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KEY POINTS

- Agricultural nonpoint source pollution has improved over the last decades but is still the main source of water pollution in the Xin'an River Basin.
- After three rounds of implementation of an eco-compensation mechanism, the water quality of the Xin'an River Basin and Qiandao Lake has improved, contributing to the overall protection and coordinated development of the basin's upstream and downstream areas.
- However, substantial gaps remain to sustainably finance eco-compensation schemes, create inclusive and equitable disbursement processes, and effectively curb remaining nonpoint source pollution. The dual Green Incentive and Investment Fund is an example of innovative financing mechanisms that can help address the remaining gaps.

Innovative Finance Mechanisms to Protect Water Resources in the Xin'an River Basin

Mingyuan Fan
Principal Water Resources Specialist
Asian Development Bank

Silvia Cardascia
Water Resources Specialist
Asian Development Bank

Christian Fischer
Consultant
Asian Development Bank

Kevin Chen
Qiushi Chair Professor and International Dean
China Academy for Rural Development
Zhejiang University, and
Senior Research Fellow
International Food Policy Research Institute

INTRODUCTION: XIN'AN RIVER BASIN AND HUANGSHAN

The Xin'an River watershed is the "water tower" of the Yangtze River Delta region,[1] supplying drinking water to and ensuring key ecosystem services for more than 10 million people. It originates at the confluence of the Hengjiang River and Shuaishuai River in Huangshan Municipality and Anhui Province and flows into the Qiandao Reservoir in Zhejiang Province before reaching the body of water at the city of Hangzhou.

Notes:
ADB recognizes "China" as the People's Republic of China.
In this publication, "$" refers to United States dollars.

[1] The Yangtze River Economic Belt (YREB) is one of the main economic engines of the People's Republic of China (PRC). Despite extensive growth and increasing environmental awareness since the late 1980s, the YREB faces development challenges from increasing pollution and extractive activities that degrade natural resources. Against this background, the Government of the PRC formulated the YREB Development Plan 2016–2030 in 2015 to prioritize ecological protection and promote green development as the guiding principle for the YREB's future growth.

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In the 1990s, increasing eutrophication compromised water quality downstream of Qiandao Lake.[2] While extensive agricultural nonpoint source pollution has been substantially reduced, it remains the main source of water pollution. Against this background, there is growing awareness of the importance of investing in nature-based solutions (NBS) as effective measures to reduce pollution and restore ecosystems while mitigating and adapting to climate change impacts including increased flood and drought risks.

NBS can provide multiple co-benefits to the environment, public well-being, and sustainable economic growth, but they face a significant funding gap globally. In its 2020 Adaptation Gap Report, the United Nations Environment Programme identified adaptation investment needs of more than $140 billion per year by 2030.[3] Therefore, innovative financial and policy mechanisms are crucial for watershed protection, especially when a watershed's upstream areas forego development opportunities and/or invest in environmental protection to provide downstream areas with sufficient quality water.[4] Box 1 defines eco-compensation and NBS.

Box 1: Eco-Compensation and Nature-Based Solutions

Eco-compensation refers to the set of fiscal public policy tools to protect ecosystems and natural resources by compensating for environmental damage. Eco-compensation policies and programs aim to duly factor in the opportunity costs of foregone development by reducing environmental externalities and valuing nature's ecosystem services. The traditional approach includes government payments directly to ecosystem service providers. Nature-based solutions (NBS), defined as "actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature," can be used in combination with eco-compensation policies.[a]

[a] International Union for Conservation of Nature (IUCN). Nature-Based Solutions. https://www.iucn.org/theme/nature-based-solutions.

Source: Authors' own elaboration.

TRANSBOUNDARY ECO-COMPENSATION AND NATURE-BASED SOLUTIONS IN ANHUI AND ZHEJIANG PROVINCES TO PROMOTE ECOLOGICAL RESTORATION OF THE XIN'AN RIVER

Acknowledging the ecological importance of the Xin'an River, the Ministry of Finance and the former Ministry of Environmental Protection signed a joint agreement with two upstream–downstream provinces in the basin (Anhui and Zhejiang) on water quality compensation in Xin'an River in 2012. The implementation of this agreement established the first transboundary (or "horizontal") ecological compensation pilot of the PRC as a mechanism to address cross-provincial water quality concerns in the Xin'an River Basin.

By the end of 2020, three rounds of eco-compensation were piloted along the Xin'an River, with a total investment of $3.4 billion. Over 10 years, the central government and provincial governments of Anhui and Zhejiang contributed a total of $797 million (Map). These public compensation funds were disbursed in the three rounds of the pilot: $314 million invested by the central government, $229 million by Zhejiang Province, and $254 million by Anhui Province (Figure 1). The three tranches were jointly disbursed to the Huangshan Municipality and Jixi County. The remaining $2.1 billion came from the green development fund and public–private partnership program, for which no granular data have been published yet. During the first round, a total of $1.7 billion was invested into 261 projects across five categories: (i) rural nonpoint source pollution, (ii) urban sewage and solid waste treatment, (iii) industrial point source pollution remediation, (iv) ecological restoration projects, and (v) capacity building. A total of $700 million was invested in the second round and $1 billion in the third round of eco-compensation pilot projects.

The Xin'an River ecological compensation fund has been key to funding NBS including comprehensive environmental treatment, water pollution prevention and control, ecological protection, industrial structure adjustment, industrial layout optimization, and other conservation activities to restore the upstream watershed. As a result, the water quality of the Xin'an River Basin has improved, promoting the overall protection and coordinated development of the basin's upstream and downstream areas, with eco-compensation as the main incentive mechanism.[5]

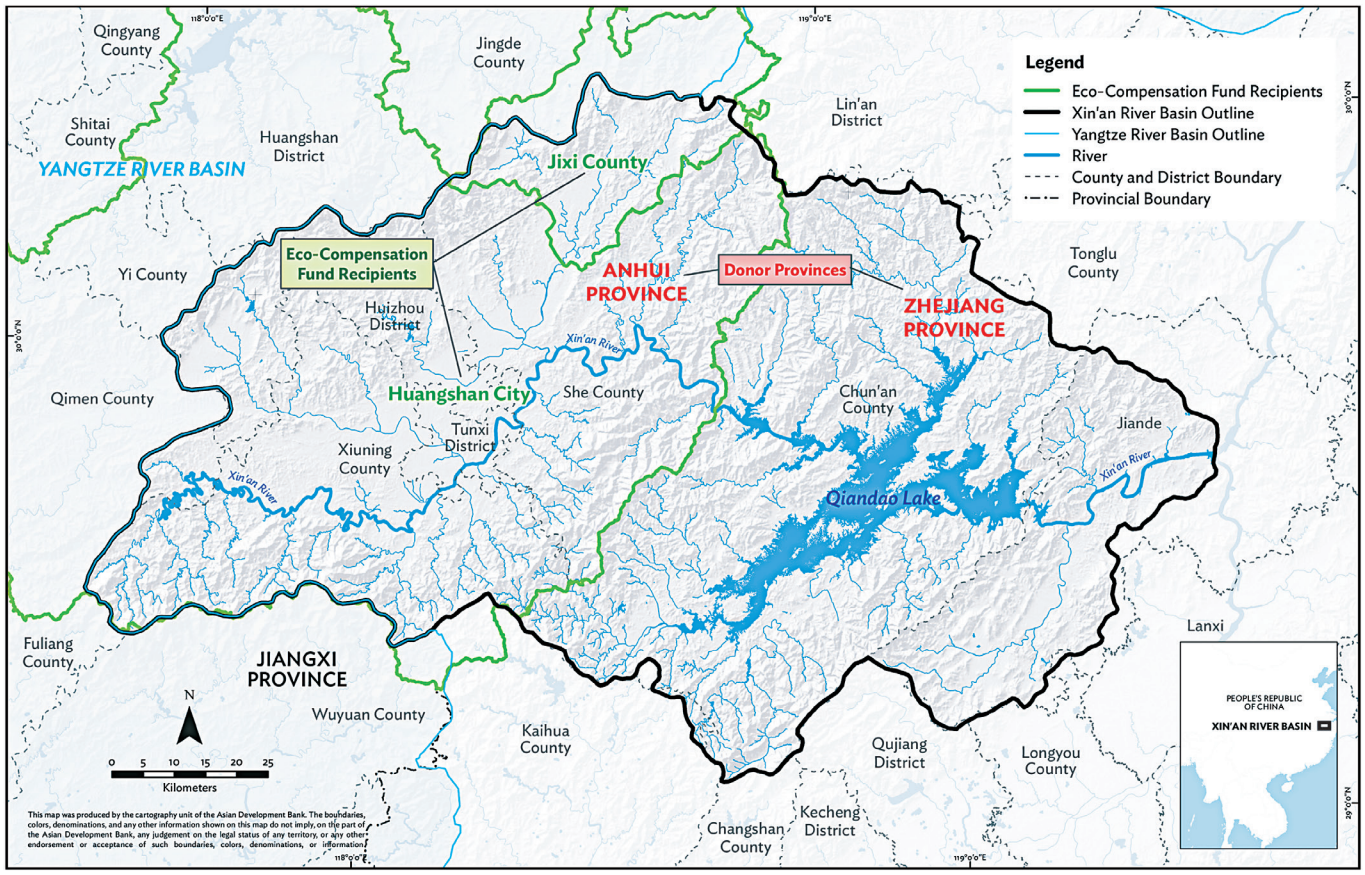
[2] Eutrophication is the excessive richness of nutrients in a lake or other body of water, frequently due to land run-off, which causes a dense growth of plant life or algal blooms.

[3] United Nations Environment Programme. 2021. *Adaptation Gap Report 2021: The Gathering Storm – Adapting to Climate Change in a Post-Pandemic World*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

[4] To support the cleanup and sustainable development of Xin'an River, the Asian Development Bank (ADB) approved a $100 million loan for the Anhui Huangshan Xin'an River Ecological Protection and Green Development Project in December 2019. This was part of the ADB–PRC development program for the YREB. The project, currently under implementation, is piloting innovative green finance mechanisms to reduce rural pollution and complement the ongoing cross-provincial eco-compensation scheme, which was launched in 2010. The project helps close the adaptation investment gap by supporting green development efforts of agroecological businesses with a dual fund mechanism: The Cross-Provincial Eco-Compensation Green Investment Fund (GIF) and the Green Incentive Mechanism (GIM).

[5] Ecological Environment of Huangshan Municipality. 2020. *Bulletin on Ecological Environment of Huangshan Municipality*. Huangshan City. The value of water quality stability coefficient K increased from 0.85 in the first round to 0.89 in the second round and 0.90 in the third round. Consultant Report. Huangshan.

Map: Xin'an River Basin Indicating the Donors and Recipients of Eco-Compensation



Source: Asian Development Bank.

A series of water and soil pollution control practices have been particularly impactful in improving the basin's water quality, including fertilizer and pesticide reduction, use of pesticides with lower toxicity, emission reduction for livestock breeding, as well as treatment of sewage and solid waste in rural areas. Box 2 describes how Huangshan's eco-beauty market has improved the city's garbage disposal, which helps clean the river.

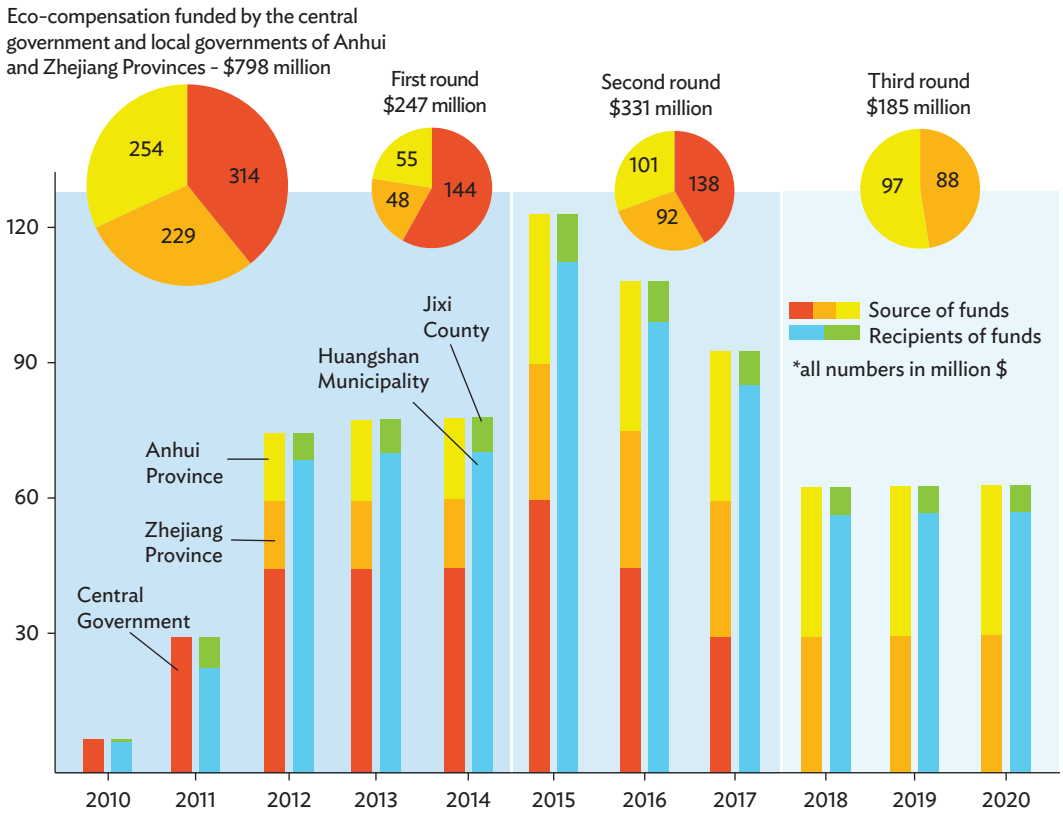
The basic principle of ecological compensation in the Xin'an River is the beneficiary payment system. The upstream and downstream areas established a valuation adjustment mechanism agreement considering the mutually agreed compensation criteria (the compensation index P).[6] The Xin'an River scheme for the PRC transboundary watershed ecological compensation is generally regarded as a successful model. Its guiding principle "shared interests and shared responsibilities" has been widely applied to many other smaller watersheds in the PRC, setting a precedent for transboundary eco-compensation in the Yellow River.[7] At the same time, a set of comprehensive water-related environmental treatment measures were initiated.[8] However, despite the remarkable achievements of the Huangshan model, a long-term mechanism for environmental preservation and control has yet to be established.

[6] The compensation index $P = KK \times \sum_{ii=1}^{4} KK_{ii}\, CC_{ii}$, KK refers to the water quality stability coefficient. The P value is based on the permanganate index, ammonia nitrogen, total nitrogen, and total phosphorus of the cross-border section of Anhui and Zhejiang provinces along Xin'an River. Anhui Province compensates Huangshan Province accordingly if P is greater than 1 or a major water pollution accident occurs within the boundary of Anhui Province in the Xin'an River Basin.

[7] For example, the Jiuzhou River in the provinces of Guangxi and Guangdong, the Ting River and Han River in the provinces of Fujian and Guangdong, the Luan River from Hebei Province to Tianjin Municipality, the Dongjiang River in the provinces of Jiangxi and Guangdong, and the Chaobai River in Hebei Province and Beijing Municipality.

[8] For example, the linkage mechanism for prevention and control between upstream and downstream, new ecological supermarkets, centralized distribution of pesticides and fertilizer, cross-sectional water quality assessment, ecological compensation funds, project management, and protection mechanisms.

Figure 1: Source and Allocation of Government Eco-Compensation Funds in the Xin'an River Basin



Source: Asian Development Bank.

Box 2: Cleaning the River—Huangshan's Eco-Beauty Market

In Huangshan Municipality, garbage disposal used to be a problem for remote mountainous areas. Houses are distributed randomly; the young generation has moved to large cities in search of work, leaving garbage disposal as a burden for the elderly. As a result, garbage started piling up along the riverside. In 2016, the eco-beauty market (then called "garbage exchange market") was launched to improve the quality of the rural living environment with public support in garbage classification and collection in the Xin'an River Basin. For example, 10 mineral water bottles could be exchanged for yellow rice wine or a toothbrush; and five old batteries or 60 cigarette packs could be traded for a packet of salt. Public environmental awareness of garbage classification and collection reduced garbage pollution. The exchangeable garbage included mineral water bottles, cigarette butts, plastic bags, and other easily collected garbage, while the exchangeable goods included edible salt, yellow rice wine, toothbrush, soap, and other basic amenities for villagers.

Source: Authors.

Measuring the effectiveness of eco-compensation schemes and use of funds remain challenging. The sole focus on certain water quality parameters makes the assessment subject to naturally occurring climatic fluctuations and cannot fully capture the breadth of ecosystem services provided by upstream protection measures. The present setup has also failed to compensate ecosystem providers directly or indirectly for their expenses or opportunity costs and to reward them appropriately for the value of the ecosystem services provided. This mostly concerns farmers who invested in the protection of the Xin'an River and fragmentation further complicates ecological supervision and management.

Agricultural nonpoint source pollution has been stagnant for many years. There is no obvious link between nonpoint source pollution control and water quality improvement. There is also disagreement between different administrative departments as to where pollution originates from. The Bureau of Agriculture and Rural Affairs of the Huangshan Municipality attributed the pollution sources to the rainfall run-off that picks up organic matter from

the forest in the upstream area. The Bureau of Ecology and Environment of Chun'an County analyzed the water quality parameters from monitoring sites, showing that the Xin'an River had substantial amounts of pollutants from the excessive use of fertilizers, herbicides, and insecticides in agriculture. In addition, rural labor shortages have led to the overapplication of chemical fertilizers and abandoned land.[9]

The source of eco-compensation funds is limited, and policies are conflicting. Pollution control, ecological protection, and restoration are promoted through top–down financial transfer payments or transregional ecological compensation lacking market-based mechanisms. While the overall amount invested in the last 10 years is substantial, the Huangshan government has limited financial and regulatory means for additional measures such as supporting the replacement of chemical fertilizers with organic fertilizers. Subsidies that foster the excessive use of chemical fertilizers and pesticides limit incentives for farmers to switch to organic fertilizers, aggravating the situation (Box 3). Additionally, high transportation costs and an aging labor force hamper the transition to organic alternatives.

The financing gaps that the Xin'an watershed experiences reflect the larger fundamental challenges around NBS. While NBS are less expensive than corresponding hard (gray) engineering solutions, the interventions still require higher upfront investments because, among other factors, the returns are often uncertain and take longer to materialize, making them unattractive to the private sector. Moreover, barriers to financing NBS include their often small-scale distributed nature, a lack of established ownership, and perceived uncertainties of their long-term impact. In this regard, traceability, certification, and labeling mechanisms can help the production, market recognition, and sales of agricultural products trusted by consumers, but developing these new supply chains requires time and resources. Thus, without policy incentives, investors and financiers prefer more liquid investments, higher financial returns, and better risk reduction measures, limiting investments in NBS.

USE OF GROSS ECOSYSTEM PRODUCT TO IMPROVE AND INCREASE ECO-COMPENSATION RATES

The first step toward greater confidence about the amount of the upstream–downstream eco-compensation is to calculate the gross ecosystem product (GEP). The GEP is also a method for streamlining expenses in the fiscal budget at the national, provincial, and local levels, providing a balance sheet for nature and ecosystem services.

Based on the data available, the GEP of forests,[10] wetlands, farmland, and other ecosystems in the Xin'an River Basin was calculated.[11] The accounting method and key parameters are based on the *Technical Guidelines on Terrestrial GEP Accounting* released by the Ministry of Ecology and Environment in 2020 (Table 1).

Results show that the GEP of the Xin'an River Basin is on the rise, reaching $16 billion in 2015 and $18 billion in 2019, with an average annual growth rate of 2.9% (Figure 2). In 2019, the gross domestic

Box 3: Subsidies Preventing Nonpoint Source Pollution Control

Globally, nearly 90% of price incentives or fiscal subsidies given to farmers have negative implications, as they incentivize production practices and behaviors that might harm the health, sustainability, equity, and efficiency of food systems.[a] Agricultural policy support and the intensity of fertilizer use are strongly correlated across countries, including in the People's Republic of China (PRC).[b] The PRC's arable land accounts for large shares of global chemical fertilizers (32%) and pesticides (43%). "The use intensities of chemical fertilizers and pesticides are four and five times that of the world average, respectively. The excessive and inefficient use of agrochemicals increases production costs. It also leads to soil pollution and the contamination of water bodies. According to [PRC's] first National Census on Pollution Sources, fertilizers and pesticides from farms are a greater source of water contamination than industrial discharges."[c]

[a] Food and Agriculture Organization of the United Nations (FAO), United Nations Development Programme (UNDP), and United Nations Environment Programme (UNEP). 2021. *A Multi-Billion-Dollar Opportunity – Repurposing Agricultural Support to Transform Food Systems*. Rome: FAO. https://www.fao.org/3/cb6562en/cb6562en.pdf.

[b] K. Mayrand et al. 2013. *The Economic and Environmental Impacts of Agricultural Subsidies: A Look at Mexico and Other OECD Countries*. Montreal: Unisféra International Center; L. Liang et al. 2019. Agricultural Subsidies Assessment of Cropping System from Environmental and Economic Perspectives in North China Based on LCA. *Ecological Indicators*. 96. pp. 351–360.

[c] Y. Wu, E. Wang, and C. Miao. 2019. Fertilizer Use in China: The Role of Agricultural Support Policies. *Sustainability*. 11. p. 2.

Source: Authors.

[9] Many young and better-educated farmers move to cities, where wages are higher.

[10] The calculation methodologies behind the GEP and respective indicators are subject to regular iteration. To this end, note that the *Opinions on Improving the Value Realization of Ecological Products* issued by the General Office of the CPC Central Committee and the General Office of the State Council in 2020 calls for a more scientific GEP accounting system by 2025 to address difficulties in measurement, mortgage, transaction, and liquidity of ecological products.

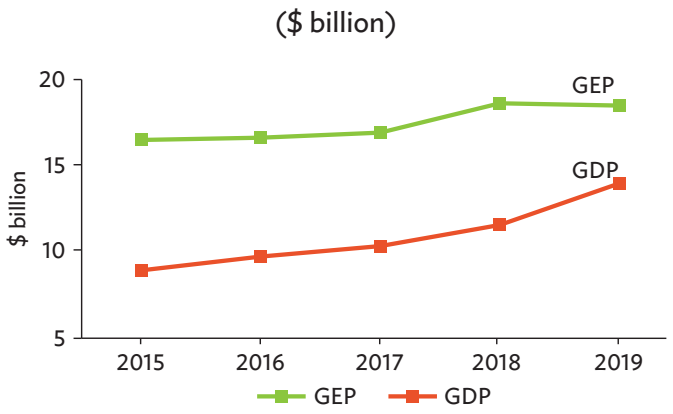
[11] Land use data with a spatial resolution of 1 kilometer from 2015 to 2019, MODIS NDVI data, and the 2020 Huangshan Statistical Yearbook were used.

Table 1: Gross Ecosystem Product Accounting Methods in Xin'an River Basin

Indicators	Physical Quantity Accounting Methods	Value Accounting Methods
Provisioning services	Statistical survey	Market valuation
Climate regulation	Evapotranspiration modeling	Replacement cost
Carbon sequestration	Carbon sequestration modeling	Replacement cost
Oxygen release	Oxygen release modeling	Replacement cost
Water purification	Pollutant purification modeling	Replacement cost
Air purification	Pollutant purification modeling	Replacement cost
Water retention	Water balance method	Replacement cost
Flood storage	Mechanism modeling	Replacement cost
Soil conservation	Revised Universal Soil Loss Equation	Replacement cost
Cultural service	Statistical survey	Travel cost method

Source: Asian Development Bank.

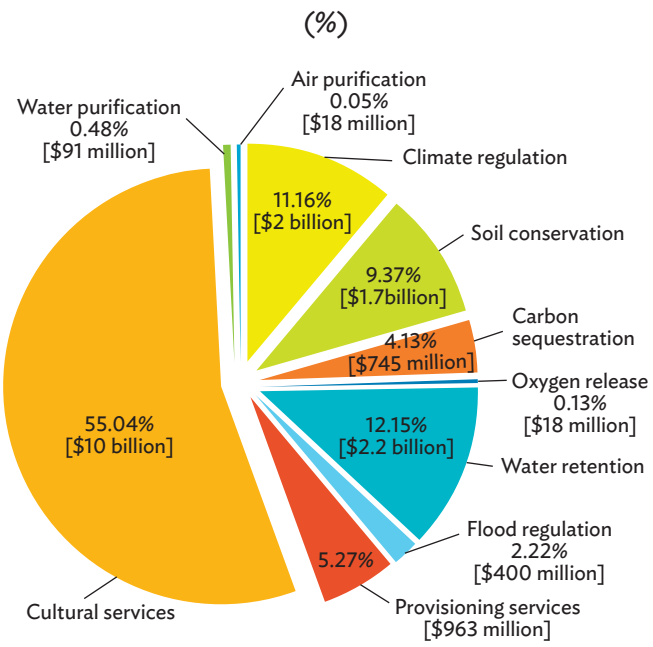
Figure 2: Evolution of Gross Ecosystem Product vs. Gross Domestic Product in the Xin'an River Basin



GDP = gross domestic product, GEP = gross ecosystem product.

Source: Asian Development Bank.

Figure 3: Share of Gross Ecosystem Product Accounting Indicators of Xin'an River Basin, 2019



Source: Authors.

product (GDP) of the Xin'an River Basin was $13.7 billion, with an annual GDP growth rate of 7.7% from 2015, and the green gold Index (the ratio of GEP to GDP) of the Xin'an River Basin was 1.32. From 2015 to 2019, the ecological value created by the upstream for the downstream stood between $2.3 billion and $3.9 billion each year. In terms of specific accounting indicators of GEP, cultural services, water retention, climate regulation, and soil conservation accounted for a substantial proportion, reaching 87.72% in 2019 (Figure 3).

Compensation should be distributed among districts and counties according to the ecological benefits generated.

The size of the region, together with the extent and quality of protective measures and ecosystem services provided, should be reflected when the Xin'an River eco-compensation funds are distributed. However, ecological compensation standards are based on different methods relying on different standards. At present, there are various ecological compensation

methods such as the ecological protection cost method,[12] opportunity cost method,[13] and GEP method.[14] The results can serve as a scientific basis for policymaking including the formulation of eco-compensation standards, the value realization of the eco-products, and the design of green financial products. However, there are still several controversies and uncertainties associated with the computation of GEP, including GEP indicators, its construction, the selection of accounting methods, the determination of key parameters, and the application of accounting results.

The data presented in this brief are based on GEP as the method to formulate the ecological compensation standard. The scale of the county and the degree and quality of the protection measures are not considered. Instead, the degree and quality of the protection measures are reflected in the calculation of the ecological compensation standard using the ecological protection cost method, which is another method for determining the standard. The ecological compensation standard in this report is the sum of the water conservation and soil conservation values generated in the upstream area as the basis for the downstream compensation to the upstream. It should be noted that only some upstream water and soil conservation measures result in downstream benefits.[15]

The calculated GEP vs. GDP shows that there is room for improvement in the ecological compensation level and diversified eco-compensation mechanisms. Nonpoint source pollution is presently the main factor affecting water quality in the Xin'an River Basin and remains difficult to control. To curb it, the government should adopt more sustainable farming techniques including regular soil testing, organic fertilization in tea plantations, and rural rain and sewage diversion facilities. To sustain it in the long term, the government should include farmers as one of the main receiving stakeholder groups for eco-compensation, rewarding their efforts and compensating for potentially reduced yield. Therefore, the Xin'an River Basin needs to expand ecological compensation funds and their scope and make use of the National Green Development Fund.[16] It should also facilitate investment in its ecological protection and green development through innovative financing mechanisms such as eco-compensation through NBS projects.

FINANCING NATURE-BASED SOLUTIONS IN THE BASIN THROUGH A DUAL GREEN INCENTIVE AND INVESTMENT FUND

Even though local governments encourage the use of green finance to support ecological restoration and adopt policy incentives to facilitate sustainable agriculture and forestry, efforts are still nascent and bottlenecks including financing challenges remain. Reasons include low recognition of green agricultural products in the market, high cost of small-scale green agriculture, and difficulties in mortgaging or pledging agriculture assets. Further investment is needed to implement more targeted and effective ecological compensation mechanisms in the Xin'an River Basin and improve the region's overall ecological governance and green industries.

ADB has invested for 6 years (2020–2026) in the Green Incentive and Investment Fund, comprising the Green Incentive Mechanism (GIM) and Green Investment Fund (GIF). Up to $145.0 million is dedicated to infrastructure investment and $37.7 million to the GIM and GIF.[17] The GIM and GIF combined the incentives of ecological compensation with market-based equity investment and were set up to explore a new market-oriented and internationally adopted model for watershed management and green development. The GIM is combined with the cross-provincial financial compensation under the existing Xin'an River eco-compensation mechanism, which raises both accuracy and efficiency of compensation. The market-based GIF equity fund can attract social capital blended with a low-cost fund from ADB, in which its equity earnings can be reinvested. Investment in eco-agriculture, eco-tourism, and other green projects is also financially feasible, allowing seamless shifts of government-led eco-compensation to market-based ecological protection.

Worth $8.7 million, the GIM is a financial rewarding mechanism that can enable farmers to actively and continuously participate in pollution prevention and control of tea gardens. It encourages practices such as a centralized pesticide distribution through unified procurement, management, and recycling. Moreover, it subsidizes farmers to buy organic pesticides and invest in other less-polluting pest controls such as sticky boards.

[12] Cities with Nature. Cost-Based Methods. https://citieswithnature.org/wp-content/uploads/2019/02/ValuES%20Methods%20for%20integrating%20ecosystem%20services_Cost-base.pdf.

[13] A. Ruijs et al. 2017. Opportunity Cost Estimation of Ecosystem Services. *Environmental and Resource Economics*. 66. pp. 717–747. https://doi.org/10.1007/s10640-015-9970-5.

[14] Z. Ouyang. Gross Ecosystem Product (GEP). Virtual Expert Forum on SEEA Experimental Ecosystem Accounting 2020. https://seea.un.org/sites/seea.un.org/files/gep-unsd-2020_07_10_spgcdscsoy_edits.pdf.

[15] A ratio of 0.6 was applied, meaning 60% of upstream investment amounts in water and soil conservation led to downstream benefits.

[16] National Green Development Fund. About. https://www.ngd-fund.com/about.

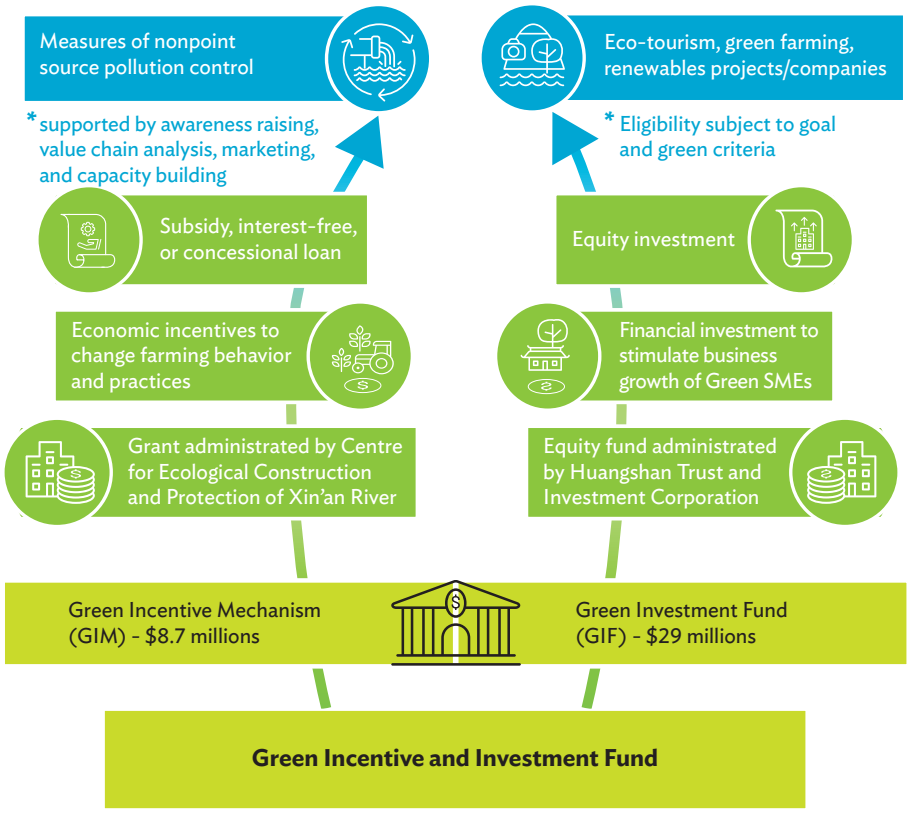
[17] The total investment amounts to $211 million and is made up of ADB sovereign loans and joint financing from KfW and the Huangshan government. During 2020–2026, this project addresses four components: (i) urban point source pollution control and governance, (ii) rural point source and nonpoint source pollution control, (iii) green finance pilots, and (iv) capacity building.

Based on the green production measures adopted by tea farmers, the size of the tea gardens, and diverse needs for future development, the GIM can be utilized in numerous ways such as direct subsidies and interest-free or low-interest loans. If the results-based targeted compensation method of GIM proves to be effective, it will provide a new way for mobilizing funds and resources for the Xin'an River ecological compensation mechanism. It can also be widely scaled up to encourage more farmers to adopt innovative and diversified sustainable farming solutions.

Figure 4 illustrates the Green Incentive and Investment Fund.

The GIF has an initial volume of $29 million and is managed by the Huangshan Trust and Investment Corporation, a subsidiary of Huangshan Xintou Group, with a maturity of 25 years (2021–2045). It aims to support small and medium-sized enterprises engaged in eco-tourism, eco-agriculture, environmental remediation, and nonpoint source pollution control in Huangshan. The GIF considers general financial indicators such as the return on investment and evaluates the expected environmental benefits.[18] These environmental performance indicators include point source pollution control indicators,[19] green economy indicators,[20] and climate change adaptation and mitigation indicators.[21] When investment is completed, the fund management company uses the same economic, environmental, and social performance indicators to regularly track its progress and provide follow-up reports. The GIM also incorporates a series of approaches including replacing slopes with terraces in tea gardens, integrating water and fertilizers, controlling green fertilizer in planting, and providing end-of-pipe treatment such as digging ecological outflow ditches in tea gardens. Auxiliary services, such as green tea garden certification, brand building, and marketing, will also be incorporated into the compensation scheme.

Figure 4: High-Level Overview of the Green Incentive and Investment Fund



SMEs = small and medium-sized enterprises.

Source: Asian Development Bank.

[18] GIF's financial internal rate of return on the green projects is designed with 3.8%.

[19] These include reducing (i) pollutants (nitrogen, phosphorus, chemical oxygen demand, and ammonia nitrogen) discharged into the water, and (ii) used chemical fertilizer and pesticide.

[20] These include the farming land area converted into green or organic agriculture, the number of jobs created by green industry, and the number of eco-tourists.

[21] These include land coverage with better adaptation to climate change and the reduction of greenhouse gas emissions.

Box 4: Qiandao Lake Water Fund

Qiandao Lake, also known as Xin'an River Reservoir, provides drinking water to more than 10 million residents in Hangzhou and surrounding areas. However, it is still affected by agricultural nonpoint source pollution from (i) excessive use of pesticides, fertilizers, and herbicides; and (ii) intensive livestock and poultry farming.

Aware that integrating the livelihoods of local farmers and economic growth with pollution control is key to the long-term sustainable treatment of rural nonpoint source pollution, The Nature Conservancy (TNC) established the Qiandao Lake Water Fund with the help of the private sector and nongovernment organizations including the Alibaba Foundation and Minsheng Foundation. The fund aims to facilitate innovative nature-based solutions (NBS) to protect water sources and ensure long-term management and financing mechanisms in watershed agricultural nonpoint source pollution.

It provides an innovative mechanism featuring multi-stakeholder joint governance and financially supports the pilot of ecological water control measures such as NBS and upscaling to the whole river basin. Supported by TNC's science-based research on watershed governance, the fund has achieved tangible ecological, economic, and social benefits, e.g., in two rice paddy and tea plantation demo sites.

The rice paddy demo site reduced its total loss of nitrogen and phosphorus by 15%–20% (36%–38% for tea plantation) while increasing farmers' income by $116 per *mu*[a] (30%–40% increase in tea revenue). Additionally, more than 100 local officials and chief volunteers in the county received capacity building on water protection. In cooperation with Jiande City, the training of *Zhejiang Qiandao Lake and Xin'an River Basin Water Resources and Ecological Protection—Jiande City Agricultural Nonpoint Source Pollution Control Project* funded by the World Bank was provided to more than 2,300 people.

[a] A *mu* is Chinese unit of land measurement that varies with location but is commonly assumed to be 1/15ha.

Sources: Asian Development Bank; and The Nature Conservancy. Qiandao Lake. https://waterfundstoolbox.org/regions/asia-pacific/qiandao-lake.

Both the GIM and GIF aim to encourage farmers to adopt environmentally sustainable farming methods or projects that can generate direct environmental benefits. Accounting for the environmental performance of projects and regularly tracking and verifying key environmental indicators will serve as a basis for eco-compensation. It also determines if an investment effectively controls agricultural nonpoint source pollution in specific areas and yields tangible environmental benefits. ADB has also supported the development of environmental, social, and governance capacity to avoid or mitigate potential environmental and social risks through its investment and financing projects. To this end, the Huangshan Trust and Investment Corporation has set up an internal environment and social manager for the first time. Traditionally, domestic practices relied on environmental impact assessments as the only environmental compliance requirement for projects or businesses. The stricter requirements can help minimize environmental pollution or ecological damage of the funded project.

POLICY RECOMMENDATIONS AND WAY FORWARD

Under the principle of shared interests and shared responsibilities, a cross-regional water pollution control mechanism through new eco-compensation models was established to promote coordinated governance of upstream and downstream provinces, public participation, and shared prosperity. However, a more inclusive, accurate, and financially sustainable long-term mechanism of environmental preservation and pollution control is yet to be developed. Many challenges remain, such as difficulties in setting assessment objectives, agricultural nonpoint source pollution, financing constraints, and controversies about the source of nonpoint pollutants.

While the ADB-funded Green Incentive and Investment Fund addresses some of these challenges, basin-wide green development through NBS to safeguard downstream water quality requires additional policy efforts including the following:

(i) Establish inclusive eco-compensation and joint governance mechanisms

Compensation funds must benefit individual farmers and households directly. Schemes and processes need to be in place, allowing individuals to claim eco-compensation for their environmental protection efforts or green farming practices in line with government guidelines. Upon request, government officials must be able to verify the initial claim and regularly audit the efforts and practices for which farmers receive eco-compensation, such as fertilizer reduction, pesticide reduction, use of pesticides with lower toxicity, emission reduction for livestock breeding, reduced sewage treatment, regular soil testing, organic fertilization in tea plantations, or construction of rural rain and sewage diversion facilities. In this process, it is key to build the respective public capacity or engage private auditors or companies accredited to issue labels for green products and whose auditing procedures align with the Xin'an River Basin ecological protection criteria and national legislation to improve water quality.

Simultaneously, it is essential to formulate and implement the new plan for joint protection and governance of the Xin'an River Basin beyond the farm level, which involves infrastructure investment and transregional restoration and protection efforts. This strategy includes ensuring comprehensive treatment and ecological restoration on the low hills and gentle slopes; enforcing the 10-year fishing ban; building ecological buffer zones in estuaries, rivers, and lake shorelines; and protecting the wetlands and forests.

(ii) Support diversity and quality of green products as well as cultural tourism and eco-tourism

The government can support eco-compensation efforts of farmers by offering capacity building on green marketing and eco-tourism and providing more targeted subsidies for the most effective green farming practices. This support is important for developing regional brands and increasing the value and visibility of ecological products. Concerted efforts are needed to obtain a price premium for the tea industry—the pillar industry of Huangshan—and to develop various forms of larger agricultural cooperatives while protecting the interests of small-scale farmers. Strengthening regional products will enhance the value of eco-tourism by promoting a pristine environment, building a brand, and forging transregional tourism and marketing alliances.

(iii) Offer innovative green financial products and services to incentivize environmental protection and increase supply, recognition, and value realization of ecological products

By setting up a joint, market-based fund for regional ecosystem investment by local governments and the private sector, local government-backed investment companies and industrial funds can also facilitate green investments. For example, the Huangshan government has used ADB's low-cost sovereign loans to set up the GIM and GIF with a dual mechanism, integrating the eco-compensation pool with market-based equity investment and facilitating the transition from government-led eco-compensation to a market-oriented protection model. In this regard, the well-designed equity fund can help attract private capital through ADB's low-cost loans and become a sustainable market model. It also encourages market players such as green agricultural businesses to join the project, getting listed when qualified.

Respective financial products should be linked to the borrowers' eco-efficient performance and consider national strategies on ecological restoration and protection, local ecological conditions, and ecological compensation and investment as references for helping borrowers set their performance targets so that more green funds can flow into businesses committed to green and ecological industries. Fintech or blockchain can help financial institutions better understand their clients' risks and help facilitate the production and sales of agricultural products trusted by consumers and help facilitate traceability, certification, and labeling mechanisms.

(iv) Strengthen regulatory frameworks for abating nonpoint source pollution control and harmful subsidies

Some of the PRC's agricultural support policies are not well aligned with one key objective of the country's rural policies—improving environmental sustainability. To achieve sustainable rural development, the government should reform agricultural support policies and reconcile agricultural and rural policies. Such measures may include removing policy distortions that slow down land consolidation and the creation of larger farms. Larger farm size is estimated to reduce agrochemical use by 30%–50% and facilitate technology transfer to rural areas and economies of scale, benefiting rural economies and making rural produce more competitive nationally and internationally.[22]

Additionally, current subsidies only incentivize farmers to switch to organic fertilizers on a narrow scale because of high transportation costs and a lack of centralized distribution. On the contrary, subsidies encourage the excessive use of agrochemicals. Fundamentally, the fact that eco-compensation payments do not reach those farmers that adopt more sustainable farming mechanisms presents a subsidy mismatch that must be addressed. Closing these gaps is as important as engaging in public consultation, fostering a sense of ownership, and allowing for adequate lead time to develop sustainable and inclusive watershed programs.[23]

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[22] Y. Wu et al. 2018. Policy Distortions, Farm Size, and the Overuse of Agricultural Chemicals in China. *Proceedings of the National Academy of Sciences*. 115 (27). pp. 7010–7015.

[23] Some of the most successful watershed protection eco-compensation schemes, such as in Munich or New York City, have adopted long-term and phased approaches that included substantial co-management and ownership of the scheme by farmers from the very start. See G. Grolleau and L. McCann. 2012. Designing Watershed Programs to Pay Farmers for Water Quality Services: Case Studies of Munich and New York City. *Ecological Economics*. 76 (C). pp. 87–94.

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Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 8632 4444
Fax +63 2 8636 2444