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# Village-Level Implementation of Gross Ecosystem Product (GEP) in China: Institutional Innovation and Practical Pathways

**Jianhong Lian [1, 2, a], Jaspal Singh Joginder Singh [3, b]**

[1] Kuala Lumpur University of Science and Technology, Kuala Lumpur, Malaysia
[2] Lishui Experimental School, Lishui, Zhejiang, China
[3] Sunway University, Kuala Lumpur, Malaysia
[a] 242924766@s.klust.edu.my, [b] jaspalj@sunway.edu.my

**Abstract:** Gross Ecosystem Product is a measure that shows ecological value in forms that allow economic assessment. China uses this approach across different levels of development. The approach provides a method for including ecological factors in development that occurs in areas with significant ecological resources. These areas show patterns where ecological value exists but economic development remains limited. This work examines the development of Gross Ecosystem Product in China and considers how this measure applies at the level of individual communities. The analysis uses cases from Zhejiang Province and from Lishui. These cases show arrangements that include organizations described as Two-Mountain Cooperatives and companies that operate with ecological resources. The arrangements also include approaches that use trading of ecological resources and financial mechanisms that use Gross Ecosystem Product measures as a basis for providing support. The study compares cases from China with cases from other contexts. The comparison includes Findhorn and Cloughjordan. These cases show different approaches but similar issues that relate to maintaining ecological conditions while supporting local development. The comparison reveals that the approach in China uses ecological assessment in combination with collective organization and market-based operation. This represents a particular pathway that differs from approaches in other contexts. The findings indicate that Gross Ecosystem Product at the community level provides more than a method for assessment of ecological conditions. The measure also provides a mechanism that affects how communities organize development and manage resources. The approach offers insights for areas that seek to include ecological value in local systems of development. The mechanism shows how ecological resources can provide a basis for economic activity in communities where ecological conditions represent a significant form of value but where economic development has been limited by other factors.

**Keywords:** Gross Ecosystem Product (GEP); Village-Level Governance; Eco-empowered Village Companies; Ecological Assets; Rural Economic Development; Market-Based Mechanisms.

## 1. Introduction

Measures such as GDP receive criticism for their inability to show how nature contributes to development in economic and social forms. This limitation provides the basis for developing GEP, which is a measure in monetary terms that includes the value of goods and services from ecosystems in economic accounts[1]. The approach follows GDP but extends measurement of growth by treating ecosystems as assets that produce value rather than as factors outside the main analysis[2]. In China, this approach relates to the Two Mountains principle, which indicates that clear waters and green mountains represent valuable assets. This principle combines protection of ecological systems with development of the economy within the framework of ecological civilization[3].

The need to use GEP appears clearly at the level where conservation of ecological systems meets directly with livelihoods in rural areas and economic activities of collectives. Many rural areas show a paradox that continues: they contain abundant resources in ecological terms but remain limited in economic development. Chinese scholars initially proposed GEP in the year 2013 as a means to indicate the economic value of ecosystems. The measure has received recognition in academic work and attention in policy development[3]. It appears in strategies for national development and programs that test the approach as a means to support transformation toward green practices. At the level of international work, GEP receives recognition as a framework that complements the System of Environmental-Economic Accounting for Ecosystem Accounting, which shows its relevance at the global level[4].

The economic meaning of GEP is commonly understood through three categories of ecosystem service functions. Provisioning services refer to tangible outputs such as water, timber, and medicinal resources, which make ecological assets "visibly productive" and directly link natural resources with collective income[2]. Regulating services include functions such as water conservation, climate regulation, soil retention, and air purification. These services underpin environmental stability and provide a key basis for evaluating the performance of ecological governance[5][6]. Cultural services cover non-material values such as landscape aesthetics, education, cultural identity, and eco-tourism, through which ecological assets are further transformed into social and economic benefits and connected with public perceptions and service industries[7]. Together, these service functions explain why GEP offers a more comprehensive and policy-relevant assessment framework than GDP alone[1][3].

Importantly, these theoretical functions of GEP have been gradually translated into concrete institutional practices at the village level. In Lishui City of Zhejiang Province, Eco-

empowered Village Companies have applied GEP accounting results to activate ecological assets for collective investment and development. In 2020, Qingtian County issued China's first "GEP loan" of 5 million yuan by using quantified ecological assets—such as water purification and forest carbon sequestration—as collateral[8]. In July 2025, Lishui completed the country's first Village Eco-Product (VEP) transaction, in which the ecological asset rights of an entire village were packaged and sold for 9.38 million yuan through the local ecological product exchange[9][10]. By the middle of 2025, the value of transactions that occurred through this platform for trading showed a total exceeding 10 billion yuan[11]. The program in Lishui that provides recruitment across different locations started in 2023. This program brought 16.21 billion yuan in investment from sources outside the area into groups that operate at the level of villages. The period for this investment was six months. These results indicate the means by which approaches that use features related to the environment and changes in structures of operation allow movement of resources for development in areas outside cities[12].

## 2. Conceptual Foundations

Chinese scholars provide the initial definition of Gross Ecosystem Product as the total value that ecosystems provide to society through products and services[1][2]. In practical application, this approach converts flows of service from ecosystems into monetary indicators[3]. These services include water that is clean, timber, and the process by which carbon is stored. The approach provides a complement to Gross Domestic Product rather than a replacement for it. It allows the inclusion of contributions from nature that do not involve markets and that conventional measures of economic activity do not reflect[3-5]. The difference between the two measures is significant. Gross Domestic Product shows only transactions that occur in markets. Gross Ecosystem Product includes values from markets and values that markets do not reflect. This allows a view that integrates the economy with the environment more completely.[6][7]

The method that underlies Gross Ecosystem Product uses approaches for valuation that are established in ecosystem service research[1][6-9]. These approaches include the use of market prices, the assessment of replacement costs, and methods that transfer benefits from other studies. Support for the approach also comes from techniques that provide valuation for particular ecosystems. The framework for this type of measurement follows the system that the United Nations developed for environmental and economic accounts relating to ecosystems[10]. In China, application of the approach in practice follows guidelines that are technical in nature. These guidelines provide definitions for services from ecosystems that directly provide benefits to society. They also provide rules that prevent the problem of counting the same value multiple times when different services are combined[1]. The approach integrates multiple types of value from ecosystems into one indicator. This indicator functions as a measure for regions that shows the supply of services from ecosystems. The role it plays is similar to the role that Gross Domestic Product plays in showing production in the economy[3].

The concept of ecological assets relates closely to Gross Ecosystem Product. These assets refer to resources from nature that produce products and services that provide benefits to society[11]. Studies that currently examine this field show four major dimensions for research. These dimensions include theory that is conceptual, evaluation, mechanisms, and strategies for realization. Evaluation remains the dimension that research explores most extensively. Reviews that are recent indicate the need to provide clarity for distinctions between ecological assets, services from ecosystems, and products that are ecological. These reviews also indicate the need to develop pathways that are practical for realizing value from products that are ecological[1]. Analyses that examine spatial patterns suggest that relationships between Gross Ecosystem Product, Gross Domestic Product, and density of population differ across regions. This suggests that arrangements for governance should be sensitive to conditions that are local[12]. These findings indicate that ecological assets are not simply units for accounting. They are components that are dynamic and that influence ecosystems in rural areas and strategies for development.

At the level of institutions and financing, Lishui developed a system that connects identification of ecological assets with financing, trading, and use in governance at the village level. In 2023, the Lishui Municipal Government Financial Office provided measures for financing using ecological assets and for compensation of risk, establishing rules for use as collateral, for guarantees, and for sharing risk [13]. In 2020, Qingtian County introduced the first "GEP Loan" in China, providing CNY 5 million in credit that ecological assets certified by GEP supported, and this served development and governance at the village level [14]. In 2025, Lishui completed the first transaction at the village level that combined value rights of ecological products (VEP), with total value of CNY 9.38 million [15,16], indicating change from separate trials to implementation across villages. In the same year, the total volume of transactions on the ecological product trading platform in Lishui exceeded CNY 10 billion [17], showing rapid expansion in use of ecological assets through markets. The "Blue Sky Loan" that the Nanjing Bank Nantong Branch introduced in 2024 extended financing using GEP to enterprises by allowing use of ecological assets certified by GEP as collateral [18]. These cases show that ecological assets identified through GEP accounting moved beyond valuation in the abstract and developed into financial products and mechanisms for trading that function in practice.

At the level of villages, these arrangements operate through Eco-empowered Village Companies (EVCs). Village collectives establish EVCs. These companies integrate ecological assets that GEP accounting identifies and operate them using a structure for corporate governance. The main function is to change ecological value into revenue through compensation for ecological protection, through tourism related to ecological features, through operation of brands, and through participation in transactions of ecological products. The income that results provides support for village governance, for development of infrastructure, and for livelihoods in the local area [19,20]. Evidence from data also suggests that approaches using GEP allow coordination of ecological protection with development of the economy and with well-being of people, supporting the role that EVCs provide for revitalization of rural areas and for the broader objective of common prosperity [5,21].

## 3. GDP Evaluation Policy in China

China has developed measures to include the concept of Gross Ecosystem Product within the approach to

development that considers the environment. The concept was presented by scholars from China in the period following 2010. Ouyang and others introduced the method for this measure in Acta Ecologica Sinica [1]. Studies that followed showed that this measure could be used at the level of provinces and regions. These studies also showed that the measure could provide information that complements the data from GDP [2,3]. The concept entered the system for national policy through the 13th Five-Year Plan in 2016. This plan incorporated the measure into the strategy for development at the national level for the first time [4].

China released the Specifications for GEP Accounting in 2022 to increase the use of this measure in practice. The National Development and Reform Commission and the National Bureau of Statistics developed these guidelines with institutions that conduct research. The guidelines provide standards for the range of services from the environment that should be included. The guidelines also provide methods to prevent the same service from being measured more than one time [5,6]. By the end of 2022, at least 36 districts and counties had completed assessments using this measure. Twenty-four of these areas had adopted systems that evaluate both GDP and the measure together [4].

At the local level, Zhejiang Province has played an important role in developing this approach. Lishui Prefecture in particular has been important. Lishui established the first system in the country that measures this concept at four levels. The system covers the city, county, town, and village. This system places the measurement of value from the environment directly into the processes for local governance and for development in rural areas [7,8]. The 14th Five-Year Plan for Realizing the Value of Ecological Products in Lishui provided additional support for governance that uses this measure [9]. At the same time, other policy measures, such as mechanisms for compensation when damage to the environment occurs, have shown how the measure has been extended into practices for governance that are concrete [10].

Beyond planning and evaluation, the measure has also provided a foundation for financial tools and for compensation related to the environment that are new. Green loans and transactions involving assets from the environment have emerged as important means for translating value from the environment into value that is economic [11,12]. Market-oriented tools of this type have gradually developed. These developments indicate that the measure is no longer limited to accounting that is statistical. The measure is increasingly embedded in applications for policy and for finance that are practical.

At the level between countries, GEP has been included in the United Nations System of Environmental-Economic Accounting that examines features of environments in relation to economic factors. The UN Statistical Commission has indicated that GEP provides a measure with significance for value relating to environments, and the assessment conducted in two thousand twenty-three that examined accounting of environments and economic factors across multiple countries identified the work that China provides through initial implementation as examples that show importance for use in other countries [13,14]. This function in two different contexts—as an approach for use in policy within China and as a form that contributes to accounting of environments between countries—shows the effort that China provides for including value of environments in processes that determine policy within the country and in work that relates to maintaining environments across countries [2,3].

The strategies that operate at the level of the country and the standards for procedures have established a basis that shows strength, but the need that requires immediate response and the significance that relates to implementation of GEP in actual settings occur at the level of the village, in which the objectives that policy establishes are changed to results that relate to economic factors and to processes for making decisions in particular locations. In Lishui, the organizations that operate in villages and that use environments to provide economic benefits have demonstrated a function that shows main importance through combining the resources relating to environments that GEP identifies and changing these resources to income that groups share. Through this process that these organizations follow, the work that maintains environments has been related in clear ways to development of economic conditions in villages and to the objective that extends across multiple contexts of providing benefits that are similar for different groups [15,16].

# 4. Village-Level Implementation

China has worked to develop the concept of Gross Ecosystem Product into forms that allow practical use at the level of villages. A main approach involves creating entities that are referred to as "Two-Mountain Cooperatives" and these are established by local authorities to provide a method for managing resources that include forests, areas of grassland, and water supplies [1,2]. The cooperatives bring together assets that villages control and this allows communities in these areas to generate income from the value that these resources provide. In Lishui, authorities have established ten cooperatives that operate at the municipal level and the county level and the purpose is to combine resources and to develop markets for products that come from these resources, and this approach provides a way to use Gross Ecosystem Product within structures that involve collective ownership [3].

A different form that operates alongside the cooperative approach involves village-owned enterprises that are referred to as "Eco-empowered Village Companies" and these entities focus on managing assets that relate to the environment in ways that are more specialized [4,5]. The companies work to develop activities that include tourism that emphasizes the environment, forestry practices that maintain resources over time, trading of carbon credits, and products that are marketed with emphasis on environmental features. In Lishui, more than 170 companies of this type have been supported and these companies use the Zhejiang Ecological Products Trading Platform to sell products and the total value of transactions that have occurred through this platform since it began operations exceeds one 100 billion yuan [6]. A case that occurred in two thousand twenty-five involved a village located in a mountain area that transferred rights to a full set of assets relating to the environment and this generated 9.38 million yuan in revenue and this transaction is considered the first case in China that involves a verified village-level ecological product transaction [7,8].

These practices at the village level show that GEP provides a means not only for placing value on natural systems but also for establishing practical structures in institutions and finance that relate conservation of natural systems to development of rural areas and to policy goals for prosperity across the population [9,10]. China's work in this area provides a case that informs discussion across the world on methods for

measuring natural systems. The work shows that GEP functions as a practical approach that complements the United Nations System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA). The case demonstrates that methods for measuring natural systems can be integrated into structures for local governance and into organizations for collective economic activity [11,12].

# 5. International Comparison with SEEA- EA

The initiative in China that measures product from ecosystems shows considerable consistency with the approach that the United Nations presents for accounting related to environment and economy. This approach provides a framework that different countries use to measure extent of ecosystems and condition of ecosystems and flows that ecosystems provide. The framework that the United Nations developed was adopted in the year 2021. Within this framework, the measure that China uses corresponds to flows from ecosystems that are final, but the measure combines these flows into a single value [1,2]. The guidelines that China uses for technical work draw on concepts that the United Nations framework presents, and reports that the United Nations provides indicate that the definition that China uses follows principles from accounting work that was experimental [3]. Work from research at Stanford that examines capital from nature also indicates that the measure from China was recognized by the Commission for Statistics at the United Nations as an important development for including values from ecosystems in decisions related to economy [4].

Important differences between GEP and SEEA-EA occur despite this overall pattern. SEEA-EA provides a system for accounts that requires development of accounts for assets and condition in systems, whereas GEP provides an indicator that shows flows of services that appear to individuals making policy [5,6]. This orientation has allowed rapid use of GEP in the framework for civilization in China and has allowed applications including providing compensation, supporting finance, and supporting governance at the level of villages [7,8]. At the same time, challenges in methods and in institutions occur, including risks that values appear multiple times in accounts, coverage that does not include all services from systems, and use across regions that differs [9,10]. These problems continue to show gaps in research in developing standards, in combining data, and in work across levels of governance [11,12].

A development that appears important involves the establishment of systems using digital approaches for accounting related to GEP. Systems that operate as initial forms allow the use of methods that provide measures of GEP in automated forms across multiple levels in administration, and the objective over time is to provide application across the nation [13]. GDP differs from GEP in that GDP is used for comparison between regions, but GEP is intended for use in following change over time within the same region. Individuals in policy positions indicate that GEP that shows stability or increase suggests that protection of features in the environment occurs with development in the economy, but GEP that shows decrease indicates that development occurs but this development produces degradation in the environment. GEP operates in this context as a form of protection for features in the environment that is included in the system for governance, and this ensures that the direction of development remains in a form that is consistent with objectives relating to the ability to sustain conditions over time [14,3].

# 6. Challenges and Research Gaps

Despite swift institutionalization, GEP accounting still confronts intertwined methodological, institutional, and cognitive questions that need to be addressed in an orderly way . Cross-regional comparability is limited due to variations in service lists, boundary definitions, and valuation methods [1]. Although China's national documents are gradually aligned with the concepts of SEEA-EA, local practice remains divided on whether to institutionalize abiotic services and how to value regulating services [2,3]. Some advances have been made, as the standardized system constructed by Ouyang's group is currently piloting on internet and the discrepancies are expected to decrease when the system is implemented nationwide [4,5]. However, reconciliation with SEEA's asset and condition accounts is still pending, and methodological guidelines for indexation and deflation are still lacking, which threatens time-series comparability [6,7].

However, valuation adds extra layers of uncertainty. Converting ecological service flows into monetary values assumes market prices, replacement costs, and benefit transfers, which may impact the reliability of results [4]. Overlapping between provisioning and regulating services, as well as regional differences in unit values, also enhance the risks of double counting [8]. Therefore, transparent price catalogs, clear uncertainty assessment protocols, and valuation standards aligned with SEEA are urgently needed [1,3].

Data on factors remain limited at lower levels. Datasets for counties and villages show gaps, and measures for services in supporting contexts are not well developed [2]. Recent work using sensing from distance has provided better coverage for grasslands and wetlands [9,10], but approaches differ across types of settings. The design focuses on following over time, and this requires arrangements that maintain consistency in data and manage breaks that occur in structure [11,5].

Integration in institutions also remains limited across regions. Research groups often produce accounts, but these are not included in systems for fiscal management, planning for land use, or frameworks that evaluate performance [12]. Local programs in Lishui show possible directions. The approach uses four levels for accounting, provides mechanisms for compensation relating to conditions, and allows for trading of assets [13,14]. Innovations in finance have also developed. Loans that use accounts as basis for collateral and transactions involving assets across villages have expanded scenarios for application, but standards for valuation and disclosure are not unified. This introduces risks in finance and in management [15,16].

Participation from the public and awareness across society show limited development. Understanding among officials in local areas, individuals working in practice, and residents in communities remains limited and affects how practices relating to GEP spread and reduces acceptance of this approach in society. Studies examining specific cases show consistently that participation involving broad groups, distribution of benefits with transparency, and improvements in livelihood that provide tangible results are important for success over the long term [17,18]. Research using data

confirms further that awareness and norms in society affect significantly how willing individuals are to participate in practices that provide protection for ecological systems [19–21]. The experience from Eco-empowered Village Companies also indicates that distribution of benefits with transparency and mechanisms for communication that work in effective ways can reduce this gap [22].

Alignment with broader objectives for sustainability remains incomplete at this point. Studies that currently exist indicate possible synergies between GEP and major objectives at the national level such as achieving neutrality in carbon, conservation of biodiversity, and revitalization in rural areas [23,24], but frameworks for analysis that are systematic are still lacking in this area. Research examining spatial patterns shows further that relationships among GEP, GDP, and density of population differ significantly across different regions, and this indicates how important it is that integration of GEP into systems for planning at national and regional levels is sensitive to governance [25,26].

In sum, GEP should be understood not only as a tool for accounting that is technical, but also as an instrument for governance with implications for institutions that are broad. The next stage in development of this approach should provide focus on three priorities that are main: first, standardizing further the methods for accounting and protocols for valuation; second, embedding GEP in deeper ways into systems that are fiscal and frameworks for planning that are spatial; and third, strengthening awareness in society and participation so that GEP can provide function both as an indicator for policy that is robust and as a norm in society that shows wide acceptance.

# 7. Case Analysis: International Eco-villages vs. China's Eco-empowered Village Companies

An international eco-village can be seen as a community-driven experimental learning process where the values, cultural cognition and social norms of low-impact living are embedded in everyday life, while the Scottish Findhorn Ecovillage exhibits relatively stable eco-culture in the face of technical and governance challenges of community scale net-zero development [1–4]; whereas the Irish Cloughjordan Ecovillage institutionalizes consensus governance, low carbon building and volunteer networks into a community-driven transition pathway [5–8]. Beyond these individual examples, comparative studies demonstrate different paths to social outcomes. For example, during the physical expansion of Hurdal (Norway) and Findhorn (Scotland), developer-led financing in Hurdal resulted in rising housing costs and greater social exclusion, whereas Findhorn relied more on community and public financing to maintain affordability. In both cases, however, the gradual decline of onboarding and training programs weakened residents' shared competences as private property became more dominant [9]. From a discourse perspective, media representations of Hurdal have also shifted from "idealistic" to "entrepreneurial," reflecting a process of sustainability mainstreaming accompanied by increasing commercial orientation and boundary work [10]. Taken together, international eco-villages perform well as culture- and norm-based engines that nurture pro-environmental intentions, yet they often face structural constraints in institutional embedding and large-scale market expansion [9,10].

In contrast, China's eco-village practice places stronger emphasis on institutionalization and marketization through Eco-empowered Village Companies (EVCs) built upon GEP accounting. In Lishui, ecological assets such as forests and water resources are formally confirmed, valued, and contributed as equity to EVCs operating under a standard corporate governance structure (shareholders' assembly, board of directors, and managerial team), which supports brand operations, factor trading, green finance, and dividend-based benefit feedback [11,12]. At the village level, Xingyuan Village in Fujian Province provides clear empirical evidence of the link between ecological value realization and improvements in farmers' well-being [13]. In Tengtou Village (Ningbo, Zhejiang), staged industrial transformation under globalization—characterized by "factor flow → structural adjustment → functional expansion"—was driven by cadre leadership and the restructuring of collective enterprises, enabling the integration of industry and eco-tourism while maintaining environmental protection [14]. Changdai Village (Jiangsu) further demonstrates the effectiveness of public-sector design in place-making and rural renewal [15]. Evidence from ten ethnic tourism villages in the Wuling Mountain area shows that livelihood resilience under company-led management (0.3250) is higher than that under government-led (0.2984) and community-led (0.2442) models, with key influencing factors including household participation in tourism, access to training, education of core household members, and subsidy structures [16]. In addition, digital village programs have been shown to reduce transaction costs and enhance grassroots governance capacity [17,18]. Overall, the EVC + GEP pathway provides both resource–capability conditions and legal–market embedding for scalable and more durable governance across different regions.

From a comparative perspective, the two pathways are complementary rather than mutually exclusive. International eco-villages mainly contribute cognition- and norm-based mechanisms, which function as a form of "soft power" for the internalization of environmental values. By contrast, China's EVC + GEP approach provides resource–capability support and institutional–market embedding, which constitute the "hard conditions" for sustained collective action. Based on this comparison, a conceptual behavioral pathway can be outlined in which GEP-related awareness shapes attitudes, subjective norms, and perceived behavioral control, which in turn influence villagers' willingness to participate in ecological practices. This process is further conditioned by governance modes (company-led, government-led, or community-led) and by digital and media exposure. At the same time, livelihood resilience is a concrete manifestation of how corporate governance and institutional ecological accounting realize ecological value, in the sense that it enhances rural resilience and eventually achieves the goal of common prosperity [13,16,14,11,10,9].

# 8. Conclusion and Outlooks

The approach using measures of product from natural systems provides an important development in China for governing the environment by establishing a practical method that connects assessment of economic value with the value that natural systems provide. This approach complements the main economic measure by including an indicator that focuses on what natural systems provide, and this redirects attention in policy toward systematic recognition that natural

systems function as valuable assets [1,2]. The adoption of this accounting approach across China—including development of standards for methods and extensive programs at the village level—shows substantial progress in institutions for including the value that natural systems provide in planning for development [3]. The immediate nature of this change appears most clearly at the local level, and this is the level where requirements for protecting natural systems directly meet the requirements for development in rural areas. Mechanisms in institutions such as particular cooperative structures and companies in villages that focus on natural systems show how local actors use measures of product from natural systems to produce income, provide reasons for conservation, and establish specific pathways toward prosperity that is shared [4].

Three directions for future work appear important. First, methods for measurement require further development to provide consistency across different areas and to support more reliable results from the approach [5]. Second, systems using digital tools should receive additional development to allow ongoing data collection that occurs across multiple levels and that provides clear information [4]. Third, the effects of implementing the approach at the village level require more examination to show how these practices relate to livelihoods, to governance, and to development in rural areas over time [6]. At the international level, connecting the approach to global frameworks such as the system for environmental and economic accounts remains important for comparison across countries and for support from policy [1].

China provides a useful case by developing consistent methods, by including the approach in local governance, and by maintaining connection to international accounting frameworks. This case shows how ecological measurement can occur within systems for public decisions. The focus on village-level practice reveals significance for global development. Development that can continue over time requires that ecological values receive recognition and governance at locations where interactions between humans and nature occur most directly.

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