and encourage public participation.

A further recent development in watershed management is the "river chief" system. This system involves creating positions at provincial, municipal, county, and township levels that are responsible for managing river sections that run through their administrative areas.[49] The system sets targets and rewards, with results included in the performance assessment of the officials involved. As of January 2019, over 1.23 million river chiefs had been appointed in 31 provinces, 75 percent of whom were at the village government level (Xu 2017; Hu, Tan, and Xu 2019). The system faces some constraints at local levels, and is yet to develop a mechanism for formal public engagement and a third-party assessment of outcomes (CCICED 2019) but has been hailed as an important step toward alignment of incentives and definition of responsibilities, with positive results (She et al. 2019).[50]

4.3.a Reforms and objectives for the Yangtze River basin

The national government has prioritized improvements in the Yangtze basin's ecological and water quality management in policy plans and law. The government's objectives for the basin were set out in the *Yangtze River Protection and Rehabilitation Strategic Action Plan* issued by MEE and NDRC in 2018, and includes protection of drinking water sources, reduction of fertilizer and pesticide application, improvement of planning frameworks, and stronger emissions standards for industry. The *Yangtze River Protection Law*, issued in December 2020, formalizes the broad goals of the plan and is the first legislation for a specific river basin in China. The law establishes a National Yangtze River Basin Coordination Mechanism and infers obligations on the national line agencies and provinces to align with its goals of ecological protection and improved water quality in the basin.

The national and provincial governments' investment has increased in line with these priorities, leading to improvements in water quality in the Yangtze. From 2008 to 2017, Yangtze River basin provinces increased pollution control funding from CNY 106.3 billion (US$16.3 billion) in 2008 to CNY 228.6 billion (US$35.1 billion) in 2017 (WWF 2020). Water quality across the Yangtze River basin has been improving over the past two decades, with the proportion of river sections that fail to meet targets decreasing steadily from around 17 percent in 2004 to around 3 percent in 2015 (Duan et al. 2018). Further investments in water quality and ecological protection in the YREB are planned under a National Green Development Fund, launched in 2020 to provide financial support to green development initiatives. The fund has an initial capital of CNY 88 billion (US$12.59 billion), contributed by the Ministry of Finance (MOF), the 11 provinces/municipalities of the YREB, financial institutions, and state-owned enterprises.

4.3.b Reforms and objectives for the Yellow River basin

Plans for the Yellow River are less well-developed, although the national government has signaled improvements in water quality and quantity management in line with "high-quality development."[51] Much of the national government's focus on the Yellow River, apart from standard national-level water quality targets, is in broad strokes. These include improved basin-wide coordination and planning, strengthening provincial government management of water quality, water use efficiency, adherence to water consumption quotas, mapping and management of pollution sources, and the protection of important natural components of the water system. At the same time, the government is also concerned with the significant regional differences in the level of economic development, and so is focusing on improving rural livelihoods in upper reaches of the basin.

49 See the Opinion on Fully Promoting the River Chief Mechanism by the General Office of the Central Committee of the Chinese Communist Party in 2016.

50 As with general reforms noted previously, an important implicit component of this approach is that it leverages preexisting Chinese Communist Party institutional channels to incentivize better management, whereby local officials rather than local industries are held accountable for pollution incidents and water quality outcomes. However, addressing pollution from the large state-owned enterprises (SOEs) with links to higher levels of government, remains a key challenge (Easton and Kostka 2017).

51 President Xi Jinping recently called for a national strategy to achieve effective ecological protection and high-quality development for the Yellow River watershed. Key documents include the Outline of the Yellow River Watershed Ecological Protection and High-quality Development Plan (MEE, NDRC, and MWR), and the Overall Work Plan for Yellow River Ecological Environmental Protection (MEE 2020).

4.4 THE ENVISIONED ROLES OF ECO-COMPENSATION IN THE YANGTZE AND YELLOW RIVER BASINS

4.4.a Eco-compensation in the Yangtze River basin

As is made clear in the Yangtze Action Plan and Yangtze River Law, among other documents,[52] eco-compensation is envisioned as a key mechanism for improving Yangtze water management. These documents indicate that "horizontal eco-compensation mechanisms"—both interprovincial and intra-provincial cross-border watershed eco-compensation (see section 3.1.a)—are envisioned to play a key role. Eco-compensation is expected to provide financial support for ecological protection and water quality management, and provide incentives to align local government actions with overall basin goals.

The national government remains vague, however, on how eco-compensation is to accomplish its goals, how it will be financed, and what form programs should take. Eco-compensation's application toward Yangtze policy goals is likely to involve the redirection of preexisting programs, including the KEFZ eco-compensation program. The *Yangtze River Protection Law* of 2020 sets a goal of establishing a national Yangtze River basin ecological compensation system, of a form to be decided.

However, the national government has clearly signaled an ambition for new horizontal eco-compensation. This has consisted to date of encouraging provinces to develop horizontal eco-compensation programs, while emphasizing broad goals and "tasks," including steadily increasing national government financing, emphasizing a need for diversified funding sources that can draw on private sector finance, market mechanisms, improving performance metrics, and improving local government management of national fiscal contributions. Eco-compensation's role thus remains conceptual at this point, with a need to define program parameters, mechanisms, and funding.

The national government has supported the development of new mechanisms with financial incentives. To catalyze horizontal eco-compensation programs, MEE, MOF, the NDRC and MWR jointly issued the *YREB Ecological Protection Rewards* Policy in 2018. This policy committed CNY 18 billion (US$2.76 billion) from the National Water Pollution Prevention and Control Special Fund to incentivize the establishment of horizontal eco-compensation schemes in the YREB, including both intra-provincial and interprovincial schemes. As a result of these incentives and stated national objectives, all provinces in the YREB have developed intra-provincial horizontal eco-compensation schemes (box 4.1 and box 3.4). Some have developed vertical programs also, drawing on national funding sources such as the key ecological function zones program (box 4.2).

4.4.b Eco-compensation in the Yellow River basin

The Yellow River basin has seen a substantial and effective use of eco-compensation over the past two decades, including large-scale national programs and more recently, provincial horizontal watershed programs (box 4.3). Specific policy frameworks are less developed than those in the Yangtze. MOF, MEE, MWR, and the State Forest and Grasslands Administration (SFGA) issued an *Implementation Plan for Supporting and Guiding Pilot Implementation of a Horizontal Eco-compensation Mechanism in the Entire Yellow River* in 2020, with proposed tasks including establishment of a river basin ecological compensation standard accounting system, improvements to the target assessment system, improvements to the compensation fund distribution methods, and standardization of the use of compensation funds.

A basin-wide platform for Yellow River basin eco-compensation is proposed for data-sharing, and interprovince and interagency coordination. The national government is developing technical and strategic plans to help provinces

52 The intention to use eco-compensation toward Yangtze watershed goals is referenced in prominent policies and guiding opinions developed in the lead-up to the Yangtze River Protection Law in 2020. These include the *Guiding Opinions on Strengthening Environmental Pollution Prevention and Control in the Yangtze River Golden Waterway* (2016) by NDRC and MEP, the *Guiding Opinions of the Ministry of Finance on Establishing and Improving Long-term Mechanisms for Ecological Compensation and Protection of the Yangtze River Economic Belt* (2018) by MOF, the *Yangtze River Protection and Restoration Action Plan* (2018) by NDRC and MEE, and the *Outline for the Yangtze River Delta Regional Integration Development Plan* (2019).

Box 4.1:

The Tuo River Watershed Cross-border Eco-compensation Pilot in Sichuan Province

The Tuo River is a primary tributary of the Yangtze River and one of the most important rivers in Sichuan Province. Its watershed accounts for 5.25 percent of the province and comprises the most densely populated and economically developed areas. The provincial government launched a pilot cross-border eco-compensation program in 2018 to combat agricultural and industrial water pollution. Ten cities—Chengdu, Zigong, Luzhou, Deyang, Mianyang, Neijiang, Leshan, Yibin, Meishan, and Ziyang—signed an agreement and pooled CNY 0.5 billion per year. Central and provincial governments provided supplementary funding of CNY 0.4–0.5 billion per year. Cities contributed according to:

> Fund contribution from city A = total fund amount x (GDP contribution + water utilization rate + Surface Water Environment Index) x 1/3

GDP contribution refers to the share of a city's GDP out of the total basin GDP; the water utilization rate refers to that city's water use divided by the total water available in the basin; and the Surface Water Environmental Index captures the proportion of river sections with good water quality.

The fund's proceeds are allocated based on each city's: (1) area in the basin; (2) water use efficiency per unit of GDP; and (3) water quality improvement. The water quality improvement is determined by chemical oxygen demand (COD), total nitrogen (TN), and total phosphorus (TP).

Preliminary results suggest that the program has catalyzed important institutional and technical capacity-building. The program has stimulated joint research, experimentation in management approaches, and third-party performance evaluation. It has also encouraged other local governments in Sichuan to innovate: Chengdu and Mianyang municipalities have launched a cross-border water quality system for the Fu River, and Nanchong municipality has launched a system for the Xichong River.

Opportunities exist to improve the system and inform the design of other systems. A stronger linkage of payments and results could strengthen program efficiency and effectiveness. For example:

1. **Linking the allocation formula to overall basin or subbasin goals:** ecological, water quality, and water use efficiency targets can be derived from basin-wide planning frameworks. At present, cities in the watershed are simply compared to the average of the group. This provides a useful dynamic incentive (i.e., an incentive for continued improvement over the performance of peers); however, alignment with larger frameworks would ensure strong contribution to provincial-level and Yangtze-level goals.
2. **Strengthening the data used for calculating pollution load indicators:** allocations are based on a fuzzy weighting of available data and do not consider flow factors, the frequency of monitoring, and data quality. Upgrading and publishing the data at fine scales will improve program transparency.
3. **Incorporating a stronger beneficiary-pays element:** downstream water using municipalities are only partially paying for the benefits they receive from upstream water quality improvements. Incentives for upstream cities to improve management could be improved if the allocation formula considered a city's location in the watershed, with increased contributions from those that more strongly benefit.

Source: Authors.

Photo: Farmland in the Tuo River basin. Shutterstock.

Box 4.2:

The Jiangxi River Basin Eco-Compensation Program

Jiangxi launched its Provincial River Basin Eco-Compensation Program (RBECP) in 2015, aiming to protect key ecological areas including Poyang Lake, the Yangtze River, and the Dong River basin. It is a vertical program providing payments to 100 counties, with funds generally used (but not mandated) for projects on ecological restoration, forest improvement, water quality protection, and livelihood improvement, among others.

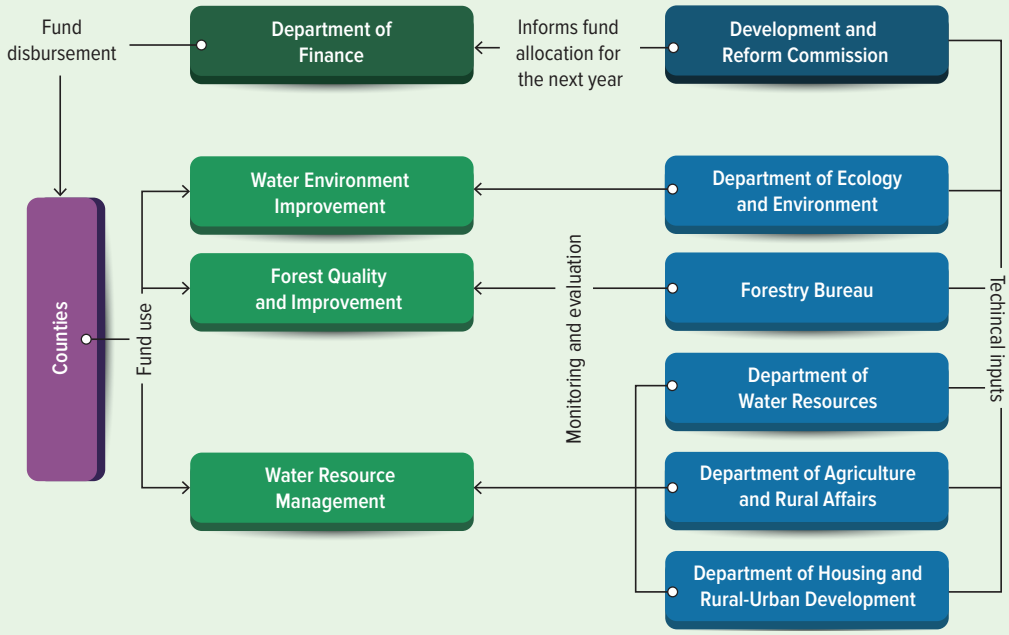
The RBECP draws on the national key ecological function zones (NKEFZ) funding, demonstrating the way in which national government programs often interact with and facilitate provincial programming. Jiangxi received between CNY 1.6 and 2.6 billion per year in the 2016–19 period. RBECP funding flows to counties according to four sets of indicators: (1) water quality; (2) forest quality; (3) water resource management; and (4) the ecological importance of the county. The program also supports poverty reduction, and makes increased allocations for those counties (cities, districts) with relatively lower local fiscal revenues.

Like many programs, the RBECP is a cross-sector program involving multiple provincial departments. The Department of Finance (DOF) manages and disburses the funds, while the Department of Ecology and Environment, Department of Water Resources, the Department of Agriculture and Rural Affairs, and the Department of Housing and Rural-Urban Development, are responsible for monitoring the relevant indicators. Counties are required to submit self-reviewed reports on the funding usage and impacts.

Lessons and opportunities based on RBECP experience include:

- **Match the scale of eco-compensation to basin processes:** There are opportunities to increase effectiveness under the RBECP via coordinated approaches between administrative units, informed by basin-level plans. Environment goals at a basin level can guide the design of eco-compensation, including priority locations based on hot spots and synergies.
- **Combine mutually reinforcing instruments and use eco-compensation to build capacity:** Horizontal eco-compensation across the basin would reinforce command and control mechanisms, as well as the vertical RBECP. It would also promote more robust monitoring of environmental outcomes and develop incentive-based management capacity among local governments. This could provide the foundation for subsequent cap and trade mechanisms for water pollution emissions.
- **Strengthen monitoring:** Limitations in RBECP monitoring limit the possibility of robustly evaluating outcomes. Demonstrating impact could support efforts to increase funding from other levels of government. Evaluation would be strengthened by using third-party monitoring.
- **Support counties with the potential for improvement (in addition to those with high performance):** The fund allocation method prioritizes counties with high environmental performance; some counties may lack the initial support required to reach high levels of performance. A tranche of funding could follow a hot spot approach, in which particularly difficult environmental problem areas are identified and supported with time-bound up-front investments.

FIGURE B4.2: Institutional Arrangements and Fund Flow Proportions under the RBECP Program



Sources: PDRC and DOF, Jiangxi Province; compiled by Authors.

improve the design of programs and link them to larger basin-wide goals. The *Implementation Plan* indicates that the national government will provide supporting funds for provinces to improve their water resources management frameworks. These funds are to be distributed with stronger weighting toward the middle reach provinces, based on achievement of water saving and water pollution reduction goals. It also indicates that penalties (i.e., reduced payments) will be applied if provinces fall behind in the development and implementation of management frameworks, with provinces that are "more advanced" in their eco-compensation frameworks given greater rewards.

4.5 OPPORTUNITIES FOR WATER POLLUTION EMISSIONS TRADING

Emissions trading is a market-based approach to controlling pollution. This report has focused so far on eco-compensation that takes the form of fiscal transfers and conditional payments for environmental outcomes, primarily with government as the source of payments (see box 1.1). However, the term eco-compensation is often also used in conjunction with environmental markets, such as emissions trading and water trading. The draft National Regulation for Eco-compensation (box 1.3), for example, calls for further establishment of market-based trading mechanisms for emissions rights (although it does not identify specific mechanisms). Both emissions trading and water allocation markets are likely to play an increasing role in water and pollution management in the Yangtze and Yellow River basins.

Emissions trading allows firms with high abatement costs to purchase pollution discharge reductions from firms with lower abatement costs, allowing for efficient emissions reductions. A well-designed market will set an overall cap on emissions in line with ecosystems limits and water policy objectives. Within the cap, emitters falling within regulated categories—such as firms over a particular size within the target sector—purchase permits to cover their emissions. Total permits sum to the value of the cap, providing environmental certainty. Firms who reduce emissions can sell unused permits to other firms, providing a dynamic financial incentive to improve efficiency, and drive emissions reductions among firms that face the lowest costs to do so. Emissions markets do not require a price of permits to be set by the government; prices are determined by the demand for permits among firms and their supply (the cap).

Emissions trading has been piloted in China for over two decades. Shanghai embarked on China's first water quality trading pilot in 1987, implementing a system of transferable permits for chemical oxygen demand (COD) emissions for 60 large emitters along the Huangpu River. In 1988, the then National Environmental Protection Agency (NEPA) issued and began enforcing the Water Pollutant Emissions Permit Management Provisional Measures, which stipulated that "the total emission allowances for water pollutants may be flexibly distributed among the emission entities in the same region" (NEPA 1988). Pilots were subsequently developed in a range of cities. The 9th Five-Year Plan (1995–2000) saw the official inclusion of a total emissions control policy for major pollutants, and nationwide implementation of an emission permit system in Chinese cities. Water pollution emissions trading was able develop in the context of these reforms.

Despite these efforts, and unlike other forms of eco-compensation, these pilots have not yet scaled in line with their potential. These and subsequent directives from the national government motivated further pilots, such as the high-profile pollutant trading program in the Tai Lake basin (box 4.4). The scope of these pilots has focused on select large-scale industrial emitters, and on select pollutants (COD and ammonia nitrate). There has been much less focus on nonpoint source emissions such as agricultural activities; these are more diffuse and thus challenging to regulate within a market structure.

Most fundamentally, there is a need for national-level laws and regulations that define emission trading practices and the rights and obligations of emissions permit holders. At the national level, the status of water discharge rights is not clearly defined in the law, despite the existence of important water quality legislation and

Box 4.3:

The Wei River Interprovincial Eco-compensation Program in Shaanxi and Gansu Provinces

The Wei River is the largest tributary of the Yellow River, shared between Gansu and Shaanxi. Management of the Wei River basin has been hampered by a lack of investment in watershed protection associated with low levels of economic development of the key upper watershed areas in Gansu, and the lack of mechanisms to coordinate between upper and lower watershed areas. In 2011, the Shaanxi government proposed the establishment of the Wei River Basin Environmental Protection Cities Alliance following an interprovincial study tour. Members consisted of Xi'an, Baoji, and Weinan municipalities and Yangling district in Shaanxi Province, and Dingxi and Tianshui municipalities in Gansu Province. As part of this framework, an interprovincial eco-compensation program was established, with payments to be made by Shaanxi to upper watershed areas in Gansu in return for meeting water quality targets.

Assessments focused on water quality at provincial and municipal borders. A monitoring network was established with stations at provincial and municipal boundaries, with chemical oxygen demand, ammonia, and nitrogen being used as indicators of water quality. Water quality assessment results were jointly approved by the (former) Shaanxi Provincial Environmental Protection Department and the (former) Gansu Provincial Environmental Protection Department. If the water quality at the border reached the target set by the two provinces, Shaanxi Province provided ecological compensation funds to Tianshui and Dingxi municipalities in Gansu. Funds were to be strictly utilized for pollution control projects, water source ecological construction projects, and water quality monitoring capacity improvements, further improving quality for future assessments. During the three-year pilot period, Shaanxi Province paid a total of CNY 11 million (US$1.69 million) in ecological compensation to Tianshui municipality and CNY 12 million (US$1.84 million) to Dingxi municipality (Dong et al. 2020).

Source: Authors.

The Shaanxi-Gansu interprovincial river basin compensation policy did not proceed beyond this three-year initial period. Contributing to this was a question around program additionality, given that water quality in the upper Wei had been improving regardless of payments. Additionally, a regulatory framework and contractual arrangements between Shaanxi and Gansu were never finalized, and the program thus lacked an institutional framework to support its continuation following a change in the provincial governor.

The program represents an important start toward interprovincial cooperation of the Wei River watershed. The program inspired Shaanxi Province to develop an intra-provincial upstream-downstream eco-compensation system among the four key municipalities of Baoji, Xianyang, Xi'an, and Weinan. A compensation standard was developed based on water quality targets. If the pollutant concentration exceeded the benchmark, the provincial Department of Finance would penalize the municipality in question by reducing, the following year, that municipality's allocation. Of the annual eco-compensation funds allocated to these municipalities, 60 percent was stipulated to be used for pollutant treatment, and 40 percent was an untied reward.

Experience in the Wei River highlights the importance of choosing targets that drive outcomes over and above the likely counterfactual. Nevertheless, important capacity-building benefits occurred regardless and set the stage for further programs. The experience also highlights the durability benefits of a contractual or regulatory framework, as well as the value of knowledge exchange between programs and levels of government, which saw the subsequent development of the intra-provincial Shaanxi program. This is well recognized by the national government, which is promoting platforms for harnessing learning opportunities from provincial and sub-provincial experiences.

policies.[53] Where programs are developing locally, such as in the pilot provinces, there is a lack of convergence between local legislation, which prevents cross-border scaling of programs (Zhanfeng et al. 2021). A stronger legal basis for permits as property rights would also help firms access finance for water pollution control investments.

Scaling will be further supported by predictable program administration, transaction transparency, and permit caps that reflect regional environmental quality goals. Frequent local government administrative changes in the context of a limited legal framework may cause uncertainty among firms, who thus hold back in participating, reducing

53 Notably, the Environmental Protection Law of People's Republic of China (2015), and the State Council's Water Pollution Prevention and Control Plan (2015).

market liquidity. Regulatory stability, along with transparency in transactions information via online platforms, will help encourage participation in trades and thus market efficiency. As programs move past the piloting stage and scale over larger areas, there is also a need to ensure a regionally appropriate aggregate emission cap, i.e., a quantity of permits that reflects environmental carrying capacity and the wider basin water quality goals. This connection is not yet seen in many of the current pilot programs.

Water quality markets have the potential to be an important tool in the Yangtze and Yellow River basins to achieve water quality targets more flexibly and at a lower cost than command and control instruments. The international experience with water pollution emissions trading is substantial, and can be instructive for China's development of these mechanisms (box 4.5).

Box 4.4:
Tai Lake Water Pollution Trading Program

Tai Lake, in the Yangtze Delta region, is the third largest freshwater lake in China. The lake's basin occupies the majority of Southern Jiangsu, three cities in Zhejiang, and the majority of Shanghai city. The basin is one of the most economically developed regions in China, responsible for around 10 percent of national GDP. The lake itself is important for irrigation, navigation, fishery production, and tourism, and is the source of water for over 20 million people.

Deteriorating water quality in Tai Lake resulted in toxic algae blooms and a drinking water crisis in 2007, precipitating government action. Wastewater discharge elevated levels of nitrogen and phosphorus in the lake, causing eutrophication and toxic algae growth. In May 2007, this resulted in a crisis in Wuxi, Jiangsu Province, a city dependent solely on Tai Lake for its water supply, after an algae bloom left approximately 2 million people without drinking water for over a week. In response, the national government pledged more than US$14 billion as part of a large-scale cleanup. A number of industrial facilities were closed, and water treatment regulations were enhanced. Wuxi city introduced river chiefs, assigning government officials the responsibility for stretches of river or lake.

The Jiangsu provincial government introduced a pilot pollution emission permit and trading system the following year. By 2010, the Provincial Environmental Department, Financial Department, and Price Bureau launched the full pollution emission permit and trading system, covering 1,357 enterprises with annual COD discharges of more than 100 ton. Tradeable emissions permits were initially allocated based on a government set price representing the estimated externality value (i.e., the cost of restoring the watershed to its original state). Firms were subsequently permitted to buy and sell permits depending on their need to cover emissions. Fiscal revenues for the government from selling permits were used for Tai Lake water quality improvement measures. Trading of permits is facilitated by a trading center that provides market information and serves as a clearinghouse. Firms are also permitted to negotiate among each other directly for bilateral trades.

The program's experience provides lessons for China's further development of water trading programs. Key among these lessons is the need to avoid conflicts between different elements of the water quality regulatory framework. The program initially laid costs of the permits on top of existing obligations on firms to pay discharge fees, essentially double charging. In addition, the firms faced conflicts in regulation: emissions permitted under the trading system could technically be in breach of firms' environmental impact assessment (EIA) obligations. Command and control pollution measures were also imposed in parallel to the market, reducing firms' flexibility (e.g., mandating technology standards, rather than allowing them to be incentivized by the market where cost-effective) (Zhang, Zhang, and Bi 2012). An overarching policy framework that resolves such conflicts and provides clarity to firms is critical.

More fundamentally, trading programs would benefit from a stronger legal basis for permits. This would provide more certainty to firms about the durability and value of their permit, and allow them to treat it as a financial asset. Property rights over emission allowances are not stipulated in laws as they are for other resources, such as forests and land, and are instead administrative permissions that are easily changed.

Source: Authors.

4.6 DRAWING CONCLUSIONS FROM ACROSS THE BASINS

The Yangtze and Yellow River basins are in many ways the crucibles of eco-compensation in China. The CCFP, for example, was first piloted in upper watershed provinces of both the Yellow and Yangtze Rivers. These river basins are again the focus of much eco-compensation innovation, as the national government calls for investments and institutions for improved land and water management in these regions. This innovation and the lessons arising are as diverse as these basins, yet the case studies and dataset assessment informing this report suggest some important common themes:

1. **There is an opportunity to better harness intra-provincial and interprovincial water management eco-compensation toward basin-level objectives.** The setting of basin-level objectives, developed through basin-wide hydrological and water quality modelling and subsequent basin management plans, would provide valuable guidance for the multitude of subnational eco-compensation programs currently arising. Basin-level plans could offer a consistent framework for monitoring and assessment (for example, to determine program baselines). Hot spot analyses to identify locations for the most cost-effective interventions would help prioritize eco-compensation development. Given that subnational eco-compensation programs are almost always supported by national government funding, there are opportunities to guide and incentivize the programs' development in line with basin-level objectives.
2. **Data transparency would improve collaboration between governments and broader stakeholders.** The extent and detail of water quality monitoring has improved substantially in recent years. Further improvements in programs will need to take account of a wider range of ecological indicators, and be able to integrate these to build more comprehensive pictures of watershed health and resiliency. While many metrics useful for developing overall assessments of watershed health are already collected by various agencies in China (e.g., forestry type, age and health, wetlands classification and status, location and distribution of build hydrological infrastructure), information availability to the public remains limited, and flows of that information within governmental systems remain siloed. Information transparency will be increasingly important for the development and deepening of effective interprovincial agreements, for credible attribution of a wider range of outcomes beyond simple water quality, and for improving opportunities to leverage private sector participation (a priority of the government and a largely unfulfilled opportunity to date). Third-party monitoring and verification could help improve and ground truth data quality, and promote accessibility and transparency.
3. **River basin eco-compensation requires interprovincial coordination and consultation mechanisms.** These programs require the cooperation of governments across provinces, and the cooperation of multiple departments within governments. There is not presently an authoritative platform for consultation at the basin level. River basin authorities could be given the mandate to act as a convenor to promote coordination between sectors and jurisdictions; interprovincial river chief coordination mechanisms could be harnessed for these purposes also.
4. **Market-based systems are underutilized but widely applicable.** This is well recognized by high-level government policy documents on eco-compensation, including by the draft National Regulation on Eco-compensation (box 1.3). Water quality trading has been widely piloted in the Yangtze River basin (since 1987 in Shanghai municipality), but unlike other forms of eco-compensation, has not scaled in line with its potential. This is partially due to a lack of a national-level or basin-level water quality trading policy, along with insufficient technical guidance on permitting systems, initial allocations, and application to nonpoint source pollution. These could be developed based on experience so far; international experience also can offer guidance (see box 4.5).

Box 4.5:

International Experience on Water Pollution Emissions Trading

Well-designed markets are reducing costs of meeting water quality standards in river basins in many countries. These examples demonstrate markets' ability to provide flexibility in how regulatory requirements are met; create new sources of revenue for government from the sale of permits support increased accountability and transparency around water quality improvements; and create new relationships between businesses, farms, and other communities. Notably, international examples have faced many of the same challenges as those facing Chinese pilots and indicate that program design is an iterative process of establishment, monitoring, and refinement. Specific examples include:

- **Water quality trading in the US:** A lack of a national-level or basin-level water quality trading policy has created barriers to scaling water pollution emissions trading in China. In the US, the 1972 Clean Water Act required the US Environmental Protection Agency (EPA) to establish total maximum daily load (TMDL) pollution limits, and allocate emissions permits within this limit for point and nonpoint sources.
- **Water quality trading in Sweden:** The Swedish Environmental Protection Agency developed a fee system with trading for nitrogen and phosphorus, a combination of a cap and trade, and a baseline and credit system. Regulated point sources receive allocations under an absolute cap, while nonregulated sources can create allocation credits by reducing their emissions beyond a set baseline.
- **Clean Water Revolving Fund in Canada:** Emissions trading in China is largely limited to systems regulating point source pollution entities. There will be an increasing need to extend systems to nonpoint source emitters in the agriculture sector. The Clean Water Revolving Fund in Canada comprises nonpoint and point source representatives who manage a Clean Water Fund, which allocates money to farmers to pay for best management practices that generate credits.

Source: Authors.

Discussion on water quality markets sometimes proposes that markets can only develop after certain regulatory, institutional, and technical prerequisites and capacities have been achieved; this need not be the case. Many initiatives internationally have been developed in contexts initially lacking in at least some of these conditions, with the market development process itself catalyzing changes in the broader management regime. This includes building better platforms for collaboration and joint decision-making, implementing measures necessary to improve understanding of the watershed in question (pollution sources, most important pollutants, range of abatement costs, relevant geographical boundary), developing approaches and protocols for more process-based problem solving and management, and introducing greater economic rationality into water resource management and planning.

CHAPTER 5.

Recommendations for Eco-compensation Development

Photo: Afforestation project in Gansu, China. iStock.

Eco-compensation represents the gradual transitioning to environmental and ecological management involving more performance-based mechanisms and cross-regional management frameworks.

More broadly, it is promoting a more explicit discussion on the apportioning of costs and benefits, and rights and responsibilities of ecological management. While these are important developments, many elements of eco-compensation policies and programs represent continuations of preexisting approaches. As discussed in section 3.4, programs remain primarily top-down in nature, both in "vertical" eco-compensation programs—for which top-down financial flows are central—but also for "horizontal" eco-compensation programs built around transfers between equal levels of government (such as interprovincial watershed programs). National government leadership, facilitation, and technical and fiscal support have been critical for these programs' establishment, and based on available information, no two counties or municipalities have to date established their own horizontal eco-compensation program without significant provincial-level encouragement and support. Programs rely overwhelmingly on public expenditure, and as seen in section 3.3, payments are often primarily linked to input-based indicators (on-site investments, management activities, financial milestones). Water quality programs represent an important shift toward more outcome-based indicators, although transparency regarding payment formulas remains limited. Thus, while China's achievements with eco-compensation are clear, there are also substantial opportunities to improve outcomes in a range of dimensions.

This report identifies five areas for improvement which can help eco-compensation programs become more effective, efficient, and equitable (figure 5.1). This chapter makes recommendations regarding these target areas, highlighting how addressing each could be expected to improve eco-compensation outcomes according to the three assessment dimensions used throughout this report: effectiveness, efficiency, and equity. Given the diversity of programs and the breadth of the eco-compensation concept, recommendations are necessarily broad. These areas are:

1. Strengthening monitoring and enforcement capacity;
2. Addressing gaps in technical capacity at local government levels;
3. Developing holistic planning frameworks to inform programs and performance metrics for both interprovincial and intra-provincial watersheds and ecosystems;
4. Developing more effective platforms and protocols for interagency and interprovincial planning, joint decision-making, and conflict resolution; and
5. Adopting greater adaptive and participatory management, program design, and implementation approaches.

TARGET AREA A. OPPORTUNITIES TO STRENGTHEN MONITORING AND ENFORCEMENT

Monitoring capacity is essential for effective and efficient management mechanisms and expanded funding opportunities. The government has significantly strengthened monitoring of core water quality indicators, with improvements in outcomes evident in recent years, and with opportunities to now expand monitoring toward a more comprehensive set of ecological indicators and better integrate these into detailed models and modelling scenarios. While the provinces remain important for implementing monitoring, a strong national government role remains critical to ensure data consistency nationwide, and to facilitate data sharing (and thus learning) between jurisdictions.

Strong enforcement capacity—linked to mandates that are based on rigorous science and tied to sufficiently strict, fair, and consistent penalties for lack of compliance—is also fundamental for achieving targeted outcomes. Enforcement mechanisms complement improved monitoring by upholding the results-based intent of eco-compensation programs, and creating the framework for robust and functional ecological markets. The following recommendations are proposed to strengthen monitoring and enforcement further.

FIGURE 5.1: Summary of Framework Recommendations and Envisioned Outcomes

KEY TARGET AREAS	RECOMMENDED MEASURES	ENVISIONED OUTCOMES
A. STRENGTHENING MONITORING AND ENFORCEMENT CAPACITY		
	A.1. **STRENGTHEN** basin-level management platforms and authorities at the national level. A.2. **STANDARDIZE** and broaden the monitoring data collected and published. A.3. **ENSURE** that monitoring and implementation functions are separate.	Effectiveness → Quantification of ecosystem services flows and land use impacts on them improved. → Better attribution of the impacts of different interventions given different contexts and baselines improved. → Targeting of investments improved. Efficiency → Capacity to evaluate the cost-effectiveness of different approaches strengthened. → "Price discovery" mechanisms facilitated through verifiability of ecological outcomes. → Conservation finance flows catalyzed via real profit opportunities linked to attributable ecological outcomes. Equity → Greater adoption of market-based mechanisms ensures that schemes benefit participants, and costs and benefits of ecological restoration, protection, and management are more equitably shared among the key stakeholders.
B. ADDRESSING GAPS IN TECHNICAL AND SCIENTIFIC CAPACITY AT LOCAL GOVERNMENT LEVELS		
	B.1. **TRAIN** provincial government personnel in knowledge areas important for eco-compensation program development and implementation. *(See A.1)* B.2. **PROVIDE** technical support to provinces where gaps in expertise exist. *(See A.2)* B.3. **DEVELOP** and strengthen knowledge-sharing platforms. B.4. **PROVIDE** stronger guidance on program design options.	Effectiveness → Capacity to deliver ecological management outcomes strengthened. → Rate of innovation in eco-compensation increased. → Scaling up of effective approaches facilitated. → Development of an environmental services sector catalyzed. Efficiency → Capacity to more efficiently use available resources to achieve outcomes strengthened. → Capacity to conduct cost-benefit analyses of potential and current programs improved. → Capacity to development and utilize market-based program design components improved. Equity → Stakeholder needs and constraints better incorporated into planning and design.
C. DEVELOPING TOP-LEVEL HOLISTIC PLANNING FRAMEWORKS TO INFORM PROGRAM TARGETS AND METRICS		
	C.1. **CREATE** a comprehensive basin-level plan. *(See A.1)* C.2. **CONDUCT** a public expenditure review. C.3. **REVIEW** the regulatory framework comprehensively.	Effectiveness → Targeting of investments within a larger landscape improved. → Landscape- and basin-level outcomes improved through stronger linkages with local eco-compensation program design and indicators. → Improved eco-compensation program design to accord with the regulatory landscape. Efficiency → Regional targeting of investments to capture comparative advantages and synergies in ecological services provision improved. Equity → Ability to identify locales where ecological and rural welfare co-benefits could best be achieved with program interventions improved.
D. DEVELOPMENT OF MORE EFFECTIVE CROSS-SECTORAL, INTERAGENCY, AND INTERREGIONAL GOVERNANCE PLATFORMS		
	D.1. **ESTABLISH** platforms for joint decision-making on basin-level planning. *(See A.1)* D.2. **CREATE** explicit institutional channels for interagency and interregional knowledge sharing. *(See A.1)* D.3. **DEVELOP** mechanisms and protocols for conflict resolution. *(See A.1)*	Effectiveness → Scaling up of effective approaches facilitated. → Development of interprovincial programs quickened. → Landscape-level planning and management improved. → Rate of innovation in eco-compensation increased. Lessons learned better captured. Efficiency → Improved regional targeting to improve cost-effectiveness improved. Equity → Stakeholder needs and constraints incorporated into planning and design.
E. GREATER ADOPTION OF ADAPTIVE, PROCESS-BASED AND PARTICIPATORY MANAGEMENT, PROGRAM DESIGN, AND IMPLEMENTATION APPROACHES		
	E.1. **BUILD** adaptivity into monitoring systems. *(See A.1 & A.2)* E.2. **EXPAND** the use of market-based mechanisms. *(See B.1 & B.2)* E.3. **EXPLORE** greater adoption of adaptive co-management mechanisms in program design and implementation. *(See B.1 & B.2)* E.4. **USE** lessons learned in co-management mechanism development to create guidelines and protocols. *(See B.1 & B.2)* E.5. **MINIMIZE** equity-efficiency trade-offs via stronger guarantees of voluntarism.	Effectiveness → Capacity to deliver ecological management outcomes strengthened. → Scaling up of effective approaches within rural landscapes improved. → Program ecological management outcomes made more stable and sustainable via local stakeholder buy-in. → Capacity to address uncertainty strengthened. Efficiency → Efficiency improved via identification of lower-cost approaches. Equity → Rural welfare outcomes strengthened and improved. → Capacity to build partnerships with local communities strengthened.

Recommendation A.1:
Reinforce the roles of the basin agencies at the national level

A stronger and more integrated national government role at the whole-basin level would help ensure that monitoring and enforcement are consistent and credible. While effective provincial coordination and authority remains critical, successful achievement of basin-level ecological targets will ultimately require strong basin-wide authority. This could be furthered by:

1. **Strengthening the river basin commissions.** These commissions are at the level of a deputy minister—i.e., below that of both a minister and provincial governor; greater seniority would allow them to set and enforce mandates within these watersheds to represent basin-wide interests;
2. **Tighter integration of management and planning responsibilities for basins, including within the National Development and Reform Commission (NDRC).** Currently, at least four departments within NDRC have responsibilities over the Yellow and Yangtze River basins and related environmental or ecological roles;[54] and
3. **Developing a more unified management authority for basins, potentially through the joint conference of ministries proposed in the draft National Regulation for Eco-compensation (see box 1.3).**

Recommendation A.2:
Standardize and broaden the monitoring data collected and published

To improve overall planning and management of river basins, it will be important to put in place systems and protocols to ensure data consistency across locations, and to assist in expanding the range of ecological indicators collected. While provincial agencies remain a critical part of China's environmental monitoring system, a national-level agency or unit could be created or reformed to guide provinces in their data collection (box 5.1), ensuring sufficient accuracy, transparency, and consistency across the country. The breadth of the data collected, by this body or others, would benefit from expansion relative to current metrics. While water quality indicators have improved substantially in recent years, further ecological health and resiliency measures will be needed complements. These include ecological function and biodiversity, status and trends in ecological and riverine health, the distribution and impacts of built components of the water system, and the mosaic of land uses and populations. Effective long-term management (particularly in the context of climate change and rapid socioeconomic development) will require this more comprehensive ability to monitor and model watershed ecological indicators and outcomes.

Recommendation A.3:
Ensure that monitoring and implementation functions are separate

A stronger national government role could help ensure independence in monitoring functions. As noted in section 2.6, the national government has been strengthening vertical lines of management and consolidating monitoring responsibilities at national and provincial levels, and will likely continue to rely heavily on provincial governments to conduct monitoring for the foreseeable future. In the absence of clear separation of monitoring and implementation roles and responsibilities, informational asymmetries and the potential for conflicts of interest at provincial and sub-provincial levels could pose risks to data integrity and dissemination (Brombal 2017; Zhang 2017). Agencies responsible for environmental monitoring should be separate from agencies responsible for achieving ecological and environmental targets. Ideally, the formulation of indicators and collection of monitoring data should be under one roof, with opportunities of promotion (i.e., incentives for officials) tied specifically to the quality of monitoring (independent of actual outcomes). Another approach would be to engender greater third-party monitoring (which would also help develop the environmental services private sector).

54 Within the NDRC they are: the Regional Revitalization Department (development and promotion of eco-compensation); the Infrastructure Development Department (implementation of the Yangtze River Ecological Belt [YREB] development plan); the Resource Conservation and Environmental Protection Department (promotion of green industry development, energy conservation, environmental protection, and clean production); and the Regional Economy Department (regional integrated development of the Yangtze River delta, ecological protection and high-quality development of the Yellow River basin, and comprehensive management of key river basins).

Box 5.1:

Suggested Functions for Strengthening Monitoring at the National Level

There are a range of functions that would help strengthen environmental monitoring systems at the national level. While the institutional arrangement that could deliver such strengthened functions varies considerably, the following core functions are suggested:

1. Develop, implement, and refine national environmental monitoring systems with a recognized mandate. This includes (1) formulating and standardizing data collection protocols and methodologies; (2) determining needed updates to technical standards for monitoring technologies, methods, and indicators; (3) standardizing methodologies for environmental and ecological valuation, including benefit-cost analysis methods suitable for assessing nonmarket values (including valuation data suitable for benefit transfer calculations); and (4) developing historical baselines, via preexisting data, for assessing outcomes and developing counterfactuals.
2. Serve as a clearinghouse for the compilation, aggregation, and improvement of preexisting environmental data.
3. Build partnerships with academia to improve technical capacity, improve metrics, and undertake cost-effective evaluations by simply allowing academia access to data for research purposes.
4. Develop partnerships with the technology sector to utilize big data, remote sensing, and distributed data systems to help lower monitoring costs and expand monitoring approaches (see box 5.2).
5. Provide training and technical support to provincial monitoring agencies, including assisting them in the development of appropriate contracts to hire outside expertise where more suitable.
6. Promote best practices to subnational governments for tracking program development and impacts through the entire program life cycle, including the tracking and evaluation of ecological and socioeconomic inputs and outcomes, and the use of counterfactuals to better attribute results.

Source: Authors.

Box 5.2:

Emerging Technologies for Environmental Monitoring and Eco-compensation

While technology is no substitute for sound policy design, an array of recent innovations offers opportunities to reduce costs, improve monitoring and accountability, and empower individual payees in eco-compensation programs. China's advanced computing and communications sectors, and government familiarity with extensive and automated data collection, make China well placed to take advantage of these innovations. Emerging examples include:

- **Blockchain for automated and secure environmental payments:** Blockchain's distributed ledger technology has the potential to contribute to eco-compensation via its ability to (1) immutably register land titles and secure property rights; and (2) increase transparency in transactions, ensuring that funding is used as intended and corruption is minimized. An initiative currently in a preliminary development stage, *Blockchain Ecosystem Payments,* combines a "smart contract" with the remote sensing platform Google Earth Engine (Oberhauser 2019). Smart contracts are automatically triggered (payment to landowners) when certain criteria are met. The app automatically measures land use change (forests) at regular intervals based on the remote sensing data; if the forested area stays within agreed-upon limits, the smart contract directly pays the enrolled landholders. The technology improves speed, traceability, efficiency, and transparency of payments, and reduces the need for government administration and verification. It is currently being developed for trial in a Namibia Wildlife Corridor.
- **Mobile money payments for reduced transaction costs:** A closely related possibility is the use of mobile money (phone-based electronic payments) for ecosystems services payments made to individual landholders. Use of this approach draws on the widespread use and success in cash transfer programs, including micro-credit, micro-insurance, and aid relief. China has high levels of mobile money penetration. Payments via mobile money lower transaction costs, enable higher frequency payments, and may improve the

traceability and security of disbursements. More frequent payments (weekly or monthly, rather than annual lump sums) may help prompt more consistent action from landholders (Adhikari and Boag 2013).

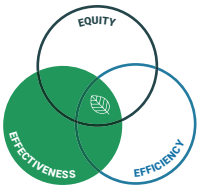
- **Remote sensing for improved water quality:** Earth observation via satellites and drones are providing growing opportunities for cost-effective, spatially, and temporally comprehensive water quality monitoring (Harshadeep and Young 2020). They are particularly beneficial for monitoring previously unsampled locations, areas with limited access, and highly dynamic water phenomena. Improved sensor technologies and associated algorithms can detect parameters such as chlorophyll (indicating algal blooms) and sediment. Machine learning approaches can help fill gaps and estimate other water quality parameters to support decision-making and eco-compensation payment triggers.[a]

Challenges remain for the adoption of these technologies. For example, remote sensing can detect some forms of water pollution such as organic matter, but not dissolved nutrients. There is also a need for governments to develop familiarity with distributed data systems and independent monitoring, and their willingness to increase data sharing and transparency. Fundamentally, technology does not replace strong institutional design and governance, but it does offer ways to reduce costs and operationalize key design principles on the ground.

Source: Authors.

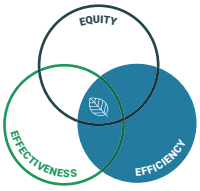
[a] For more information, see AquaWatch, an initiative of the Group on Earth Observations (GEO), dedicated to supporting deployment of remote sensing technology for water resources management and decision-making. https://www.geoaquawatch.org/.

ENVISIONED OUTCOMES: *EFFECTIVENESS*



Rigorous, science-based monitoring of ecological status, trends, and outcomes unlocks opportunities for the assessment of program effectiveness. It is only when outcomes are observable that they can be linked with program design and implementation effectiveness. This allows for results attribution—the linking of interventions to outcomes—and thus the ability to evaluate the effectiveness of different approaches. This then facilitates better targeting of investments and confirms that they are achieving the outcomes targeted.

ENVISIONED OUTCOMES: *EFFICIENCY*



The ability to assess effectiveness (i.e., the degree to which outcomes are being achieved) further unlocks the means to improve efficiency. The ability to assess effectiveness means that different eco-compensation approaches can be compared and their relative returns (e.g., money spent per unit of outcome achieved) assessed. As highlighted in section 3.4, most current eco-compensation programs have significant room for improvement regarding efficiency.

Stronger monitoring, linked with enforced and sufficiently strict mandates, can also unlock innovation, which can further improve efficiency. Allowing flexibility in how outcomes are achieved can engender innovation but is only feasible if outcomes are clearly observable and attributable. Specifically, in the absence of the ability to clearly monitor outcomes, proxies for such outcomes (e.g., mandated "input-based" interventions such as land use practices assumed to deliver ecological functions and services) are often targeted instead. With observable and attributable outcomes combined with clearly defined responsibilities, the inputs-based mandates can be relaxed, allowing provincial and sub-provincial government and business-sector actors greater flexibility in how they achieve outcome-based mandates (i.e., flexibility in what "inputs" they use).

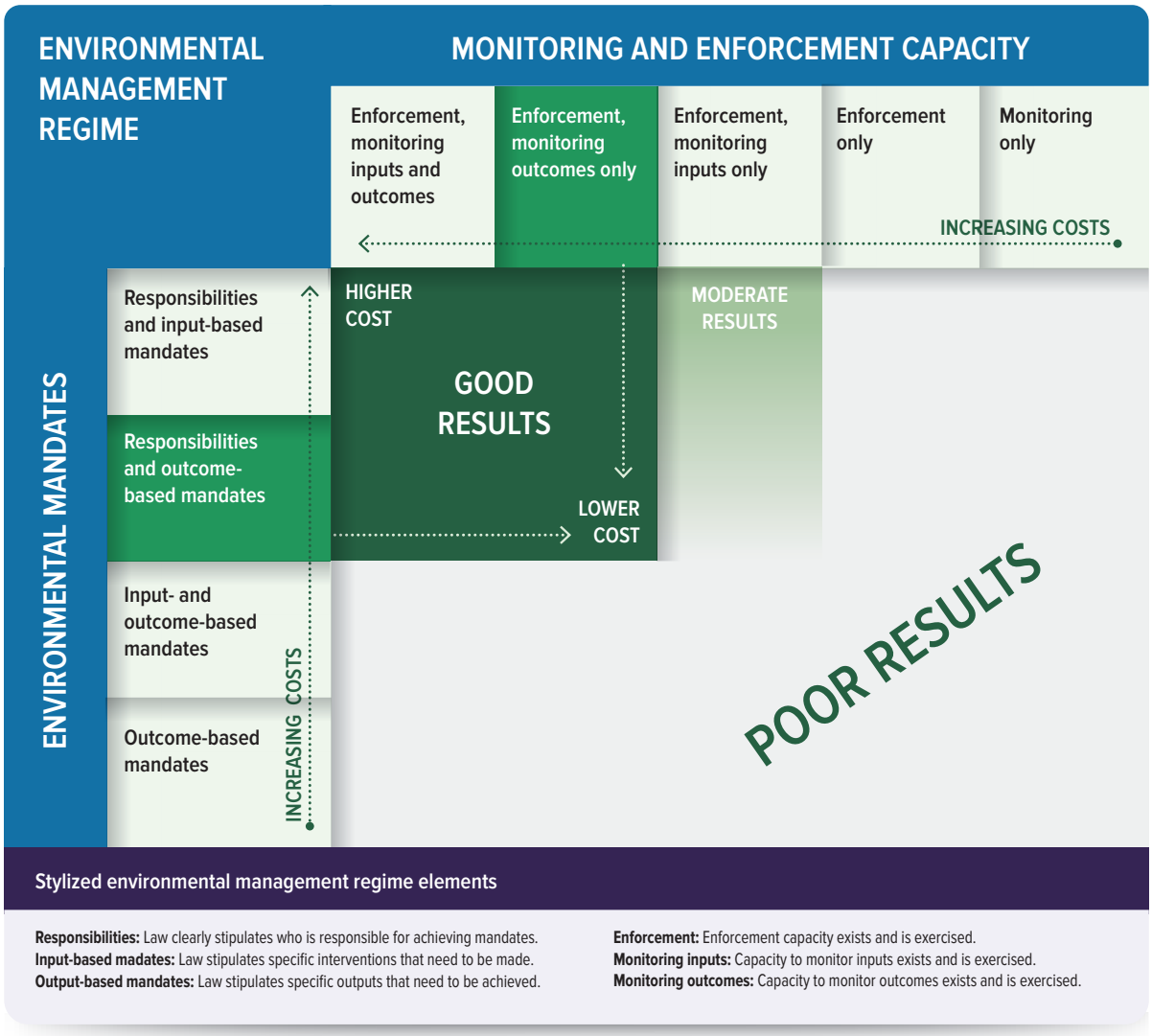
When either enforcement or monitoring capacity exists without the other, targeted results are difficult to achieve (figure 5.2). Activities either cannot be verified or cannot be enforced. When enforcement capacity, combined with the ability to monitor inputs exists and is couched in a regulatory regime that stipulates who is responsible for achieving outcomes and what input-based measures must be used, moderate results are achievable (although this also depends on the degree to which stipulated inputs are good proxies for the targeted ecological outcomes). Once the capacity to monitor and attribute ecological outcomes exists, and

is couched in a regime that stipulates responsibility and mandates either input-based or outcome-based targets, achievable results improve considerably. Within this, the use of outcome-based targets rather than input-based targets can achieve results at lowest costs, and as noted above, can catalyze innovation that further lowers these costs.

Improved monitoring would also facilitate greater use of markets within eco-compensation. Many governments in China remain focused on using "scientific" methods to calculate the "correct" eco-compensation rate. A more productive and critical role for government is the quantification of ecosystem services flows, and the identification of the linkages between land use interventions and ecosystem service provisions so that the attribution of outcomes is possible. Once basic information regarding these connections is available, participants within eco-compensation schemes can negotiate agreements based on their own costs and benefits, with the outcomes determining what the eco-compensation rate will be.

Made into a more formal process of ongoing, negotiated contracts or auctions, eco-compensation programs could then realize their potential as a market-based mechanism. One of the important functions of markets is price discovery. In the case of eco-compensation,

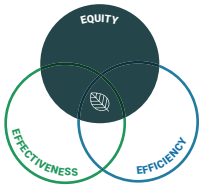
FIGURE 5.2: Expected Results and Costs of Combinations of Monitoring and Enforcement and Mandates



Source: Authors.

generally only ecosystem service providers know their costs of provision, while beneficiaries know their own valuation of the benefits. Negotiated contracts, or reverse auctions (in which participants bid for the right to provide a certain level of ecosystem services at a given price) reveal prices and incentivize cost-lowering competition. Such mechanisms can be a valuable additional tool to help identify the actual costs and benefits of ecosystem services provision, as well as their regional and temporal distribution, which could further help with improved targeting. Facilitating the adoption of voluntary agreements in some contexts will require changes to the pricing and regulatory framework to ensure that beneficiaries do not double pay for targeted services.[55]

ENVISIONED OUTCOMES: *EQUITY*



Monitoring and enforcement capacity lies at the heart of equitable program design, ensuring that payments reach those responsible for real ecological improvement, and that enforcement of program rules is consistent and equitable. In addition, greater adoption of market-based elements, made possible by improved monitoring and enforcement, could also help to make management regimes more adaptive and equitable. Market-based approaches, in which prices and quantities of ecosystem services provision are determined via repeated negotiations or auctions, ensures that prices paid match opportunity costs. Ecosystem services beneficiaries or providers can decide whether or not to participate based on the negotiated prices, helping to ensure that benefits and costs are fairly apportioned.

55 In the case of Colombia, for example, a long-levied fee of 3 percent of revenues from hydropower producers to finance conservation has significantly dampened incentives for voluntary payment agreements, since producers would be paying twice for the same services. In contrast, Costa Rica has dozens of voluntary agreements under which water users pay for watershed management. Key for this has been regulations to prevent double payments: the water tariff (part of which pays for conservation) is rebated to water users who enter into voluntary conservation agreements (personal communication Stefano Pagiola, 2021). See also box 4.4 for the example of Tai Lake, where regulatory conflict was initially a challenge.

TARGET AREA B. ADDRESSING GAPS IN SCIENTIFIC AND TECHNICAL CAPACITY AT LOCAL GOVERNMENT LEVELS

The needs within monitoring and enforcement functions highlight the broader importance of addressing scientific and technical capacity gaps at provincial and sub-provincial government levels. Such constraints are particularly pronounced for poorer inland and western regions, which are also the key repositories of much of China's critical biodiversity and important headwaters for the Yellow and Yangtze Rivers.

Gaps in local government capacity are exacerbated by insufficient knowledge sharing of China's eco-compensation experiences. National government guidelines, opinions, and policy documents have, to date, primarily provided broad frameworks and principles for the development of eco-compensation programs, leaving the heavy lifting in operationalizing the concept to provincial and sub-provincial governments. While this gives provinces welcome room to innovate, and while there has been some degree of information sharing regarding successful domestic models, there remains a need to better educate policy makers on best practice and the current state of innovation. Measures to catalyze innovation should be accompanied by knowledge platforms for sharing lessons, capturing experience, and promoting the scaling of successful approaches. To date, the magnitude of success in China and lessons from specific experience have yet to be fully captured and promoted. The following recommendations are proposed to address gaps in scientific and technical capacity at government levels:

Recommendation B.1:
Train provincial government personnel in knowledge areas important for eco-compensation program development and implementation

Ongoing national government support for provincial government capacity-building will be important to facilitate improvements in management, especially for China's lesser-developed regions, and could help to catalyze more effective problem solving and experimentation.

Special-purpose grants could support training of provincial government staff, with a priority focus on key knowledge areas including:

1. Agricultural best management practices (in light of the particular challenges around nonpoint source pollution control);
2. Land use—ecological impact linkages;
3. Climate change impacts and adaptation strategies;
4. Market-based approaches to environmental management; and
5. Protocols and methodologies for developing programs with rural communities in a consultative and adaptive fashion.

Recommendation B.2:
Provide technical support to provinces where gaps in expertise exist

The national government has a strong role to play in providing technical support to assist provinces in developing effective programs. While strengthening capacity via training will be important, many provincial governments will not have the full range of expertise needed for more sophisticated eco-compensation mechanisms. Nor is it desirable that they do, since this would create redundancies and inefficiencies. Areas of technical support could include, for example, benefit-cost analysis, ecological/environmental market and trading platform design, hydrological and climate change modelling, and community consultation and engagement. This could be done via one of two channels:

1. **Direct national government provision of technical support**—possibly from an institute created explicitly for this function (e.g., see Recommendation A.2); and
2. **Provision of special-purpose grants** to support the hiring of needed expertise from third parties.

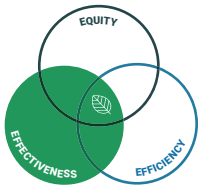
Recommendation B.3:
Develop and strengthen knowledge-sharing platforms

Strengthening of knowledge-sharing platforms will be critical for capturing experience and lessons learned across regions and levels of government. China already has a wealth of experience regarding eco-compensation programs, but to date has not leveraged it effectively. The joint ministerial conference proposed in the draft National Eco-compensation Regulation is a welcome step toward a knowledge-sharing platform. Special grants to encourage study tours between provinces, and to facilitate workshops and working groups between different agencies and regions, could help to speed up and catalyze innovation and program development.

Recommendation B.4:
Provide stronger guidance on program design options

While the national government has given provincial governments significant flexibility in program development and innovation, more explicit guidance on program design options would significantly boost the effectiveness of provincial efforts. Flexibility should remain an important part of these policy frameworks, but with better use of experience and lessons learned—what types of approaches generally work best in specific contexts and regarding specific resources—provinces need not "reinvent the wheel" whenever they wish to develop a new eco-compensation program. Providing flexibility, but also a more detailed menu of policy options, could help make provincial efforts more successful and speed up program development.

ENVISIONED OUTCOMES:
EFFECTIVENESS

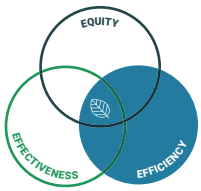


As the key developers and implementers of eco-compensation programs, strengthening of provincial government capacity will help to improve effectiveness. If done systematically and in combination with other recommended measures, this will speed up development of effective eco-compensation programs, improve overall management capacity, and engender greater experimentation and innovation in management at provincial levels.

This could also serve to catalyze the development of both national capacity and a third-party environmental services sector. National capacity would be developed via the use

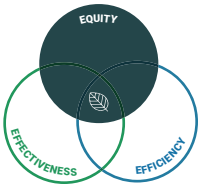
of a specific agency with the express purpose of providing such technical support (e.g., see Recommendations A.1 and A.2). The concentrated expertise that such an agency would build through ongoing technical support work would feed into more effective program design and development processes and insights, and could help to inform future regulatory frameworks and guidelines. Providing grants and other incentives for third-party provision of such technical support would help to engender an environmental services sector, an important goal of the government.

ENVISIONED OUTCOMES: *EFFICIENCY*



Stronger provincial government capacity will also help to engender efficiency via better use of available resources to achieve environmental mandates. One way in which efficiency could be improved is through providing provinces with the technical support needed to conduct an ecosystem services valuation and a benefit-cost analysis, linked with scenario building to inform initial program development (box 5.3). Such an analysis is critical to clarify the assumptions behind program interventions, identify where eco-compensation interventions could provide value, and identify how such programs could be designed to be cost-effective. More fundamentally, technical capacity-building and an environmental services sector facilitate cost reductions through better program design and implementation.

ENVISIONED OUTCOMES: *EQUITY*



Providing provinces with support to conduct effective community consultation and engagement as part of program development, and to incorporate adaptive co-management elements within program design, could help improve equity. Such components will ensure the longer-term outcomes of programs by building in elements to ensure that programs help to equitably apportion the costs and benefits of environmental management, and that the needs and constraints of participant communities are addressed.

TARGET AREA C. GREATER ADOPTION OF HOLISTIC LANDSCAPE-LEVEL OR BASIN-LEVEL PLANNING

Lack of holistic landscape- or basin-level planning constrains provincial and sub-provincial governments in their ability to develop programs with meaningful targets and metrics. This is especially true regarding the contributions of such programs to basin-wide management goals such as maintaining and strengthening watershed health, flood mitigation capacity, seasonal flow regulation, climate resiliency, and stable long-term water quality. This also greatly hinders the national government's ability to strategically target interventions within the larger water system to improve the overall effectiveness and efficiency of ecological investments. Important contributors to this challenge are the ongoing barriers to interdepartmental data sharing and the lack of open, collaborative database systems (WWF 2020). The following recommendations are proposed to develop greater adoption of landscape-level or basin-level planning:

Recommendation C.1:
Create a comprehensive basin-level plan

A comprehensive basin-level plan is a core component of improved management. This would be most effectively conducted by a strong basin-level authority as per Recommendation A.1. The creation of such a comprehensive plan can in itself entail a valuable exercise in watershed governance development, since it can be used as a means to identify, engage, and consult with key stakeholders, raise awareness, facilitate information-sharing, and identify where potential conflicts or synergies exist. A basin-level plan would also help ensure that provincial and sub-provincial targets accord with basin-level goals.

Recommendation C.2:
Conduct a public expenditure review

Conducting a public expenditure review will help to ensure better alignment between current fiscal flows and landscape- or basin-wide planning objectives. The magnitude of financing under eco-compensation programs is large and disparate, and it targets a wide array

Box 5.3:

Ecosystem Services Valuation for Eco-compensation Program Design

Many eco-compensation programs can be understood as mechanisms that perform the role of a market for ecosystem services in circumstances where a market has failed to develop. In the absence of buyers and sellers that would otherwise lead to markets (and market prices), governments must decide on (1) where and when eco-compensation programs should be used, and (2) appropriate prices for ecosystem services provision (i.e., subsidy rates) within those programs.

The decision to proceed (or not) with a program may be supported by ecosystem service valuation, which indicates the utilitarian benefits of changes to the natural environment. The results of valuation feed into decision-making frameworks such as a benefit-cost analysis, which weighs the expected social benefits of the program against its social costs. A traditional benefit-cost analysis includes direct market values. Applied to an eco-compensation program aimed at increasing forest cover in a watershed, this may entail consideration of the direct market benefits of timber and carbon credits weighed against the cost of lost agricultural output and program administration costs.[a]

Ecosystems services valuation methods may add indirect market values and nonmarket values. In addition to the market values captured in the above example, an ecosystem services valuation would provide a social cost of carbon (i.e., avoided damages from emissions), and benefits of reduced erosion through avoided costs of water treatment due to reduced sediment loads, among others. These would be weighed against the same costs. Other valuation techniques can be used to develop estimates of nonmarket values. Ecosystem services which lack any market value can be assessed using surrogate markets. For example, the value of a landscape is revealed by what visitors paid to reach it (travel cost method), or by the uplift in housing prices in nearby areas (hedonic pricing method). Yet more intangible values may also be quantified, such as the existence value of an endangered species that provides no obvious economic or social benefit. Hypothetical markets, presented in questionnaires, are used to assess these values (contingent valuation and choice experiments).[b]

While indirect market values (and even nonmarket values) considerably expand the decision-making framework relative to traditional approaches, participatory approaches increase their utility further. Ecosystems make contributions to human well-being that go beyond the sum of individual, self-assessed economic welfare (Costanza et al. 2017). Group valuation exercises, using deliberative processes such as multi-criteria analyses and participatory mapping, require stakeholders to converge on a shared assessment of ecosystems values, providing a more community-minded and socially just assessment. Public debate is captured in the values, and the process itself is often valued by participants, strengthening their subsequent commitment to the program.

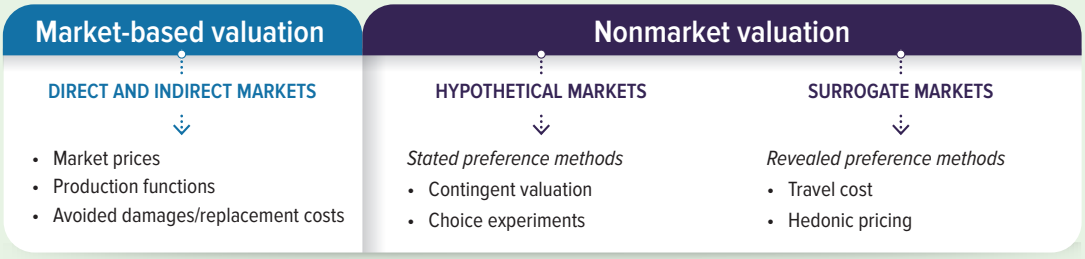
An ecosystem services valuation may also help inform appropriate prices (i.e., eco-compensation rates). Payments should be lower than or equal to the marginal value of the expected ecological outcome for an economically efficient program. In addition, the techniques used to determine nonmarket values, such as choice experiments, may also be used to determine how much landholders will be willing to accept, indicating the likely cost to government of the eco-compensation program a priori. These exercises provide initial indications of the cost of ecosystem services delivery based on survey responses. Once the program is in operation, reverse auction type mechanisms can be used to reveal the true costs. This approach is relevant for programs with voluntary landholders as payees.

Source: Authors.

[a] Note that these costs do not include the cost of payments to farmers; these are transfers (from government to farmers) and thus do not represent economic costs to society. By contrast, a financial analysis would include these payments.

[b] Indirect market and nonmarket values are difficult to elicit; a careful use of benefit transfers can be used to make assessments practical. Benefit transfer takes existing nonmarket valuation studies from other areas and applies them to the area of interest, rather than undertaking new empirical studies. Given differences between the original site and the site of interest, a careful benefit transfer exercise will adjust values to take into consideration the local context (often by constructing a benefits function, a regression fitted to multiple existing studies to build a statistical relationship between observed benefits and site characteristics). While there are challenges with a benefits transfer, even rough values usually improve decision-making over an absence of the value entirely (Richardson et al. 2015).

FIGURE B5.3: An Overview of Economic Approaches for Valuing Ecosystem Services



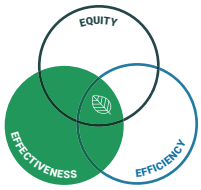
Source: Authors.

of objectives. A systematic analysis would aim to account for all such flows at the national government level, assess what outcomes those flows are achieving (where possible), and establish the degree to which redundancies or gaps exist in funding flows in relation to top-level planning objectives. Such a process would employ well-established international methods.

Recommendation C.3:
Comprehensively review the regulatory framework

A detailed review and examination of the overall regulatory regime could be conducted to complement the public expenditure review. This would focus on the identification and mapping—across sectors and governmental levels—of preexisting regulatory incentives and disincentives for land use and ecological conservation and restoration, as well as other activities that could affect watershed outcomes. The joint ministerial conference proposed in the draft National Eco-compensation Regulation could also help to facilitate such a review.

ENVISIONED OUTCOMES: *EFFECTIVENESS*



Holistic planning would improve effectiveness by facilitating greater impacts at scale and by identifying how eco-compensation programs can best be designed within the current regulatory landscape. Much work in land and water management internationally struggles to achieve impacts at scale; by contrast, China's challenge is to improve the quality of already scaled approaches. The national government's push for provinces to develop watershed eco-compensation programs, and the ongoing expansion of key ecological function zone fiscal transfer eco-compensation, have resulted in significant scale and regional coverage, albeit with significant opportunities for refinement.

Improving impacts at scale will also require a strong national government role. As highlighted in several examples presented in this report, performance metrics and indicators remain insufficient. As was also discussed above, eco-compensation outcomes could be better informed by, and directly linked to, landscape- and basin-level ecological targets developed as part of holistic planning frameworks. Again, the role of providing and refining such science-based frameworks, especially for interprovincial watersheds and eco-regions, is best provided by the national government.

Developing a clearer picture of the larger regulatory landscape in which eco-compensation functions will also help to improve its effectiveness. Though evolving into the national government's stated primary tool for achieving landscape- or basin-wide objectives, eco-compensation is still couched within a larger regulatory framework. Improving understanding of this will help to identify where and how eco-compensation can best fill gaps in management, and how the unintentional creation of additional regulatory conflicts can be avoided. For example, removing preexisting regulatory disincentives (e.g., agricultural subsidies that incentivized adverse environmental outcomes) would be an impactful complement to eco-compensation interventions in some settings.

Identifying where regulatory conflicts exist will also help to create the conditions for more effective programs. For example, water pollution emissions trading pilots have faced barriers due to conflicting elements of the regulatory system. As noted in the example of the Tai Lake emissions trading pilot (box 4.4), initial tension between the older command-and-control regulations and the new flexible market system hampered firms' willingness to trade, and risked double charging participating firms (Zhang, Zhang, and Bi 2012).

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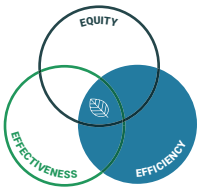

Holistic planning would improve efficiency by facilitating a more strategic assessment of the best division of roles and responsibilities between central and subnational governments. Those ecosystem services with disperse beneficiaries and suppliers often require a greater national or provincial government role to achieve effective outcomes. Conversely, cases where beneficiaries and/or suppliers are more concentrated can be left for local governments or even business sector interests (in the cases of the most concentrated services provision or use, such

as local watersheds) to address. Landscape-scale holistic planning frameworks would also identify the distribution of the providers and beneficiaries of specific ecological services.

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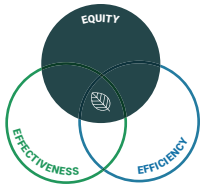

Holistic planning frameworks can also increase equity by strengthening the ability to achieve rural welfare co-benefits along with ecological outcomes. Holistic planning includes mapping of the distribution of socioeconomic conditions and land uses across targeted landscapes. While this facilitates a more cost-effective program design by better informing estimates of participant opportunity costs and constraints, this also creates opportunities for identifying locations within landscapes where synergies might exist in achieving both ecological and socioeconomic targets. The government has been placing significant emphasis on better incorporating rural welfare co-benefits in eco-compensation programs, along with its rural revitalization strategy.

TARGET AREA D. MORE EFFECTIVE PLATFORMS AND PROTOCOLS FOR INTERAGENCY AND INTERPROVINCIAL PLANNING, JOINT DECISION-MAKING, AND CONFLICT RESOLUTION

As recognized by the national government, platforms for interagency and interregional communication, joint planning, decision-making, and conflict resolution are essential for good basin-level governance, and could be further improved. Gaps in this area remain a key challenge to more effective management of shared landscapes and watersheds, not only for interprovincial watersheds such as the Yangtze and Yellow Rivers, but within province landscapes where planning and management have traditionally been siloed by agency and governmental level (see chapter 2). The government's vertical management reforms and consolidation of environmental responsibilities into the Ministry of Ecology and Environment (MEE) and the Ministry of Natural Resources (MNR) are major steps forward, and the government continues to emphasize the importance of coordination, including via the development of basin-level bodies for both the Yangtze and Yellow Rivers. In the absence of sufficiently strong interagency and interregional authorities, whole basin and whole eco-region management goals will be unachievable through disparate and disconnected provincial interventions. The following recommendations allow for more effective platforms and products for planning, decision-making, and conflict resolution:

Recommendation D.1: Establish platforms for joint decision-making on basin-level planning

Platforms for joint decision-making and planning between the key agencies and provincial governments in the Yangtze and Yellow River basins should be established and strengthened. Current river basin commissions serve an advisory role, with no institutional mechanisms for bringing in provincial governments or other ministries for joint governance activities. Furthermore, they lack the seniority to motivate other governments or ministries. The stronger basin-level management authorities as described in Recommendation A.1 thus have a valuable role to play, and should explicitly incorporate such joint decision-making and planning components into its institutional and governance structures. The joint ministerial conference proposed in the draft National Eco-compensation Regulation could also help to facilitate this.

Recommendation D.2: Develop institutional channels for interagency and interregional knowledge sharing

Stronger interagency and interregional coordination and cooperation platforms and channels should be created. One approach could be to create specific departments within each ministry—analogous to the traditional international cooperation departments—whose sole purpose would be to interface with different agencies and regional levels of government and facilitate knowledge sharing. Another approach would be to use the basin-level authorities suggested in Recommendation A.1 as platforms for such

sharing. The joint ministerial conference proposed in the draft National Eco-compensation Regulation could also help to facilitate and operationalize more formalized and explicit mechanisms for effective knowledge sharing.

Recommendation D.3:
Develop mechanisms and protocols for conflict resolution

Mechanisms and protocols for conflict resolution among key stakeholders are core components of effective basin-level governance regimes. Again, such mechanisms could be housed within the strengthened basin-level authorities proposed in Recommendation A.1. Conflicts can also be reduced through work to clarify property rights in environmental markets, as per *Guiding Opinions on Promoting Reform of the National Resources Asset Property Rights System*,[56] and the identification and removal of conflicts in the regulatory regime, as per Recommendation C.3.

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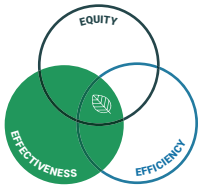
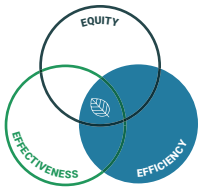


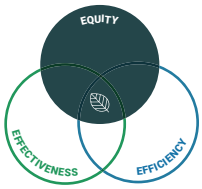
Integrated basin-level authorities will help to improve effectiveness by better coordinating the disparate activities of the provinces. As a platform for information sharing, such authorities would also help to accelerate innovation and adaptation. This would occur via improved channels of information sharing and cross learning, and the improved facilitation of interregional joint management approaches such as interprovincial eco-compensation schemes. Improved conflict resolution will also help to align incentives and better incorporate regional issues and constraints into planning frameworks, thereby improving outcomes.

ENVISIONED OUTCOMES: *EFFICIENCY*



Efficiency would be improved by reducing transaction costs for the establishment of intergovernmental agreements. A basin-level authority could help reduce transaction costs through joint planning and management, and through improved conflict resolution and communication. Furthermore, strong conflict resolution mechanisms, combined with clarifications of property rights and reduced regulatory overlaps, will give the economic actors in eco-compensation programs and environmental markets the confidence required to participate (larger numbers of participants and trade volumes generally improve efficiency).

ENVISIONED OUTCOMES: *EQUITY*



Better incorporating the needs and constraints of the different economic and governmental actors into planning and management frameworks and scenarios would improve equity. This includes serving the valuable role of arbitrating trade-offs and conflicts between users within different parts of the basin to ensure that basin-wide distribution of the costs and benefits of sustainable river basin management is sufficiently equitable to incentivize the participation of all key stakeholders in basin-level management frameworks.

TARGET AREA E. ADOPTION OF ADAPTIVE AND PARTICIPATORY DESIGN AND IMPLEMENTATION APPROACHES

Building flexibility and adaptivity into both monitoring and management frameworks are critical for addressing uncertainty and improving outcomes. Rapid and complex social, economic, and environmental changes, and the uncertainties inherent in climate change and climate change impacts, can all conspire to challenge and potentially upend systems based on overly programmatic and rigid policy interventions and ecological targets. Effective management requires the ability to continually update assumptions, approaches, goals, and metrics based on the current state of science, experience, and changing realities on the ground. The following recommendations are aimed to support adoption of design and implementation approaches:

56 GOCCCPC and GOSC (2019).

Photo: Terraced fields along Leaping Tiger Gorge, Yunnan Province, China. iStock.

Recommendation E.1:
Build adaptivity into monitoring systems

Adaptivity should be explicitly built into environmental monitoring systems to account for uncertainty and improve management capacity. This could include creation of specific teams and protocols for updating monitoring technology, and for experimenting with new approaches to help lower costs. Data collection and integration activities under Recommendation A.2 could serve to facilitate such updating, with the strong basin-level authorities in Recommendation A.1 functioning as the platform for dissemination of improved and updated monitoring technologies, standards, and protocols. Monitoring outcomes could also incorporate measurements of accuracy and statistical significance, with standards for these continually refined and updated.

Recommendation E.2:
Expand the use of market-based mechanisms

Adoption of market-based mechanisms should continue to be promoted, where appropriate, as a means to make management frameworks more adaptive. As socioeconomic and environmental conditions change, so do relative prices in an economy, such as the value of ecological benefits and the opportunity costs of ecological services provision. Market-based mechanisms explicitly allow for adjustments in subsidy rates or compensation types to best accord with these changing relative prices. Greater adoption can be facilitated and promoted through the training and technical support activities outlined in Recommendations B.1 and B.2.

Recommendation E.3:
Promote adaptive, joint, or integrated management mechanisms

Approaches that closely and effectively partner with the local governments, households, and communities that supply targeted ecological services should be promoted and scaled up. The training and technical support activities detailed in Recommendations B.1 and B.2 can serve to support and facilitate the exploration of these approaches. The knowledge sharing platforms outlined in Recommendation B.3 can also help to identify promising examples to pilot and emulate.

The co-management should be part of an overall balance between top-down and bottom-up program development processes. National and provincial governments have

essential roles to play in program development. In contexts with significant collective action problems, for example, top-down goal setting and design might be necessary to catalyze changes in management and achieve targeted outcomes. Technical issues, such as appropriate land use measures and locations to achieve targets, are also best addressed and resolved by technical experts (see Recommendation B.2). However, once a menu of options for interventions is developed, consultations with communities are key to identify trade-offs, feasibility, and costs.

Recommendation E.4:
Use lessons learned in co-management to create guidelines and protocols

The process of better capturing and utilizing knowledge could be made more explicit by developing guidelines and protocols. This would involve identifying the factors that lead to success and the pitfalls to avoid, and using these to create guidelines and protocols for use in other settings. Program tracking and periodic evaluation along various socioeconomic and environmental dimensions—e.g., ecological outcomes; leakage to other areas; program impacts on income, structure of livelihoods, and community equity; household and community attitudes and awareness; and changes in these—could be made an explicit part of program development from early stages. Program impact evaluation methodologies are well developed internationally, and should be an important knowledge area to include in the training and technical support activities outlined in Recommendations B.1 and B.2.

Recommendation E.5:
Minimize equity-efficiency trade-offs via stronger guarantees of voluntarism[57]

Program participation should be made strictly voluntary—where appropriate[58]—to minimize potential equity-efficiency trade-offs in program implementation. One of the most effective mechanisms to ensure that both rural household and community welfare are not adversely impacted by eco-compensation programs, and that ecological service provision is cost-effective, is to simply ensure that programs are voluntary. Households for whom subsidy rates do not offset opportunity costs will choose not to participate, while those households and communities who can provide services at lowest cost will be more willing to participate. An even more effective approach used internationally is "reverse auctions," whereby potential program participants "bid" to participate in the program (i.e., state the lowest subsidy they would need to receive in order to be willing to participate), with lowest bids per unit service provision enrolled into the program first. To accord with the realities of rural China, reverse auction mechanisms could also be applied at the village level, whereby whole villages would "bid" to be ecological services providers.

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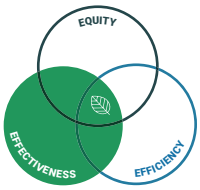

Adaptivity in monitoring and management frameworks would improve effectiveness along a range of dimensions. This includes improving the identification of key ecological targets and goals through a more adaptive and up-to-date monitoring system, improving rural program outcomes through more effective collaborations with rural households and communities, and facilitating more effective scaling up via development of protocols and guidelines from experience.

As discussed in section 3.4, eco-compensation programs remain predominantly top-down in design and implementation, with low scores for co-management. In the case of the Conversion of Cropland to Forest Program (CCFP), for example, initial stages involved limited local consultation in design and implementation, and so participant farmers and local governments were unclear on program goals and requirements. The development of watershed eco-compensation programs has also progressed in a primarily top-down fashion. Insufficiently consultative and collaborative problem solving, target setting, and program design also raise the risk that stakeholders not vested in program outcomes will undermine those outcomes via hard-to-monitor actions. Giving stakeholders a sense of

57 Equity efficiency trade-offs occur when ecological outcomes are weakened or made more costly due to the joint pursuit of equity goals.

58 Some eco-compensation programs provide payment in exchange for regulatory takings. These are inherently nonvoluntary programs and so are not targeted by this recommendation.

ownership through engagement and consultation can, by itself, help to improve the durability of outcomes.

This sense of ownership will be critical for China to effectively address its largest source of water pollution: rural nonpoint source pollution. This comes from an agricultural sector dominated by more than 250 million household farmers (Huang, Wang, and Qiu 2012). While rural nonpoint source pollution has yet to be explicitly targeted in eco-compensation policies, most current watershed management eco-compensation schemes necessarily involve the rural sector, and so improving approaches to engage with communities will be critical for ensuring outcomes. Greater adoption of market-based mechanisms will also give programs the ability to rapidly adjust program subsidy or payment rates to reflect changing relative prices in the economy due to changing conditions.

The process of ongoing refinement of eco-compensation approaches can, by itself, be a valuable exercise in capacity-building and process-based management. While the process of improving ecological management requires a "destination" or set of goals, these are simply milestones in what is an ongoing and adaptive process. Often there is a perception that specific "preconditions" are needed in order to begin to develop certain types of management capacity and mechanisms. In reality, the process is what develops many elements of these preconditions. The US experience in developing water quality trading programs highlights this observation. While these trading programs are meant to be innovative mechanisms for addressing water quality management challenges, many US local governments have benefited simply from embarking on the process of their development, and faced similar institutional and capacity gaps like many local governments in China. That the national government is encouraging provincial development of eco-compensation programs is partly due to recognition of this. Such encouragement should continue, based within a framework of appropriate support and capacity-building that can do much to help to catalyze improvements in environmental management more broadly.

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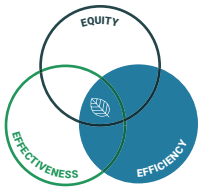

More effective engagement partnership building with rural communities can also help to identify ways to reduce program costs. Costs can be reduced via better incorporation of local knowledge in program design and management approaches, and the engendering of a local community "sense of ownership" of programs, which would incentivize an ongoing search for more efficient approaches for achieving outcomes (box 5.4). Not all communities in all contexts require cash compensation to be willing to engage in programs for improving the local environment. Strong community consultation during all stages of program design can help to identify lower-cost options for compensation and program support.

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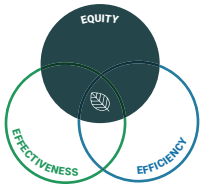
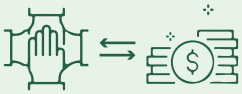


By making programs more about "win-win" outcomes through the consultation and joint development process, equity issues can be more effectively addressed. Rural communities will be unwilling to engage in programs that do not provide them with appropriate benefits to offset their costs, be they opportunity costs, program implementation costs, or other costs created through program interventions. A clear consultation with communities to identify these costs and other issues will ensure that the program design will achieve the goal of improving equity.

Box 5.4:

Stakeholder Consultation for Identification of Cost-Saving Designs: an Example from Poyang Lake



The experience in Jiangxi for protecting Poyang Lake wetlands shows ways in which consultation can improve the cost efficiency of the design. Research on participant preferences suggested that a range of compensation types could be suitable, in addition or apart from the traditional direct cash used in most programs. Research also suggested that framing subsidies as compensation for crop damage due to wetlands wildlife incursions risked engendering a victim-offender dynamic between communities and the local nature reserve.

By incorporating these findings into program design, participatory approaches could help improve outcomes, lower costs, and build social acceptance, which are important in a context of rapid socioeconomic change. Consultations with communities in and around the Jiangsu Yancheng Coastal Wetlands National Nature Reserve identified lower cost compensation options, minimizing the need for direct cash subsidies in some cases. Crop data collected from these consultations revealed that despite perceptions to the contrary, wetland birds were an insignificant source of crop damage compared to other factors, including weather conditions, insects, and fungal pests, with important implications for program development.

Source: Authors based on Bennett, Gong, and Scarpa 2018.

CHAPTER 6.
Conclusion

Photo: A bend in the Yangtze River in Yunnan Province, China. iStock.

China's drive to address its complex environmental and ecological management challenges is impressive.

Eco-compensation's rapid expansion in recent years embodies this drive. Governments across China have achieved significant scale in eco-compensation programs, but there remains much that can be done to improve how well these programs achieve their targets. In addition, despite the enormous scale of China's challenges and significant achievements, the rest of the world knows relatively little about these programs.

The goal of this report has been to shed light on China's eco-compensation policy and program developments, provide recommendations on how these programs can be improved, and begin to synthesize the valuable insights provided by efforts to date. While China is unique, it can offer important insights from its eco-compensation experience for the rest of the world. Important caveats, of course, exist: few countries have China's financial resources, nor its multi-layered government reach and implementation capacity. Nevertheless, the empirical and qualitative assessments of programs conducted for this report offer at least four broad insights that may be useful for other countries:

1. The value of allowing flexibility in how programs are developed:

Allowing flexibility on the ground is as an important factor in the successful expansion of eco-compensation across China. "Adaptation to local conditions" (因地适宜) has been a motivation for China's local capacity-building via learning by doing, and has been an important part of the national framework programs. In these programs, the national government provides funding and broad guidelines, and also provides subnational governments with the latitude to interpret and adapt them. In more recent developments, such as intra-provincial cross-border eco-compensation programs, the national government has again created broad policy guidelines, strongly encouraged provinces to develop these programs, and provided support for piloting and some capacity-building to facilitate this process, again leaving provinces latitude in how these programs are developed. Flexibility is also facilitated through blended government finance opportunities wherein local governments have some ability to mix and match different tranches of national government funds, for example, the Forest Ecological Benefit Compensation Fund (FECF) combined with local matching funds. Other countries may similarly be able to apply such flexible framework approaches.

2. The value of striving for scale in the early stages of program development:

Much work in environmental management internationally struggles with the challenges of achieving impacts at scale. Often interventions and approaches are carefully piloted and refined to address specific local conditions, but are not easily adapted to a broader range of contexts. The Chinese government has generally approached policy development from the other end of this spectrum, by focusing on achieving scale rapidly and then later refining interventions (although piloting remains an important part of this process).[59] For example, the national government's push for provinces to develop watershed programs, and the ongoing expansion of key ecological function zone fiscal transfer eco-compensation, have resulted in significant regional coverage. Now that these scaled but shallow program frameworks are in place, many opportunities exist for introducing impactful improvements in program designs and approaches. This is a valuable paradigm for other countries that face broad diversities of conditions but need to address environmental management at scale. This is not to discount the value of piloting to address the specifics of local conditions—China used pilots effectively to inform scaling and subsequent refinements (although many of those pilots would be significantly improved if paired with more rigorous tracking and evaluating of program impacts and drivers of success).[60] Nevertheless, China's experience suggests that scaling while also using

59 Even with piloting, scale-up is often fast. In the case of the Conversion of Cropland to Forest Program (CCFP), for example, the pilot initially started in the three provinces of Sichuan, Shaanxi, and Gansu in 1999. By the end of the pilot phase in 2001, it had scaled up to 20 provinces, with 1.2 million hectares (ha) enrolled. This further jumped to 7.1 million ha by the end of 2003 (Xu et al. 2004; Bennett 2008). Many intra-provincial cross-border eco-compensation programs have similarly quickly scaled up to the whole province, though they still need to refine mechanisms and evaluation frameworks.

60 For example, by using rigorous program impact evaluation methodologies with data collected for both participants and nonparticipants (treatment versus control) to construct plausible counterfactuals.

flexible implementation approaches can include finding a valuable middle ground.

3. The value of using programs as capacity-building processes:

China's experience also suggests that embarking on program development, by itself, can serve as a valuable entry point to capacity-building, leading to improved management. Often discussions of more "advanced" market-based approaches include the importance of "preconditions" (e.g., having a strong water management agency with consolidated responsibilities, and with clear legal authority to issue and enforce allowances). In practice, however, such approaches can be developed in contexts where such preconditions don't exist or are relatively weak, and still obtain valuable results. The US experience in developing water quality trading programs highlights this observation: many US local governments at times faced similar institutional gaps as local governments in China, yet they benefited simply from embarking on the program development process. China's encouragement of provincial development of eco-compensation programs suggests that it recognizes this underlying value, and as highlighted in chapter 2, eco-compensation has been serving as a valuable vehicle to promote and establish the preconditions themselves. This must be balanced with ambitions for rapid scaling (as above) which requires some baseline of capacity.

4. The value of monitoring, information sharing, and transparency:

Gaps in monitoring, information sharing, and transparency in China have potentially resulted in some missed opportunities to improve program design and adaptation, as well as potential missed opportunities to tap into wider sources of finance for environmental management. While programs in China are benefiting from recently improved monitoring and data sharing, particularly around water quality, additional improvements are needed, including in the breadth of data collection and the sharing of environmental and program data. Making data available to a wider range of institutions (such as universities), and/or the public, promotes objective and rigorous evaluation, helps make systems more adaptive, and opens opportunities for private sector involvement. It can also lower costs for the government by creating opportunities for collaboration with academia and the private sector to innovate on monitoring approaches and technologies. Other countries can avoid missing such opportunities by adopting rigorous monitoring and data transparency measures early on.

The scale and diversity in eco-compensation program developments in China suggest that these broad insights are only the tip of the iceberg. Many of the program "types" described in this report encompass significant diversity in either formal or de facto program designs and implementation approaches, especially at provincial and sub-provincial levels. Greater data transparency, combined with fieldwork and ground-truthing, would allow for the development of a more complete picture of current programs, and a greater ability to link programs with outcomes. Combined with best practice in program impact evaluation methodologies, this could not only improve attribution but—given wide diversity in socioeconomic, institutional, and ecological contexts—could unlock additional insights regarding how these contexts influence and interact with program design elements to deliver targeted outcomes.

Such work could also serve to inform the key role eco-compensation has to play in China's global environmental commitments. Better identification of what programs can most easily be refined to better capture biodiversity and carbon co-benefits, and how such programs and the relevant wider regulatory framework can best be refined to expand financing opportunities, could do much to help China achieve its commitments under the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). Moreover, better understanding of its own experience could inform mitigation measures to minimize the environmental footprint of its growing global infrastructure investments, as well as inform international best practice, which would strengthen China's role as a global development partner.

China's success with eco-compensation at scale is motivating new programs, as well as efforts to further improve existing programs. The scale of coverage already achieved suggests that with relatively minor tweaks, major gains in effectiveness, efficiency, and equity can be captured. Development of more holistic planning frameworks, stronger river basin management authorities, greater technical and capacity-building support to provinces, improved monitoring, and greater adoption of adaptive and participatory program development approaches can all serve to advance progress. Greater monitoring and transparency in program outcome data-sharing will facilitate these advances and help promote China's important lessons to the world.

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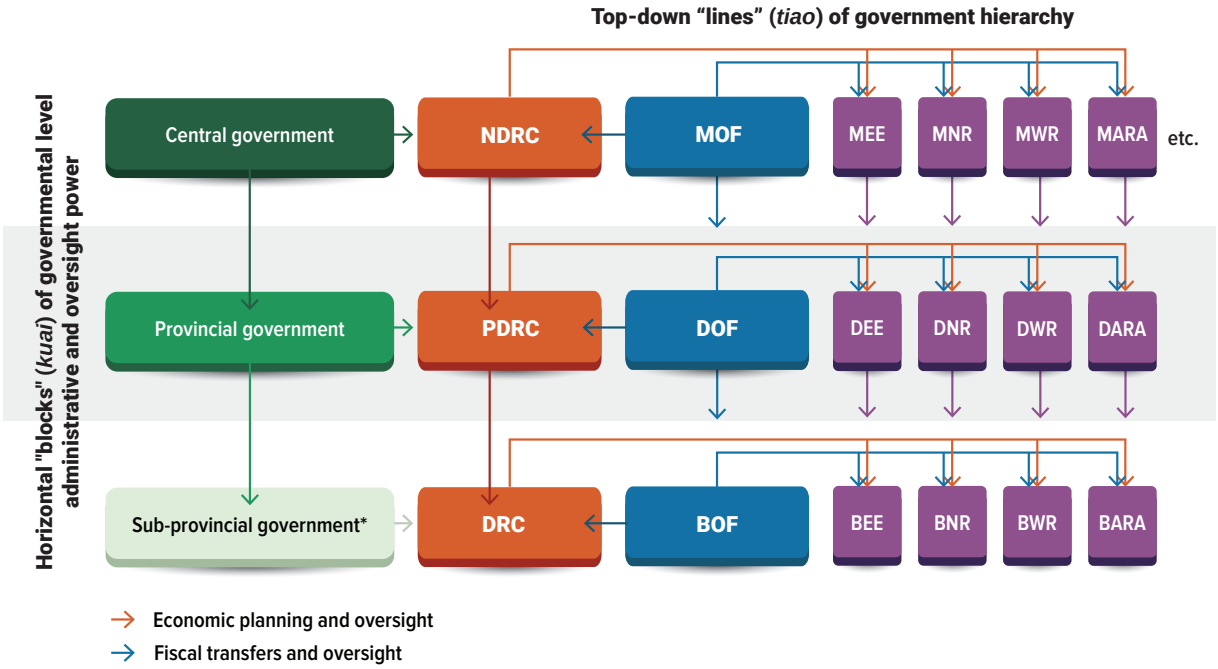
APPENDIX A:

China's Environmental and Fiscal Governance System

Eco-compensation has become an increasingly important component of China's environmental governance and fiscal system. As a fiscal and cross-governance coordination tool, eco-compensation is part of the fiscal and organizational structure of the Chinese government. China's environmental management system began taking shape in the 1970s and was formalized in the *Environmental Protection Law* of 1989 (Zhou 2020). It is supervised by the National People's Congress and has been managed by the relevant national environmental protection authorities—now the Ministry of Ecology and Environment and the Ministry of Natural Resources—with the onus of implementation and performance responsibility on provincial and sub-provincial governments and agencies (Zhou 2020; Cai et al. 2015; PRC 2014).

The Chinese government is structured with overlapping vertical and horizontal lines of management and oversight, traditionally termed the tiao-kuai (条块) system (Lieberthal 1997)**.** This consists of the horizontal "blocks" (*kuai*) of governmental levels (i.e., national, provincial, municipal, county, and township) overlaid by the vertical "lines" (*tiao*) of the top-down hierarchical relationships within agencies (figure

FIGURE A.1: Chinese Government Fiscal and Organizational Structure, with an Emphasis on Environmental Management



Abbreviations: NDRC = National Development and Reform Commission; MOF = Ministry of Finance; MEE = Ministry of Environment and Ecology; MNR = Ministry of Natural Resources; MWR = Ministry of Water Resources; MARA = Ministry of Agriculture and Rural Affairs. Subnational agencies simply sustitute the M for a D = Department or B = Bureau with the exception that PDRC = Provincial Development and Reform Commission and DRC = Development and Reform Commission (at the relevant level of government).
Note: Management and fiscal transfers generally go to municipalities then counties, but some provinces have direct province-county management and funding linkages.
Source: Adapted from Deng et al (2016), Shah and Shen (2006), Zhou (2020).

A.1). This overlapping system has resulted in environmental management conflicts; for a given subnational agency, both its regional level of government and its superior counterpart agency exert degrees of management and oversight authority (Zhou 2020; Deng et al. 2016). This has created conflicts wherein the local protectionism of the "blocks" overrides the hierarchical "lines" of the superior agency, impeding effective implementation of national environmental policy (Eaton and Kostka 2014; Mertha 2009).

China is one of the most fiscally decentralized countries in the world, with 85 percent of government spending occurring at subnational governmental levels (Wingender 2018).[61] The fiscal reforms in 1994, which created the State Administration of Taxation and a rules-based revenue-sharing and intergovernmental transfer system, strengthened the national government's ability to conduct fiscal policy and redistribution across regions. However, as the national government took a larger share of local revenues, these reforms also left local governments initially struggling with budgetary shortfalls and increasing local government fiscal dependence on sales and value added tax (VAT) from local enterprises (Brondolo and Zhang 2017; Ahmad, Singh, and Fortuna 2004; Wang and Herd 2013; Qiao and Liu 2013; Shen and Jiang 2020).

The national government's spending power is one of its most important tools to influence regional governments. Sub-provincial governments are the key implementers of national government policy (Shen and Jiang 2020; Zhou 2020). Central-provincial and provincial–sub-provincial fiscal transfers remain the dominant source of revenues of subnational governmental levels in China. These take the form of ongoing "general-purpose transfers" (一般性转移支付) and one-off "special-purpose transfers" (专项转移支付). Both transfer types are important tools of the national government for incentivizing subnational governments to achieve national objectives and for influencing and aligning local priorities (Zhou 2020; Wingender 2018; Shah and Shen 2006).[62]

Fiscal transfers are made vertically to the next subordinate level of government, so that the national government makes transfers to provincial governments, provincial governments to municipal or county governments, and so on. All such fiscal transfers are conducted between the finance departments of the respective government levels, after which funding is distributed from finance to the individual departments of the respective levels of government. As a result, the financial departments are important gatekeepers of funding flows. Generally, no central to sub-provincial fiscal transfer channels exist, nor do they for interprovincial transfers whereby one province provides transfers to a sub-provincial government in another (Shah and Shen 2006). Where eco-compensation programs require such transfers, they rely on provincial agreements.

An exception to this is China's "paired assistance" or "counterpart support" (*duikou zhiyuan*, 对口支援) programs, which have been in existence since the 1960s. These consist of central government-facilitated cross-regional government fiscal and technical support transfers from more to less developed regions and provinces to address disaster relief, poverty alleviation, and economic development funding shortfalls. For example, mobilized funding via these paired assistance channels was important for disaster relief during the severe flooding in the Songhua and Nen Rivers in Northwest China in 1998, during the Wenchuan Earthquake in Sichuan Province in 2008, and for combating COVID-19 in Wuhan in 2020 (Zhong and Lu 2018; Zhang and Tao 2018; Hu et al. 2020). However, despite the existence of these paired assistance programs, and the fact that the government has advocated the establishment of horizontal fiscal transfer payments since the reforms of 1994, there has as yet been no substantial progress toward embodying these programs in a strong legal and institutional foundation. These programs thus generally require national government facilitation to function (Yang 2018).

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61 This increase to 89 percent when including local government financing vehicles.

62 In 2003, for example, these transfers financed 57 percent of prefecture and 66 percent of county and lower level expenditures (Shah and Shen 2006). A third group of transfers, "compensation transfers," has also existed to reduce revenue loss accruing to some local governments after the 1994 reforms. In 2011, general transfers made up 46 percent, special transfers 42 percent, and compensation transfers 12 percent of total fiscal transfers from the national government (Wang and Herd 2013).


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