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Ecosystem Restoration in Smallholder Settings:

Lessons from China's Grain for Green Program

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Executive Summary

Land degradation threatens rural livelihoods across the developing world. Large-scale ecosystem restoration programs offer a way out, yet they remain poorly understood in terms of their socioeconomic effects and transferable lessons. China's Grain for Green (GforG) program, which was also called "the Returning Farmland to Forests Program" in the official documents, launched in 1999, offers an extensive evidence base on government-led smallholder land retirement at scale in low-and-middle income countries. By 2020, the program had converted approximately 14 million hectares of sloping cropland to forest or grassland across 25 provinces, compensating 41 million rural households at a cumulative central government investment exceeding USD 77.62 billion. Total program area, including restoration of non-cropland areas, reached approximately 34.33 million hectares.

This paper synthesizes evidence on the GforG's design, implementation, and outcomes to distill transferable lessons for smallholder land restoration programs, particularly in low- and middle-income countries.

The Green for Grain Program

Origins and scale: The program was established in 1999 and piloted in Sichuan, Gansu, and Shaanxi before expanding nationally between 2002 and 2003. By 2020, it had converted approximately 14 million hectares of cropland specifically retired from agricultural production to forest or grassland across 2,435 counties in 25 provinces; total program area, including reforestation of non-cropland areas, reached approximately 35 million hectares, making it one of the largest land ecosystem restoration initiatives globally.

Objective: The program paid farmers to stop agricultural production on enrolled land and replace it with trees or grassland, targeting sloped and degraded cropland in ecologically sensitive areas which suffered from severe soil erosion.

Compensation structure: Farmers initially received grain subsidies and cash payments for living expenses; from 2004, grain subsidies were replaced entirely with cash. A one-time seedling subsidy was also provided. Subsidy rates varied by region, reflecting differences in agricultural opportunity costs.

Conditionality: Payments were tied to tree survival — 50% was paid upfront, with the remainder released only if 70–85% of trees survived after one year. In practice, survival rate targets were somewhat relaxed, to account for heterogeneity in local contexts.

Species selection: The first phase required at least 80% of converted land to be planted with ecological (non-income-generating) trees, with limited farmer choice. The second phase, starting in 2014, removed these restrictions and gave farmers full autonomy over species selection.

Decentralized implementation: Land conversion targets were cascaded from the national government down to provinces, counties, townships, and villages. Local governments bore primary responsibility for enrollment, monitoring, and compliance — a notably decentralized model.

Scale of investment and reach: By 2020, cumulative central government investment exceeded USD 77.62 billion, affecting 158 million farmers across 41 million households

Design and implementation. The GforG operated through a four-level governance structure linking central policy commitments to provincial, county, and household implementation. Compensation evolved across three phases, from in-kind grain payments to differentiated cash subsidies. Targeting criteria, species requirements, and farmer autonomy were progressively refined as the program drew lessons from various implementation phases. The program began at considerable scale with a flexible design rather than beginning as a refined pilot; this flexible design enabled rapid learning across diverse contexts while tolerating known implementation imperfections in the early phases.

Economic outcomes. Compensation payments were modest relative to foregone agricultural income for many participants, and direct income effects from tree-planting were limited. Instead, the program's most significant economic contribution was associated with indirect and possibly more sustainable channels: by retiring marginal land and relaxing liquidity constraints, it accelerated the reallocation of household labor to off-farm employment. Based on a consecutive field survey over twelve years, farming's share in household income in the Beijing–Tianjin Sandstorm Source Control Project area under the GforG implementation declined by 44 percent while the share of off-farm income rose correspondingly, with the largest gains accruing to the lowest-income households. Distributional effects were broadly positive, with Gini coefficients declining substantially in participating provinces. Complementary investments in rural development, especially skills training, biogas infrastructure, and farmland consolidation, were critical to sustaining this transition.

Key lessons for policymakers. Five principles emerge from the GforG experience as most relevant for converting smallholder agricultural land into forestland or shrubland in low-and-middle income country contexts:

1. *Clarify program intent upfront.* Whether payments serve as a transitional bridge to alternative livelihoods or as compensation for lost incomes has different fiscal and policy implications. The GforG's most successful outcomes occurred where payments facilitated labor transitions and where land was targeted using simple, low-cost proxies for determining opportunity costs and environmental benefits, such as slope.
2. *Match fiscal commitment to transition timelines.* Households may require longer than anticipated to establish viable alternative livelihoods; payment reductions should be gradual and contingent on evidence of successful economic transitions, supported by parallel investments in land tenure security, off-farm employment, and rural enterprise development to sustain outcomes once payments end.
3. *Invest in human capital alongside land retirement.* Skills training and support for off-farm labor transitions were vital for increasing incomes and reducing reconversion risk; direct payments alone were insufficient for improving economic outcomes if alternative livelihood pathways were absent.
4. *Build in adaptive management from the start.* Real-time monitoring and learning, transparent data sharing with research institutions, and flexibility in revising targeting criteria, payment structures, and tree species requirements are more important than optimizing initial design.
5. *Align governance accountability with fiscal incentives.* Clear assignment of responsibilities across government levels, performance-based payment mechanisms tied to verified outcomes rather than inputs, and community-level coordination structures are important for improving compliance in implementation of programs and equity in outcomes.

The GforG demonstrates that the ability of large-scale tree-planting on degraded farmlands can deliver both ecological benefits and improved economic outcomes for smallholders. Realizing this dual benefit, however, requires long-term thinking and depends on a confluence of conditions including institutional capacity, sustained fiscal commitment for payments and human capacity building, dynamic labor markets, and complementary rural development investments. Honest assessment of these enabling conditions is essential before adapting this model to other contexts.

1. Introduction

Land degradation poses a significant threat to rural livelihoods, particularly in regions that are heavily dependent on agricultural land and other renewable natural resources. Soil erosion, deforestation, and unsustainable land use practices have intensified pressure on ecosystems that support rural populations. Globally, initiatives such as the Bonn Challenge and frameworks under the United Nations Framework Convention on Climate Change (UNFCCC) emphasized the need for large-scale ecosystem restoration to address environmental challenges and support sustainable development. These international commitments reflect growing recognition that environmental degradation undermines both ecological integrity and human welfare.

Ecosystem restoration can contribute to rural income and environmental sustainability. Rural populations, particularly the poor, depend substantially on natural resources for their livelihoods, with agriculture providing essential employment and income opportunities in these areas (Angelsen, 2014; Wei et al., 2017). This dependence creates complex tradeoffs between restoration objectives and livelihood security. Understanding how households respond to restoration policies and identifying the factors that enable or constrain successful implementation, is essential for designing interventions that achieve both environmental and social goals. Indeed, economic viability is a precondition for ecological success: programs that fail to deliver meaningful benefits to participating households risk low uptake, non-compliance, or early withdrawal, ultimately undermining their environmental objectives. This paper therefore focuses on economic outcomes not as a narrowing of scope, but as a lens through which the conditions for lasting restoration can be understood.

In China, agricultural expansion onto sloping lands, combined with industrial pressures and population growth, contributed to soil loss and erosion, problems that became salient in the late 1990s. The catastrophic floods of 1998 caused extensive loss of life and economic damage, highlighting the consequences of decades of deforestation and unsustainable land management. These disasters prompted a major policy shift toward ecosystem restoration and rural development.

In 1999, the government launched the Grain for Green (GforG) program, alternatively known as the Returning Farmland to Forests Program (RFFP), the Conversion of Cropland to Forest Program (CCFP), or Sloping Land Conversion Program (SLCP)[1]. The program compensates smallholder farmers to retire sloping cropland from agricultural production and restore it by converting it to forest or grassland, to reduce soil erosion, restore degraded ecosystems, and mitigate flood risk (Gutiérrez Rodríguez et al., 2016). Alongside with other large-scale ecological programs such as the Natural Forest Conservation Program, the Three-North Shelterbelt Program, and more recently, the "Shan-Shui" Initiative, the GforG represents one of the world's largest payments for restoration schemes, affecting millions of rural households across multiple provinces. Given its large timespan, budget, and continued program design refinement, it provides important evidence on the implementation of land restoration for poor smallholder farmers.

This review examines the experiences and outcomes of China's GforG to distill lessons learned and identify transferable policy solutions that can inform ecosystem restoration efforts in China and other contexts. By synthesizing evidence on program implementation, household participation, livelihood impacts, and long-term sustainability, this analysis aims to provide actionable insights for policymakers seeking to balance environmental conservation with rural development priorities.

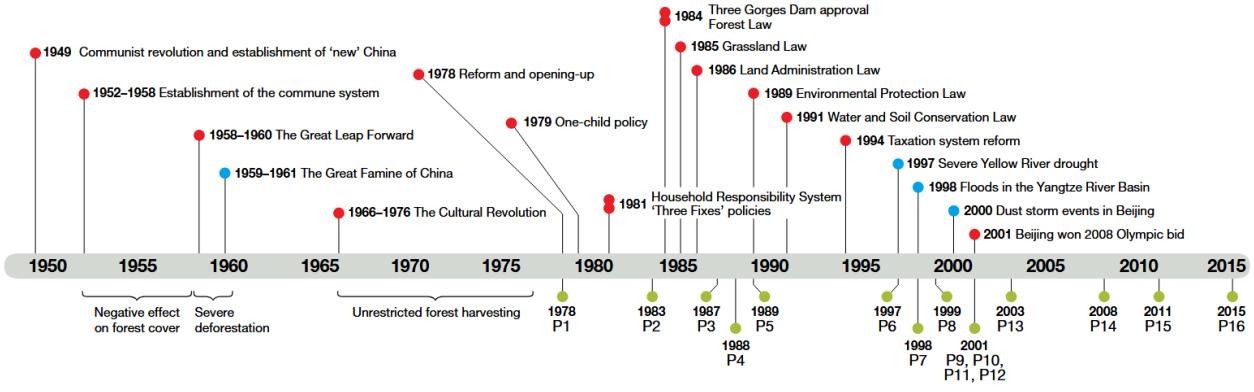
1 For ease of reference, the rest of the report will use the name and abbreviation of Grain for Green (GforG).

2. The Grain for Green Program

Following the 1978 reform and opening-up period, which saw a transition towards privatization and free-market elements, China experienced rapid economic growth accompanied by intensifying environmental pressures. The policy landscape shifted progressively towards restoration and conservation of forest resources, guided by a series of institutional and legal milestones such as: the Household Responsibility System and "Three Fixes" policies[2], the 1984 Forest Law, the 1985 Grassland Law, and the 1989 Environmental Protection Law. Subsequent legislation, including the 1991 Water and Soil Conservation Law and the 1994 taxation system reform, further established the legal and fiscal framework for environmental management.

However, severe environmental events, including the 1997 Yellow River drought, the catastrophic 1998 floods in the Yangtze River Basin, and the 2000 dust storm events in Beijing, underscored the urgency of large-scale ecological intervention and directly catalyzed the development of the GforG (Delang and Wang, 2013). The annual investment in land restoration increased steadily as China's economy grew, from US$3.52 billion in 1998 to US$40.6 billion in 2015 (about 0.34 to 0.37 percent of GDP respectively) (Bryan et al. 2018).

Figure 1. Timeline of key political, socio-economic, and policy events; human-environmental disasters; and major sustainability programme responses in China from 1949 to 2015 (Bryan et al., 2018)[3]



2 The aim was to address three issues: (i) provide clarification on the rights to forests, with a special focus on forests in mountainous areas, (ii) delimiting boundaries of private plots, and (iii) establishing a forestry production responsibility system (Delang and Yuan 2015).

3 The authors identify 16 programs aimed at forest restoration in China:

P1 Shelterbelt Development Program—Three North. 1978–2050.

P2 Soil and Water Conservation Program—National. 1983–2017.

P3 Shelterbelt Development Program—Five Regions. 1987–2020.

P4 Comprehensive Agricultural Development Program. 1988–2020

P5 Soil and Water Conservation Program—Yangtze. 1989 - indefinite.

P6 National Land Consolidation Program. 1997–2020.

P7 Natural Forest Conservation Program. 1998–2020.

P8 Grain for Green Program. 1999–2020.

P9 Fast-growing and High-yielding Timber Program. 2001–2015

P10 Forest Ecosystem Compensation Fund. 2001–2016.

P11 Sandification Control Program—Beijing/Tianjin. 2001–2022.

P12 Wildlife Conservation and Nature Protection Program. 2001–2050

P13 Partnership to Combat Land Degradation. 2003–2023.

P14 Rocky Desertification Treatment Program. 2008–2020.

P15 Grassland Ecological Protection Program. 2011–2020.

P16 Cultivated Land Quality Program. 2015–2030.

A temporary grain surplus created an opportunity for retiring ecologically vulnerable agricultural land, while the concentration of both poverty and ecological degradation in China's marginal land provided the rationale for using compensation payments to decrease rural impoverishment (Delang and Yuan, 2015; Cao et al., 2009). Thus, the ambition of GforG was twofold: it aimed to convert degraded cropland, often on sloped land, to forests or grasslands; while also reducing rural poverty (Bennett 2008, Lu and Yin, 2020). Due to its focus on marginal agricultural land, it was especially smallholders who were targeted by the program (Gutierrez Rodriguez et al. 2016).

The GforG operated alongside other major ecosystem restoration initiatives in China (Figure 1). The Three North Shelter Program (TNSP), which included agroforestry components, aimed to create protective forest belts across northern China to combat desertification. The Three Rivers Grassland Restoration (TRGR) program focused on restoring degraded grasslands in the headwaters of the Yangtze, Yellow, and Lancang rivers. Together, these programs represented a comprehensive national strategy for ecosystem restoration spanning multiple ecosystems and environmental challenges (Cao et al., 2020; Zhai et al., 2023).

2.1 GforG Program Design and Implementation

The GforG was established in 1999 and rolled out nationally between 2002 and 2003. The program was piloted in three provinces (Sichuan, Gansu, and Shaanxi) before gradually expanding into most of China (Delang and Yuan, 2015). By the conclusion of the second implementation round in 2020, the program had converted approximately 14 million hectares of cropland specifically retired from agricultural production to forest or grassland, with total program area — including restoration of non-cropland areas — reaching approximately 34.33 million hectares, making it one of the largest land ecosystem restoration[4] initiatives globally (NFGA 2020). The program primarily targeted sloped and degraded cropland in ecologically sensitive regions, with particular focus on the upper Yangtze and Yellow River basins and the Loess Plateau, areas characterized by severe soil erosion and environmental degradation (Bennett, 2008; Delang and Wang, 2013; Lu, 2023). By 2020, implementation had occurred in 2,435 counties across 25 provinces, affecting 158 million farmers across 41 million households, with cumulative central government investment exceeding USD 77.62 billion (CNY 535.3 billion[5]; Li & Liu, 2022).

The basic principle of GforG involved paying farmers to discontinue agricultural production on enrolled land. The compensation structure evolved substantially over the program's implementation period and included several components (see Table 1). In the initial phase, farmers received annual subsidies paid in kind as grain, intended to compensate for the loss of food production from retired plots, alongside a separate annual cash payment for living expenses. From 2004, grain subsidies were replaced with cash payments at a fixed conversion rate (Bennett et al., 2014; Jin & Yabuta, 2024). Farmers also received a one-time seedling subsidy to support vegetation establishment. The program distinguished between two categories of tree cover: ecological forests, planted primarily for environmental services such as soil conservation and water retention, and economic forests, planted for commercial returns such as fruit production. Subsidy rates were differentiated by region, with higher payments reflecting higher agricultural productivity and therefore greater opportunity costs of land restoration in those areas (Bennett, 2008; Jin & Yabuta, 2024).

4 While GforG is frequently described in restoration terms, its implementation — primarily through tree planting that has often resulted in compositionally simple plantations — does not meet the more stringent definition of "ecological restoration," which requires recovering ecosystems to a native reference state (Gann et al., 2019; Hua et al., 2016; Hua et al., 2018). It is therefore referred to as ecosystem or forest restoration throughout this document.

5 For consistency and ease of reference, all yuan values are converted to USD using the 2020 average exchange rate of 6.9 CNY per USD.

Table 1. Overview of the evolution of the subsidy structure of the GforG policy

Phase	Period	Annual Compensation Payment	One-time payment	Subsidy Duration by cover type
Pilot Phase	1999–2001	**Paid in Grain - South**: 150 kg/mu/year (2,250 kg/ha) **Paid in Grain - North**: 100 kg/mu/year (1,500 kg/ha) **Annual living allowance**: CNY 20/mu/year (USD 43.5 /ha)	**Seedling fee:** CNY 50/mu (USD 108.75/ha)	Ecological forest: 8 years Economic forest: 5 years Grassland: 2 years
Phase 1	2002–2006: Full subsidy 2007–2014: Extended subsidies (reduced)	**South**: CNY 210/mu/year (USD 456.75/ha/year) **North**: CNY 140/mu/year (USD 304.5/ha/year) **Reduced by 50% from 2007**: South CNY 105/mu/year North CNY 70/mu/year. **Annual living allowance**: CNY 20/mu (CNY 300/ha) retained throughout	**Seedling fee:** CNY 50/mu (CNY 750/ha)	Extended 2–8 years beyond initial period Duration varied by forest type and region
Phase 2	2014–2020	**Unified national cash rate.** **Forestland**: CNY 300/mu/year (USD 652/ha/year) **Grassland**: CNY 200/mu/year (USD 435/ha/year). Regional distinctions eliminated. Provincial governments authorized to supplement	Seedling and reforestation fee included in first-year payment	Forestland: 5 years Grassland: 3 years Shorter than first round

Notes:

1. 1 mu = 1/15 hectares.

2. In the Pilot Phase, subsidies were paid as physical grain deliveries. From 2004, grain subsidies were replaced by cash payments at a fixed conversion rate of CNY 1.4 per kilogram of grain, with the monetary equivalent determined by the regional grain quantities established during the Pilot Phase.

3. South refers to the Yangtze River Basin and southern regions; North refers to the Yellow River Basin and northern regions. This regional distinction was eliminated in Phase 2, replaced by a unified national rate.

4. Under-performance against survival rate standards could result in withheld payments.

Sources: *Bennett (2008); Delang and Yuan (2015); Li et al. (2021); Yibin et al. (2024); Delang (2019); Zhang and Paudel (2019); Ren and Li (2018); Jin and Yabuta (2024).*

Compensation at the farm level was conditional on tree survival, with 50 percent of cash and grain compensation provided upfront and the remainder released if more than 70-85 percent of trees survived after one year. This conditionality sometimes resulted in tree density being too high, as farmers planted densely to ensure they met survival thresholds (Bennett et al., 2011). In practice, survival rate standards were sometimes not enforced: local officials were reluctant to withhold subsidies given the program's dual objectives of ecosystem restoration and poverty reduction, and supervision of compliance proved costly, particularly in the early stages of implementation (Bennett, 2008).

The program design evolved over time with respect to tree species selection. In the first phase, the government required that at least 80 percent of converted land be planted with 'ecological' trees (trees that do not provide yearly income), with only up to 20 percent permitted for 'economic' trees (trees yielding sustainable income, such as fruit trees). Farmers could only choose from government-approved species. In practice, farmers had limited choices as seedlings of government-approved species were sometimes unavailable at local forestry offices (Delang, 2019). In the second phase of the program beginning in 2014, restrictions on species selection were removed, giving farmers full autonomy to choose tree species suitable for their conditions, with the government playing an advisory role (Delang, 2019).

The process for determining eligible land was defined by slope gradient as well as other geophysical characteristics. In practice and in line with China's governance system, the State Forestry Administration[6] set land conversion targets per province; provinces set targets per county; counties set targets per township; and townships set targets per village. This cascading target system meant that implementation responsibility was highly decentralized, with local governments bearing the primary burden of enrollment, monitoring, and compliance verification, in contrast to many national land management programs elsewhere, such as the United States Conservation Reserve Program, which is administered directly by federal agencies (Bennett, 2008). Local governments were motivated to meet targets in part through a performance accountability system in which under-performance could result in withheld funding and negative career consequences for officials within the Communist Party's cadre evaluation system (Bryan et al., 2018).

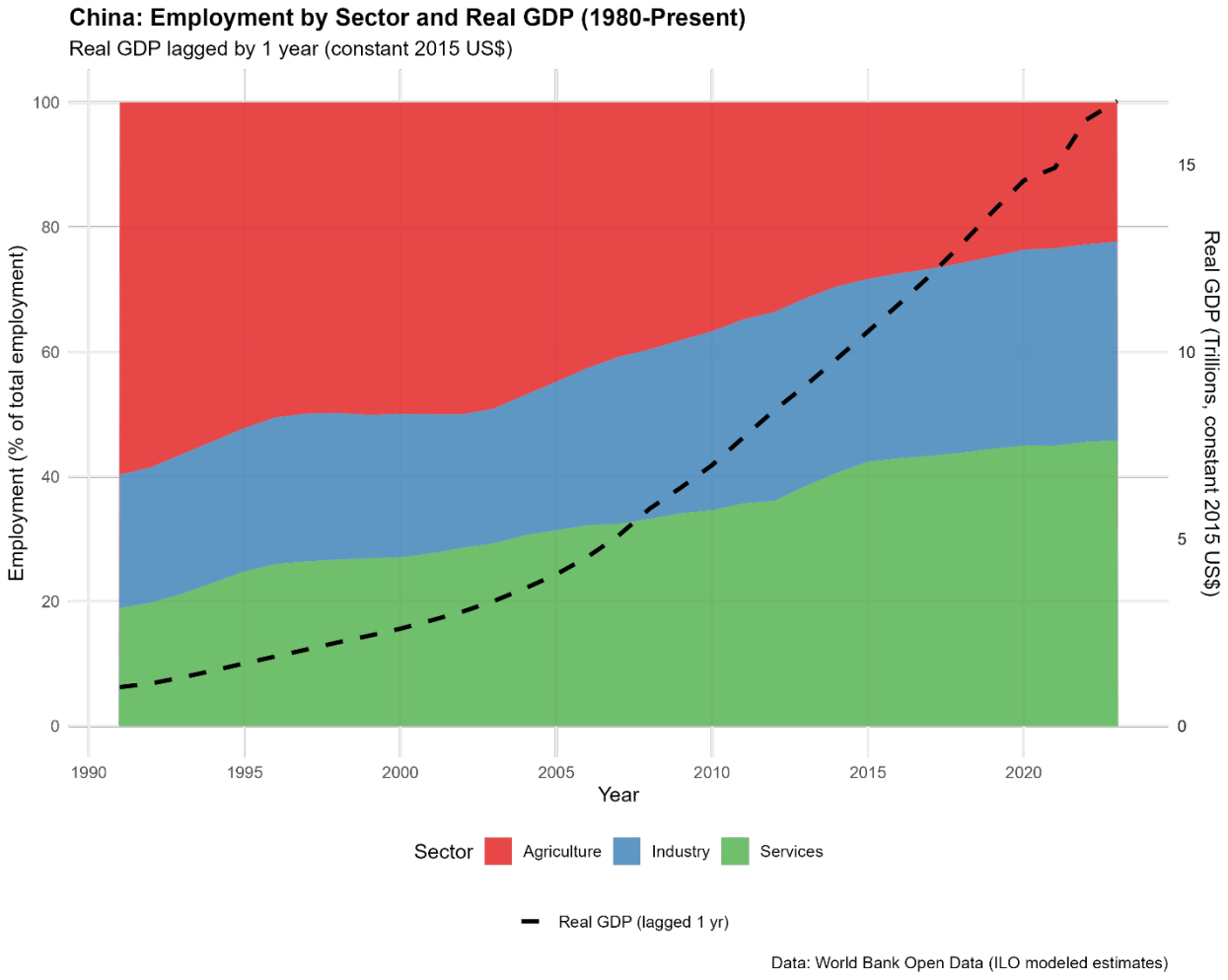
A significant implementation challenge involved land classification. China's Basic Farmland Protection Regulation requires protection of high-quality farmland, which could not be converted to alternative uses. In practice, some steeply sloped land eligible for conversion had been classified as "Basic Farmland" while productive flat land had been classified as "Non-basic Farmland," potentially for subsequent sale to developers. This misclassification created some challenges in enrolling appropriate land into the program (Delang, 2019). To address this challenge, some provinces adopted a strategy of converting eligible Basic Farmland before formal reclassification was approved, which accelerated implementation in provinces such as Guizhou (Delang, 2019). Participation by farmers was designed to be voluntary, with the potential to create challenges for achieving administrative targets (Delang and Wang, 2013). In practice, early surveys documented that some households had limited effective choice over whether and what to enroll, with local officials prioritizing target achievement (Bennett, 2008).

2.2 Ongoing economic and demographic changes supported implementation of GforG

The GforG's implementation coincided with—and was shaped by— a period of dramatic structural transformation in China's economy and population distribution. Between 1990 and the program's conclusion in 2020, China experienced substantial economic growth, with real GDP increasing from approximately 1 trillion to over 15 trillion constant 2015 US dollars (see Figure 2, dashed line). This growth was accompanied by a fundamental shift in employment opportunities. Agricultural employment, which comprised approximately 60 percent of total employment in 1990, declined to roughly 25 percent by 2020, while service sector employment expanded from under 20 percent to nearly 50 percent over the same period. Industrial employment also grew, though more modestly (see Figure 2, sectors). This structural transformation created expanding opportunities for non-farm employment, fundamentally altering the economic context in which rural households made decisions about land use and program participation.

6 In 2018, the State Forestry Administration was renamed the National Forestry and Grassland Administration (Jin and Yabuta, 2024).

Figure 2. Real GDP per sector, lagged by 1 year at constant prices (2015 US$). Data from World Bank Open Data



Concurrent with economic transformation, China experienced significant internal migration and rural depopulation. Between 2005 and 2020, population density declined across much of rural China, particularly in the mountainous regions where the GforG was most intensively implemented. This pattern of rural-to-urban migration reduced labor availability in participating communities and likely negatively influenced both the feasibility of continued agricultural production on marginal lands and households' willingness to enroll land in conservation programs.

The country's strong state capacity enabled effective program implementation across diverse geographic and social contexts, while sustained fiscal commitment ensured that compensation payments remained reliable over multiple years. The combination of economic dynamism, expanding non-farm employment opportunities, declining rural population density, strong institutional capability, and substantial financial resources created conditions that facilitated large-scale participation and compliance. These contextual factors distinguish the GforG from conservation programs implemented in contexts with weaker state capacity, more limited resources, or less dynamic labor markets (Bennett, 2008; Bryan et al., 2018; Yibin et al., 2024). Acknowledging these enabling conditions is essential for identifying which elements of the GforG model may be transferable to other settings.

3. Economic, social, and institutional factors that supported implementation of GforG

The GforG's scale and success in achieving land restoration and facilitating livelihood transitions stemmed from a combination of four key elements: multi-level governance and accountability, adaptive program design, complementary policy interventions, and quality assurance mechanisms. For each, we consider both the specific features of China's implementation and the underlying principles that might apply in other contexts.

3.1 Multi-Level Governance and Clear Accountability

The GforG operates through a four-level governance structure, comprising central, provincial, county, and household tiers, each assigned specific roles and responsibilities (Zuo et al., 2003). At the **central level**, policy design, fiscal transfer allocation, and overarching oversight are managed through a coordinated inter-ministerial mechanism established under State Council Decree No. 367 (State Council, 2002), in which the Administrative Department of Forestry (now NFGA) leads planning and implementation, the Department of Development Planning (now called National Development and Reform Commission, or NDRC) examines and balances annual plans, the Department of Finance (now called Ministry of Finance, or MOF) administers central subsidies, and the Agency of Western Development under State Council provides comprehensive coordination across departments.

The "Four-to-Province" system devolves four specific accountabilities to **provincial governments**: meeting state-defined targets for retired area and vegetation survival; disaggregating the national annual quota into county-level assignments and certifying their completion; disbursing central subsidy transfers and answering for delivery in full and on time; and signing letters of responsibility that name the officials subject to sanction for non-compliance (State Council, 2002).

County-level governments are responsible for implementing policies, preparing annual implementation schemes, contracting farmers, organizing and supervising land restoration, and planting activities, performing inspections, and managing subsidy distribution. County-level governments coordinate among forestry, agriculture, water resources, and transportation sectors. The administrative department of forestry oversees the restoration of farmland and forest stewardship; the administrative department of agriculture provides technical guidance on seed and sapling quality, as well as overseeing grassland restoration; the administrative department of water provides technical guidance on drainage management and soil and water conservation; and the department in charge of finance handles financial management. County-level compliance is formally incentivized through cascading letters of responsibility, with subsidy disbursement contingent on examination and acceptance of outcomes and officials subject to sanctions for non-compliance (State Council, 2002).

Under the program's individual contracting system, households serve as the primary implementation unit, directly linking ecosystem restoration outcomes to land management rights and subsidy entitlements. The program formally protects voluntary participation, prohibiting coercion of farmers into contracting (State Council, 2002). In practice, however, early implementation was predominantly top-down, with only around half of surveyed households reporting genuine choice in whether or where to participate (Xu et al., 2010). Over time, village-level collective action — including unified land-use planning, collective tree planting, and coordinated communication with the administrative departments of forestry emerged as a key complement to individual contracting, significantly enhancing household income growth and reducing income inequality among participants, particularly in socioeconomically disadvantaged areas (Wu et al., 2026). By substituting village-level coordination for individual information acquisition, collective organization also lowered barriers to participation for less-informed households (Wu et al., 2026). The latest round of GforG employs a "pay for result" system allowing farmers to choose tree species, density, and management approaches. Survey evidence from multiple provinces suggests that voluntary participation rates were substantially higher than in the initial phase, a shift attributed

to reduced land dependence, improved rural social security, and greater farmer autonomy in the contracting process (Xie et al., 2016). Research indicates that allowing farmers autonomy in land selection can improve policy cost-effectiveness and poverty reduction outcomes (Ren and Li, 2017).

This governance structure was enabling in several respects. Clear assignment of responsibilities across levels reduced coordination failures and finger-pointing common in multi-level programs. The "Four-to-Province" accountability system created strong incentives for provincial governments to achieve targets, backed by fiscal transfers that gave them resources to do so. Direct payments to farmers through bank accounts reduced fund diversion and corruption risks present in systems with multiple intermediaries. The conditional approval mechanism provided legitimacy and reduced resistance, though survey evidence indicates that a substantial share of participant households did not feel they had autonomy to choose whether or not to participate (Bennett, 2008).

Contextual factors associated with China's institutional capacity contributed to the effectiveness of this structure. China's strong state capacity enabled enforcement of accountability mechanisms and coordination across multiple agencies. Fiscal resources were sufficient to honor payment commitments over extended periods. Provincial governments had administrative authority and technical capacity to implement targets. In contexts with weaker state capacity, more limited resources, or less hierarchical governance traditions, putting in place similar structures will require ex ante capacity building work, though China's own experience suggests that program implementation, tailored and simplified at local levels, can itself be a driver of institutional capacity enhancement rather than merely a beneficiary of it (World Bank, 2021). The key transferable principle may be less about the specific four-level structure and more about ensuring clear assignment of responsibilities, adequate funding of implementing agencies, and direct payment mechanisms that reduce transaction costs and fund diversion.

3.2 Adaptive program design

The phased implementation and dynamic adjustment strategy enables the GforG policy to respond effectively to evolving environments and circumstances, thereby preserving both its flexibility and adaptability while mitigating policy rigidity and delays. The compensation framework evolved markedly over time (see Table 1), shifting from a uniform approach to one that was more differentiated.

In terms of targeted land selection, analysis of county-level data suggests deviations from national targeting guidelines in some places in the early phase of the program, with county governments (who prepared annual implementation plans within broader provincial targets) tending to enroll land with lower slopes than eligibility criteria specified (Li et al., 2025). This reflected county-level efforts to minimize implementation costs, reduce monitoring difficulties, and achieve high enrollment rates (Li et al., 2025). In later phases of the program, counties applied more rigorous criteria, prioritizing marginal lands and impoverished regions, though implementation continued to involve achieving a balance between centrally set objectives and local realities (Xie et al, 2016; Delang, 2019).

The capacity to adjust program design was enabling in several respects. First, it **reduced the risk of continuing ineffective approaches** (which are often due to bureaucratic inertia and path dependencies). This responsiveness, while imperfect and sometimes slow, allowed the program to evolve rather than ossify. Crucially, this adaptation occurred simultaneously across many localities rather than only sequentially through time, with subnational governments interpreting and adjusting centrally set guidelines in parallel (World Bank, 2021). China's "framework approach", providing funding and broad parameters while granting provinces and counties latitude to tailor implementation, was itself a key driver of scalability, enabling rapid rollout across highly diverse contexts without requiring central prescription of every operational detail (World Bank, 2021).

Second, the adaptive approach **created space for policy learning**. This learning occurred through multiple channels: academic research evaluating program impacts, government monitoring data showing implementation challenges, farmer feedback revealing implementation difficulties, and provincial experimentation with different approaches that could be adopted more broadly (Lu and Yin, 2020; Zhang and Paudel, 2019).

Third, the **willingness to extend payment periods, even at significant fiscal costs, demonstrated the government's commitment to restoration.** As the first round of payments began expiring around 2007, evidence suggested that many participating households lacked viable alternative income sources and faced pressure to reconvert land back to agri-

culture (Chen et al., 2009; Xie et al., 2014). The government's decision to extend payments for another cycle at half the original rate reflected both concern about losing ecological gains and acknowledgment that the program had not fully achieved its livelihood transition objectives; however, evidence on whether this extension improved farmers' economic outcomes is mixed, due to inflation (Delang, 2019).

Fourth, **program implementation granted farmers greater agency over time.** While participation was formally voluntary from the onset, early implementation was predominantly top-down, with local government enforcing centrally set targets and farmers having little practical discretion over plot selection or tree species (Bennett, 2008; Uchida et al., 2009; Chen et al., 2015). Later phases shifted toward voluntary application and a more advisory role for local government, with farmers granted greater discretion over plot and species selection within program requirements, supported by village committees and forestry cooperatives that helped align ecological objectives with household livelihood needs (Zhang and Paudel, 2019).

3.3 Complementary Policies including Livelihood Support

The GforG program operated within a broader portfolio of complementary policies designed to address multiple sustainability challenges simultaneously. This integrated approach recognized that land restoration alone was insufficient to achieve program objectives without addressing systemic socioeconomic drivers of land degradation and providing viable alternative livelihood pathways for participating households.

Under the Forest Tenure Reform, also known as the "Three Fixes" (introduced in Section 2) which was initiated since the mid-1980s aiming to stabilize forest tenure, demarcate responsibility hills (plots allocated to households for management under a contracted responsibility system) and freehold hills (plots fully owned by households) and establish responsibility systems, **China aimed to strengthen long-term investment incentives for forestland management by clarifying use rights and ownership** (Delang and Yuan, 2015). China's collective forest system historically created ambiguous property rights that discouraged land investment (Bennett et al., 2011). Reforms beginning in the 2000s clarified individual household use rights to collectively owned forestland, extended contract periods, and strengthened rights to forest products (Yi et al., 2014). Evidence suggests that improving tenure security provided investment incentives, with forest investment rising following reforms (Yi et al., 2014). In the future, systematically addressing existing logging and rental restrictions would improve farmers' ability to optimize land allocation decisions and improve their incomes (Bennett et al., 2011; Grosjean and Kontoleon, 2009).

In 2008, the Chinese government launched a complementary consolidation fund, valued at 95.865 billion RMB, financing the following three components:

- **Basic farmland establishment** in more suitable areas to offset retired cropland under GforG and thus reduce food security pressures.
- **Biogas digesters** and **solar stoves** to reduce firewood consumption and thus support ecosystem restoration.
- **Skills Training and Industrial Development**: Between 2008 and 2013, a total of 12.08 million farmers received skill training to improve their capacity for non-farm employment as well as high-yield cultivation and management techniques for fruit trees. In addition, 92.13 million mu of (6.1 million ha) forestry-related production bases, such as agroforestry and understory forestry, were established to enhance the economic returns of planted forests. Ren & Li (2017) found that farmers participating in the new round of the program were 25% less likely to choose to reclaim their land than non-participants, and their planned degree of reclamation was reduced by 36%, based on a farmer survey in Wuqi County, Shaanxi Province. Households engaged in non-farm employment also showed greater willingness to maintain converted land (Zhang, 2020).

3.4 Technical Assistance, Monitoring, and Evaluation

Program compliance was enforced through a three-tier inspection system established in 2002 regulations: county self-inspection, provincial review, and national verification, with subsidy disbursement conditional on verified compliance with restoration and maintenance standards (State Council, 2002; Zhang, 2007). Ongoing forest tending and protection remained a persistent challenge, with pest and rodent damage affecting a substantial share of planted areas in some localities and no clear mechanism in place to sustain maintenance incentives once subsidies expire (Zhang, 2007). Starting in 2008, annual performance checks — assessing whether counties met restoration acreage targets, achieved required tree survival rates, and protected converted land from reversion to farmland — reduced funding by 10 percent for non-compliant counties, supported by a national monitoring program using remote sensing and ground sampling across 100 counties (Liu et al., 2011). This conditional payment structure was associated with a roughly 30 percent increase in the likelihood of continued forest maintenance (Xie et al., 2014). However, survival rates function primarily as a compliance metric for subsidy disbursement rather than a comprehensive measure of restoration quality or ecosystem function; this reflects a deliberate tradeoff between technical rigor and administrative feasibility at national scale.

A technical support mechanism and a public agricultural extension system played a vital role in restoration efforts. At both national and provincial levels, NFGA developed technical specifications to guide selection of tree species and tree-planting practices, according to local conditions. Implementation focused on the quality and suitability of seedlings. For instance, in the Loess Plateau, drought-resistant and barren-tolerant species such as sea buckthorn and lemon strips were chosen due to their ecological suitability (Zhao et al., 2002).

The public agricultural extension system provided farmers with technical guidance and service support throughout seedling selection, planting and land management, helping to increase sapling survival rates. The extension system decreased sapling failure rates using a three-level training framework: counties provide training to townships, townships to villages, and villages to households. Since 2020, central government subsidies have included support for tree nurturing, management, and care, with an annual subsidy of 15.23 USD (CNY 105) per ha (NFGA, 2022).

4. Effects of land restoration on rural economic outcomes

Literature on the socio-economic effects of the GforG program is abundant, including the publication of comprehensive reviews (Yin et al., 2010, Liu et al., 2010, Chen et al. 2015, Gutierrez Rodriguez et al. 2016, Bryan et al. 2018, Lu and Yin, 2020). This section summarizes empirical evidence on program outcomes, synthesizing findings on income effects, employment transitions, migration patterns, and distributional impacts across demographic groups. Because GforG operates largely on a voluntary basis, farmer participation and the economic conditions that sustain it constitute a critical enabling factor for the program's objectives. A program that fails to deliver meaningful economic benefits to participating households risks low uptake, non-compliance, or early withdrawal, thereby undermining its environmental goals. Understanding the economic dimension is therefore not separate from understanding ecological outcomes; it is central to explaining when and why the program succeeds. This synthesis serves three purposes. First, it documents the range of observed program effects (both intended and unintended) across diverse contexts and implementation periods. Second, it identifies which design features and contextual conditions were associated with more favorable outcomes. Third, it demonstrates limitations on the evidence base. The key findings are summarized in Box 1.

Box 1. Key findings on economic outcomes

Compensation payments were modest relative to foregone agricultural income for many participants, and direct income effects from tree-planting were limited. The program's most significant economic contribution came indirectly, by accelerating the reallocation of household labor to off-farm employment. Over twelve years, farming's share in household income in GforG areas declined by 44 percentage points while incomes from off-farm labor rose, with the largest gains accruing to the lowest-income households. These effects took time to materialize and were stronger among younger, better-educated, and land-scarce households. Distributional effects were broadly positive, with Gini coefficients declining substantially in participating provinces.

4.1 Direct Income Effects

Compensation payments in the GforG program have been modest relative to the agricultural income foregone by many participants. A meta-analysis of 66 studies finds that while the program had a significant positive effect on total income when subsidies are included, its effect on total income excluding subsidies was not statistically significant, and its impact on farm income was also insignificant or potentially negative (Lu, Kong & Xu, 2025). Evidence from the early phases illustrates why: compensation standards fell below 1999 net income from enrolled plots for approximately 50 percent of participants in Gansu Province, 30 percent in Sichuan, and 7 percent in Shaanxi (Bennett, 2008). Beyond inadequate standards, actual subsidy delivery frequently fell short of stipulated amounts due to fund diversion and administrative shortfalls, with some surveys finding that nearly half of participating households received only partial compensation (Bennett, 2008).

While compensation payments have increased over time, the share of compensation payments in households' total income continued to be small. In Ziyang County (Shaanxi Province), payoffs from the first phase accounted for 10 percent of total household income, which reduced to less than 5 percent in the second stage (Delang, 2019). The loss in importance of compensation payments was due to growing household incomes from non-agricultural sources; and inflation in food prices and wages (Delang, 2019).

Income from restored land was minimal for most participants in the early phases. Approximately 70 percent of households obtained no such income from their enrolled land in the early implementation period (Delang, 2019). The requirement that at least 80 percent of trees be ecological species in the early phase restricted income opportunities from pruning and logging, with China's logging quota system severely limiting farmers' ability to harvest trees (Delang, 2019). Economic trees, which could provide annual income from fruit sales, often failed to generate expected returns, in large part due to the fact that only 20 percent of trees on a plot of land could be 'economic'. In the early phases, farmers often lacked sufficient training in tree cultivation, resulting in poor-quality fruit. When marketable fruit was produced, farmers often lacked market access or buyers. In some cases, converted plots were geographically distant from markets; and the effort required to harvest fruit may have exceeded revenues (Delang, 2019).

Regional patterns in income effects reflected underlying geographic heterogeneity in agricultural productivity and ecological conditions. Analysis of 314 counties across China's Loess Plateau found that grain production losses were greatest in the valley plains and earth-rock mountainous regions of the southeast, where the yields were higher and ecological compensation was insufficient to offset the reduction (Wang et al., 2024). In the loess plateau gully and loess hilly-gully regions, where productivity was lower due to steep slopes and poor soils, production losses were smaller and were outweighed by gains in ecological benefit at the county level (Wang et al., 2024). As these are composite index measures rather than household income, the comparison describes aggregate social-ecological tradeoffs rather than compensation received by individual participants. This spatial pattern suggests that the economic opportunity costs of program participation varied across landscape types, with implications for both program targeting efficiency and distributional equity.

4.2 Indirect Income Effects

Program participation was associated with increased pursuit of off-farm employment, which brought in higher incomes than from agriculture (Uchida et al., 2009). Over time, program participation increased the likelihood of non-agricultural employment while decreasing engagement in agricultural work (Giefer & An, 2022). A longitudinal study in Shaanxi and Sichuan from 1999 to 2008 documented a 250 percent increase in household incomes, driven by off-farm employment (Yin et al., 2014). The magnitude of this effect increased with the amount of land enrolled in the program (Li et al., 2015). Income effects strengthened over time as households adjusted to new livelihood strategies and market conditions improved (Liu et al., 2014). As the scale of land conversion increased, remaining farmland was often insufficient to meet household food needs, making rural households shift to off-farm employment, including migrating to pursue such opportunities. While self-selection into the program is a plausible concern, given its voluntary nature, empirical tests using matched comparison groups have not found evidence that participating and non-participating households differed systematically in ways that would explain this pattern independent of the program (Li et al., 2021). Positive effects on forestry labor input and off-farm employment became more pronounced in later implementation years (Li et al., 2021).

The income effects of labor shifts towards off-farm work took time to materialize. Early assessments found no significant program impact on off-farm work or migration (Uchida et al., 2007). Later studies, drawing on longer time series, revealed positive effects, with stronger impacts among young and educated individuals (Uchida et al., 2009). Over 12 years, participating households in a three-province survey shifted markedly from farm to off-farm work: the share of income from farming fell by 20 percentage points while the share from remittances rose by 10 percentage points, and out-migration rose by 44 percentage points, with the largest shifts among the lowest income groups (Moioli et al., 2023); this study surveyed 880 households across 32 counties in Jiangxi, Shaanxi, and Sichuan.

The impact of compensation payments on labor migration occurred over time. In theory, compensation could reduce incentives for out-migration by providing an adequate income substitute. Where payments are modest, however, they can encourage migration by relaxing liquidity constraints, especially for households with limited education, skills, and market access (Démurger & Wan, 2012; Uchida et al., 2009). Empirical findings reflected this ambiguity: early assessments found no significant migration effects (Uchida et al., 2007), while longer time series revealed positive impacts, suggesting the program required sustained implementation for migration effects to emerge (Démurger & Wan, 2012).

Remittances had significant implications for both household welfare and environmental outcomes. Program participation increased the probability of receiving remittances from out-migrants, with substantial forest cover recovery—measured by both forest coverage and the Enhanced Vegetation Index from satellite imagery—observed around recipient households (Zhang et al., 2024). Approximately 12 percent of forest regeneration was attributable to remittances. Conversely, migration without remittances proved less effective at supporting forest recovery: the dual loss of human and natural capital made remaining household members more dependent on forest resources, resulting in vegetation degradation around non-recipient households (Zhang et al., 2024). Remittances represented the primary driver of household income growth in rural China, with multiplier effects boosting local economic activity (Giefer & An, 2022; Delang, 2018).

The program did not significantly encourage local entrepreneurship. Whether the lack of such entrepreneurship might lead to land clearing after compensation payments expire, or whether the migration effects have been large enough to exit households from agriculture permanently is not well understood and needs to be examined (Giefer & An, 2022).

4.3 Distributional Effects

Effects on income inequality have been broadly positive. Among participating households in western China, income inequality was lower than among non-participating households seven years after implementation (Li et al., 2011), with program contributions to inequality varying over time and across locations (Liu et al., 2014). Analysis of 880 households across three provinces found that the Gini coefficient decreased by 23 percent over 12 years of implementation, with the largest reductions in Shaanxi (27 percent) and Sichuan (22 percent) (Moioli et al., 2023). Both equality and equity improved: low-income households experienced proportionally larger income gains (515 percent for the lowest quintile versus 16 percent for the highest) and greater shifts in economic structure (Moioli et al., 2023). Remittances were the primary driver of inequality reductions both before and after implementation (Moioli et al., 2023).

Effects differed by ethnicity and gender. In Ningxia, the program's impact on migration propensity (and consequently changes in income) was stronger for ethnic minorities[7], even though minority households participated at lower rates (56 versus 67 percent) (Démurger & Wan, 2012). Ethnic minority households also experienced lower tree survival rates (Bennett et al., 2014). Gender disparities in migration were reinforced by the program, with male propensity to migrate increasing by 13.5 percentage points compared to smaller effects for women (Démurger & Wan, 2012).

Age and education shaped household responses to the program. In Ningxia, younger cohorts showed the strongest migration responses, consistent with human capital theory: participation increased migration propensity by 12.9 percentage points for those aged 15-29, with effects becoming insignificant for older cohorts (Démurger & Wan, 2012). Better-educated household members were more likely to transition successfully to off-farm employment, and enrolled plots most likely to remain retired belonged to households with fewer, better-educated members (Giefer & An, 2022).

Geographic and resource endowment factors also moderated program effects on labor allocation. Regional heterogeneity in agricultural productivity meant that economic opportunity costs of participation varied substantially across landscape types (Wang et al., 2024). Further, the program showed no significant effect on household incomes (direct or indirect) in the Yangtze River Basin but positive effects in the Yellow River Basin (Li et al., 2021). Households with smaller farmland endowments showed a significant positive effect on out-migration labor input following program participation, while this effect was absent for medium- and large-farmland households, consistent with the interpretation that land-scarce households faced stronger incentives to reallocate labor off-farm when cropland was retired (Li et al., 2021).

These patterns suggest several program design implications for other contexts. Targeted outreach to ethnic minority groups during enrollment could increase both program uptake and impact (Démurger & Wan, 2012). Skills training, financial assistance, or transportation support may help extend off-farm transitions to older or less-educated household members (Giefer & An, 2022). Complementary support such as childcare provision or local, non-migratory off-farm training may extend livelihood benefits more equitably to women, given the role of caregiving responsibilities in constraining their off-farm and migration options (Démurger & Wan, 2012; Giefer & An, 2022). Livelihood packages may be more effectively tailored by landholding size, with larger-landholding households needing different forms of support than land-scarce households to achieve comparable transitions (Li et al., 2021).

7 This does not mean the household incomes of ethnic minorities was higher than that of Han households.

5. Insights for land restoration programs, especially for low- and middle-income countries

The transferable lessons lie in the key principles: sustained government commitment, adequate fiscal capacity, clear accountability structures, spatially differentiated targeting, comprehensive support for livelihood transitions, adaptive management underpinned by monitoring and evaluation, and explicit attention to distributional outcomes. Successful implementation of land restoration requires honest assessment of these factors in a national and subnational context. Box 2 summarizes the main takeaways for low- and middle-income countries. Table 2 distinguishes these transferable principles from the China-specific conditions that enabled them.

Box 2. Transferrable lessons for low-and middle-income countries

The GforG experience points to five principles relevant beyond China's context:

1. Clarify upfront whether payments are a transitional bridge or compensation for lost incomes, using low-cost targeting criteria such as slope or land opportunity cost
2. Match fiscal commitments to the time households realistically need to establish alternative livelihoods
3. Invest in human capital alongside payments
4. Build in adaptive management from the start, supported by transparent data sharing with research institutions, rather than optimizing initial design
5. Ensure clear governance accountability at all levels, using performance-based payment mechanisms tied to verified outcomes.

These principles are not a replication model, rather they are necessary conditions for designing smallholder land retirement programs in low- and middle-income country contexts. China's strong state capacity, sustained fiscal commitment, and dynamic labor markets were enabling conditions at the time GforG was being implemented.

These lessons rest on a foundation of credible, sustained government commitment. Land restoration requires credible, long-term government commitments to foster trust that household-level participation depends on. Compensation payments were extended across multiple phases of the GforG to allow participating households to bridge the period between income losses from agricultural production and gains from alternative sources (Bennett, 2008; Jin & Yabuta, 2024). Predictable, multi-year compensation enabled households to plan livelihood transitions rather than treating program participation as a short-term transfer. Equally important was the signal sent by program extensions: when the Chinese government renewed compensation in 2007 and again through the second phase beginning in 2014, it demonstrated a commitment to the program's long-term objectives that sustained farmer participation and ecological outcomes.

Clarity on purpose of payments matters. A critical but often overlooked question for land restoration programs is whether payments are intended as a bridge to a new productive land use, or as indefinite compensation for permanent land retirement. These two models have fundamentally different fiscal and policy implications. In a bridging model, payments are investments that help households transition to alternative livelihoods such as off-farm employment, agroforestry, or diversified income sources, after which payments can, in principle, be reduced as households become self-sustaining. This is the model that best describes the GforG's most successful outcomes, where program payments relaxed liquidity constraints and facilitated labor reallocation to off-farm work (Uchida et al., 2009; Lu, Kong & Xu, 2025). In contrast, where land is retired for permanent ecological forest planting with no alternative income pathway, payments function more as indefinite compensation for foregone agricultural income. If payments cease in this context without households having secured alternative livelihoods, reconversion risk is high (Chen et al., 2009; Bryan et al., 2018).

Fiscal capacity is needed to implement land restorations and should be matched to the program model. Where a bridging approach is adopted, fiscal planning should account for the time required for households to establish viable alternative livelihoods, which the Chinese experience suggests may be longer than initial program designs anticipate. A 50 percent reduction in payments following the initial phase had measurable negative effects on household income and off-farm labor transitions, with recovery occurring only where pre-existing training and stronger land rights were in place (Li et al., 2021; Howell, 2023). This suggests that payment reductions should be phased gradually and contingent on evidence of successful livelihood transitions rather than set by fixed program timelines. Where indefinite payments are the intended model, sustainable fiscal mechanisms should be identified before program launch. The strength of the underlying liquidity-constraint mechanism depends on the availability of off-farm labor demand; China's exceptionally strong labor market growth during this period may limit the replicability of comparable income effects in slower-growing economies.

Supporting training for off-farm activities is important for improving household incomes and transforming the rural economy. The later phases of the GforG program incorporated such skills training, which led to improvements in household economic status. Land restoration programs' largest effects tend to come from stimulating households to shift to off-farm work. In that regard, coupling restoration programs with training in skills to improve human capacity would help households seek off-farm opportunities and improve their economic status, particularly in contexts where agricultural intensification or diversification alone may be insufficient to offset opportunity costs of land retirement. This approach recognizes that successful land use transitions may require investments in human capital alongside direct payments, particularly when program participation necessitates shifts in household economic strategies.

Allowing learning-by-doing and gradual adaptation is critical for successful implementation of land restoration programs, especially in contexts of poverty. The GforG program offers an important and somewhat counterintuitive lesson for other countries: rather than starting as a carefully confined pilot that was refined before expansion, it launched at considerable scale across several provinces with a deliberately flexible design, and then incorporated assessments and studies through the life of the program to adapt land eligibility, payment amounts, and tree species across different locations. This "scaled but shallow" approach stands in contrast to the more common practice of piloting and perfecting an intervention under specific local conditions before attempting to scale.

A defining strength of the program was the alignment of centralized policy direction with strong subnational accountability mechanisms. China's governance structure created a system in which the central government set high-level objectives and fiscal commitments, while provincial and local governments refined plans based on regional conditions, managed funding, and supervised implementation (Bryan et al., 2018). The accountability system created strong incentives for provincial governments to achieve targets. Direct payments to farmers through bank accounts reduced diversions of funds and corruption risks present in systems with

multiple intermediaries. Village committees and forestry cooperatives facilitated communication with forestry authorities, coordinated maintenance activities, and provided targeted support to households with limited technical knowledge, with effects on both tree survival rates and equitable access to program benefits (Bennett et al., 2014; Wu, Yuan & Wang, 2026). This approach also generated well-documented problems in the early phases, including insufficient technical support, shortfalls in subsidy delivery, limited community consultation, and early planting of ecologically inappropriate tree species in some areas (Bennett, 2008; Bryan et al., 2018). Programs operating in contexts with stronger implementation capacity may be better placed to manage the tradeoff between scale and quality than those where local institutional capacity is limited.

Several knowledge gaps remain. Whether retired land would be reconverted to agriculture once compensation payments cease is not understood, nor whether the migration and livelihood transitions induced by the program have been large enough to permanently exit households from agricultural dependence (Giefer & An, 2022). Whether strengthening land rights would stimulate rental markets and thereby reduce reconversion risk remains an open question (Howell, 2023). It is similarly unclear whether skills training investments reduce the propensity to revert to agriculture after payments end (Démurger & Wan, 2012).

Table 2. Transferable principles versus China-specific enabling conditions

Transferable Principle	China-Specific Enabling Condition
Clarify program intent upfront (bridging vs. indefinite payments)	Bridging worked because of expanding non-farm employment opportunities during implementation. This labor-market condition may not hold in slower-growing economies.
Match fiscal commitment to transition timelines	Sustained central fiscal capacity allowed program renewal in 2007 and again in 2014 even at significant cost, sending a credibility signal that a fiscally constrained government could not easily replicate.
Invest in human capital alongside land retirement	Broader state institutional capability to design and deliver programs at scale across diverse localities is a general enabling condition rather than one specific to training delivery.
Build in adaptive management from the start	China's "framework approach" gave provinces latitude within central parameters, and established research-institution linkages enabled policy learning through monitoring data, farmer feedback, and provincial experimentation
Align governance accountability with fiscal incentives	China's four-tier hierarchical administration with binding letters of responsibility and sanctions for non-compliance is a specific bureaucratic feature not easily replicated in weaker-state contexts

6. Conclusion

China's GforG program offers one of the most comprehensive real-world tests of large-scale smallholder land restoration undertaken to date. Its experience shows that ecosystem restoration at scale is not primarily a technical challenge, but an institutional and economic one. The program's environmental gains were sustained where land retirement was embedded in a broader process of structural transformation—characterized by expanding non-farm employment, complementary human capital investments, and credible, multi-year fiscal commitments—rather than treated as a stand-alone conservation intervention.

Two overarching conclusions follow. First, compensation payments functioned mainly as *transitional instruments*, easing liquidity constraints and facilitating labor reallocation, rather than as permanent substitutes for agricultural income. Restoration outcomes were therefore tightly coupled to households' ability to exit low-productivity farming and access alternative livelihoods. Second, *adaptive governance proved more consequential than optimized initial design*. The willingness to scale early, tolerate initial imperfections, and iteratively recalibrate targeting, payment structures, species rules, and governance arrangements was central to the program's longevity and effectiveness.

The bottom line for replication. For policymakers, the GforG experience underscores that replicability lies not in copying program parameters, but in assessing whether enabling conditions—state capacity, fiscal space, labor market dynamism, and coordination across policy domains—are present. Where these conditions are weak, large-scale restoration will require upfront investments in institutions and livelihoods, not just trees.

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