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How Eco-Efficiency Is the Forestry Ecological Restoration Program? The Case of the Sloping Land Conversion Program in the Loess Plateau, China

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Abstract: The Forestry Ecological Restoration Program (FERP) aims to restore the world's degraded forest landscapes to restore biodiversity and mitigate climate change. Scientific evaluation of eco-efficiency of forestry restoration programs (EEoFERPs) is the basis for developing and implementing inclusive and sustainable development policy measures. We take the world's largest FERP—China's Sloping Land Conversion Program (SLCP)—as an example. Using 314 county-level panel data in the Loess Plateau, the core area for the implementation of the SLCP, during 2002–2015, this study aims to evaluate the eco-efficiency of the Sloping Land Conversion Program (EEoSLCP) based on a DEA model and to measure the eco-efficiency dynamic changes through a Malmquist index model. The results show that: (1) The overall EEoSLCP of the Loess Plateau is at a low level, with an average efficiency of only 0.357 from 2002 to 2015. EEoSLCP is on an overall upward trend, mainly influenced by technical efficiency. (2) There are significant spatial differences in EEoSLCP among counties on the Loess Plateau, with an overall decreasing distribution trend from south to north and from southeast to northwest. (3) The Malmquist index of the EEoSLCP grew at an average annual rate of 17.7%, with technical efficiency changes being the most important factor driving its growth. Our results suggest that in the future, when implementing or designing FERPs, it is necessary not only to select the appropriate restoration plan precisely while respecting the laws of nature, but also to improve the management and technical level of FERPs accordingly.

Keywords: Forestry Ecological Restoration Program (FERP); eco-efficiency; Sloping Land Conversion Program (SLCP); Loess Plateau

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1. Introduction

Since the mid-20th century, the entropy increase caused by the rapid development of human society has led to the disorderly development of natural processes within the Earth [1], such as the decline of forests, soil erosion, land degradation, flooding, and loss of biodiversity, which have become the most serious ecological and environmental problems that hinder the development of human society [2,3]. Although this socio-economic development process is considered irreversible and this natural resource-based economic growth is not sustainable [4–6], by introducing ecological restoration programs as a negative entropy flow [7], not only can we reduce the overall entropy of the Earth, but more importantly, we can achieve win-win development for both humans and nature. This includes an unprecedented series of Forestry Ecological Restoration Programs (FERPs) implemented worldwide [8]. For example, the Prairie States Forestry Project in the United States [9], the Green Plan in Canada [10], the Green Dam Project in North Africa [11], the Natural Resources Management Project in Indonesia [12], the National Greening Program in South Korea [13], and the National Afforestation Program in Vietnam [14], etc. In response to the deteriorating ecological environment, China implemented a large number of forestry ecological restoration programs in the 20th century, including the "Sloping Land Conversion Program (SLCP)", the "Natural Forest Conservation Program (NFCP)", the "Three North Shelterbelt Development Program (TNSP)" and so on [15]. Among them, SLCP is the largest FERP in the world because it has the largest implementation area, the largest financial investment, and the largest number of people covered [16].

There is no doubt that FERPs around the world have achieved good ecological restoration results and played a vital role in the improvement of the ecological environment of each country [17]. However, we rarely know the eco-efficiency behind the great ecological effects of these programs. It is well known that the implementation of FERPs requires a large amount of financial, land, and other resources [18]. For example, since its implementation in 1999, the SLCP has invested a total of 517.4 billion yuan in finance, converting a total of 515 million mu of sloping farmland prone to soil erosion into forest and grassland, and involving 41 million farmers in the program [16]. In addition, after the United Nations (UN) General Assembly declared 2021–2030 the "UN Decade on Ecosystem Restoration" [8], countries around the world made a commitment to restore at least one billion degraded hectares of land by 2030 [19]. To achieve land restoration targets by 2030, UNEP and FAO estimate that investment of at least 200 billion USD per year by 2030 will be needed [20]. However, organizations driving activities on the ground are often underfunded and face long-term financial insecurity [8]. In this context, there is an urgent need to evaluate the eco-efficiency of forestry ecological restoration programs (EEoFERPs) in order to inform decision-makers in maximizing limited funds and optimizing resource allocation in FERPs, thus enabling us to better achieve the UN Sustainable Development Goals.

Cost–benefit analysis is the mainstream method used in most studies on eco-efficiency evaluation of FERPs. Birch et al. [21] conducted a cost–benefit analysis of different FERP scenarios in four drylands of Latin America, and he found that passive restoration was more ecologically efficient than active restoration in the implementation of FERPs. Molin et al. [22] used cost–benefit analysis in the design of the Atlantic FERP in Brazil to determine the most eco-efficient program implementation scenario. Schiappacasse et al. [23] analyzed the cost–benefit of the dryland FERP in central intelligence and found that the net benefit of the program was negative, and the program implementation was in a state of inefficiency. Newton et al. [24] evaluated the eco-efficiency of six FERPs in Latin America using cost–benefit analysis, and they concluded that the programs would achieve high eco-efficiency through a combination of passive and active restoration methods. Wang and Bennett [25] used cost–benefit analysis to evaluate the eco-efficiency of the Sloping Land Conversion Program (EEoSLCP) in northwest China, and found that the SLCP is generally effective, and if the value of ecosystem services generated by the SLCP is incorporated into the implementation of the SLCP, then the EEoSLCP will be further improved. Xian et al. [26] used cost analysis to evaluate the EEoSLCP in each province in China, and they found that the EEoSLCP varied greatly among provinces, and the different implementation modes in each province were the main reasons for the high and low eco-efficiency of each province; specifically, the eco-efficiency was higher when the fruit tree plantation mode was chosen, while the eco-efficiency was highest when the natural forest protection mode was chosen. Li et al. [27] attempted to apply the cost–benefit method instead of the slope method to identify different potential afforestation areas, and validated it under different implementation scenarios of SLCP. The results show that the potential afforestation areas identified by the cost–benefit method have higher eco-efficiency than those identified by the traditional slope method, and that the potential afforestation areas identified by the cost–benefit method are more conducive to fine afforestation management under resource-limited conditions.

While the above literature has broadened our understanding of EEoSLCP, two main limitations remain. First, the efficiency obtained based on the cost–benefit method is simply a single ratio of implementation costs to final benefits. Although simple and straightforward, it does not strictly reflect the changes in efficiency caused by changes in the allocation of different input indicators and does not give decision makers flexibility in their choices and an optimal set of ratios [28,29]. Second, as the basic unit for the implementation of SLCP [30], few studies have evaluated the EEoSLCP from the county level. Most of the existing studies on the EEoSLCP focus on micro-scale, such as a village or a small watershed [31], which will make it difficult to extend the research results to the practice of large-scale FERPs. Although some studies have further evaluated the EEoSLCP from the provincial scale [26], considering that a province contains many counties and the EEoSLCP may be significantly different among different counties, evaluating the EEoSLCP at the provincial level is probably ignoring the differences within counties, thus making it difficult to provide effective and differentiated policy recommendations for policy makers.

Our research goes beyond these two limitations in the literature. First of all, on the basis of defining the EEoFERP, taking the SLCP as a case, we constructed the eco-efficiency evaluation framework of the SLCP. Secondly, using 314 county-level panel data of the Loess Plateau, the core area for the implementation of the SLCP, from 2002 to 2015, the DEA model was used to measure the EEoSLCP in 314 counties of the Loess Plateau from a static perspective; then, the Malmquist index model was used to measure the dynamic changes of the EEoSLCP in 314 counties of the Loess Plateau from a dynamic perspective. The results of our study not only help to improve the EEoSLCP, but also provide references for other countries to evaluate the EEoFERP or design FERPs.

2. Materials and Methods

2.1. Study Area

The Loess Plateau of China is located in the eastern part of Asia and Europe (33°43′ –41°16′ N, 100°54′–114°33′ E), with a total area of about 6.49 × 10^5 km^2, which is a typical arid and semi-arid region in the world with a fragile ecological environment (Figure 1a). On the administrative scale of China, the Loess Plateau spans 341 counties in 7 provinces of Qinghai, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, and Henan, of which 314 counties are involved in the SLCP (Figure 1b). Loess Plateau is high in the northwest and low in the southeast, with an average altitude of 1500–2000 m (Figure 1b). The distribution of land use types on the Loess Plateau is closely related to bioclimatic zoning (Figure 1c), which transitions from semi-humid areas in the southeast (where land use is dominated by forest and cropland) to semi-arid areas in the center (where land use is dominated by grassland and cropland) to arid areas in the northwest (where land use is dominated by unused land and grassland). The Loess Plateau has 70% of the world's loess soils, which are loose and have poor erosion resistance. The average annual rainfall in the region is 144–812 mm, mostly concentrated in the summer, and there are many heavy rainstorms, which have a strong ability to scour the ground [32]; The Loess Plateau has a low level of socio-economic development and a large agricultural population, and the improper exploitation and use of land has led to a continuous deterioration of the ecological environment [33]. The above-mentioned natural and social factors make the Loess Plateau one of the regions with the most serious soil erosion in the world [34]. Since the implementation of the SLCP in 1999, the Loess Plateau has achieved remarkable ecological results, the vegetation has increased (Figure 1d), soil and water loss has been effectively controlled, and the ecological environment has been greatly improved [35].

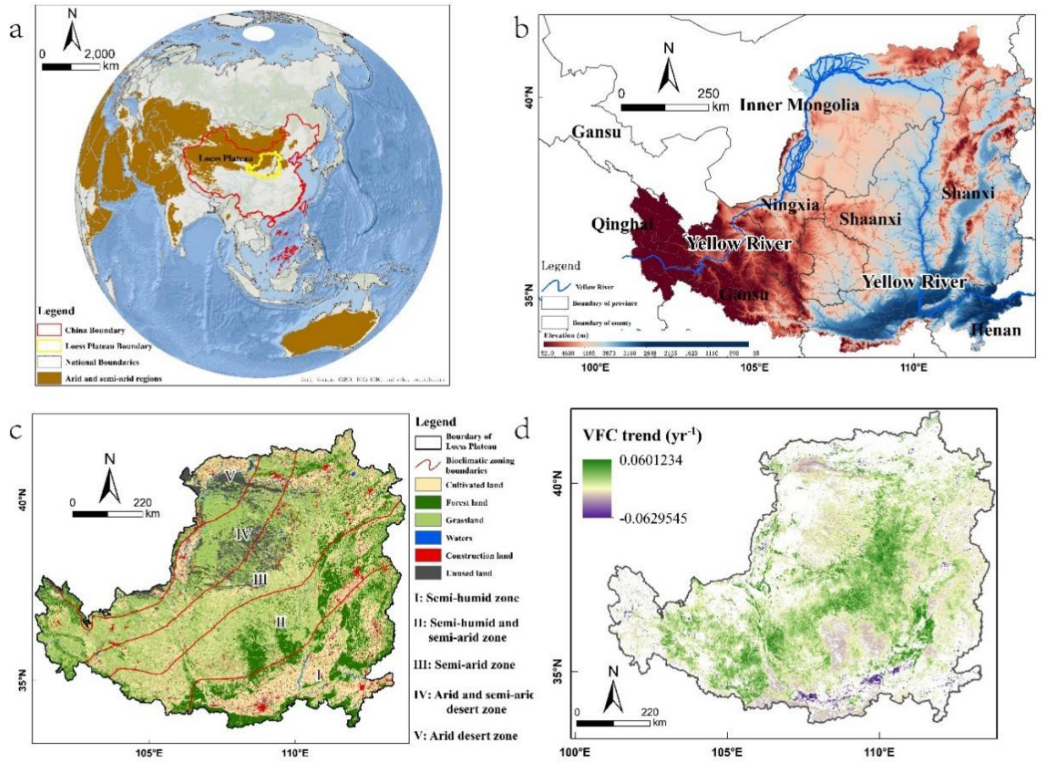

Figure 1. Study area. (**a**) Location of Loess Plateau in the world and China. (**b**) Topography and administrative divisions of the Loess Plateau. (**c**) Bioclimatic zoning of the Loess Plateau and land use types in 2018. (**d**) The vegetation fraction cover (VFC) of Loess Plateau has changed significantly ($p < 0.05$) from 2002 to 2018.

2.2. Methodology

Figure 2 shows the analytical framework and the methodology used in this paper. First, we collected data to reflect the inputs and outputs of SLCP. Second, the DEA-BCC model was used to evaluate the relatively static EEoSLCP between different counties in Loess Plateau. Then, the Malmquist index was adopted to evaluate the dynamic efficiency changes of EEoSLCP for different counties during 2002–2015. Finally, the annual difference of EEoSLCP in Loess Plateau and the spatial difference of each county were analyzed and discussed.

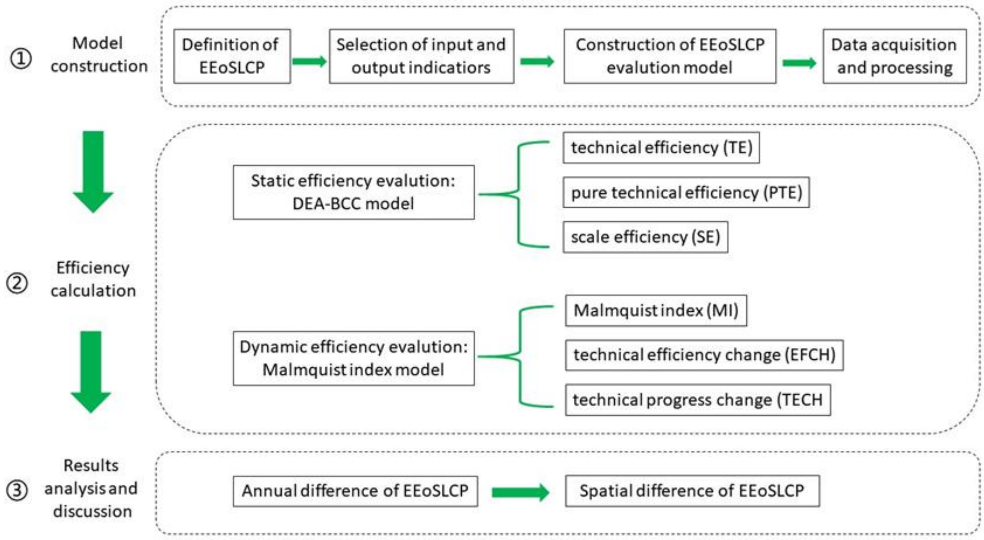

Figure 2. The analytical framework and the methodology used in this study.

2.3. Definition of EEoFERP

The EEoFERP can be defined by connecting the connotation of eco-efficiency [36] and the operation practice of FERP. The EEoFERP is the ratio between the outputs of the obtained products and ecological effects, and the inputs of resource consumption and environmental load in the FERP implementation. It actually reflects an empirical relationship of FERP between the implementation activities and the ecological benefits and losses. Obviously, high efficiency means acquiring greater economic and ecological effects with less investment in resources in the FERP. Following the definition of EEoFERP, relevant studies, and data availability, the evaluation index system of EEoSLCP is constructed from the perspectives of inputs and outputs (Table 1).

Table 1. EEoSLCP measurement index system.

Indicator	Variable	Variable Description	Unite
Input	Land	Accumulated area of SLCP in each county	*Mu* [1]
	Capital	Accumulated financial investment of SLCP in each county	*Yuan* [2]
	Labor	Accumulated households participating in SLCP in each county	*Hu* [3]
	≥10 °C accumulated temperature	Average annual ≥10 °C accumulated temperature in each county	°C
	Precipitation	Average annual precipitation in each county	mm
Output	VFC	Cumulative increase in average VFC for each county compared to 2002	%
	SR	Cumulative increase in average SR for each county compared to 2002	$t\cdot hm^{-2}\cdot yr^{-1}$
	VCS	Cumulative increase in average VCS for each county compared to 2002	$gC\cdot m^{-2}\cdot yr^{-1}$
	WC	Cumulative increase in average WC for each county compared to 2002	dimensionless, value range 0–1
	Biod	Cumulative increase in average Biod for each county compared to 2002	dimensionless, value range 0–1

[1] The *Mu* is a unique area unit in China that mainly used for land measurement, 1 *Mu* equals 1/15 hm^2 (https://www.convertunits.com/from/mu/to/hectare). [2] According to the foreign exchange rate released by the U.S. Federal Reserve Board on 25 April 2022, 1 USD equals 6.50 *Yuan* (https://www.federalreserve.gov/releases/h10/current/). [3] The *Hu* is a unique number unit in China that mainly used for number of households measurement. According to data published by China's National Bureau of Statistics, 1 *hu* equals 3 people (http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/201104/t20110428_30327.html).

2.3.1. Input Indexes of EEoFERP

The inputs for FERPs come from two main sources. The first is the socio-economic factors required for FERPs, such as financial, afforestation area, and labor inputs. Secondly, the implementation of FERPs must also consider the inputs of natural elements [37], such as precipitation, temperature, and soil. Based on this, when measuring the inputs to the SLCP, we selected a total of five input indicators from the following two aspects. Firstly, starting from the elements invested in the practice of SLCP, three input indicators were selected: land, capital, and labor. Land refers to the accumulated area converted from sloping land to forest in the process of implementing SLCP in each county of Loess Plateau. The capital refers to the accumulated financial investment of the central government in SLCP in each county of the Loess Plateau. The labor force refers to the accumulated number of households participating in SLCP in each county of the Loess Plateau. Secondly, considering that precipitation and temperature are the dominant factors affecting vegetation growth on the Loess Plateau [38–40], we selected the average annual precipitation and ≥10 °C average annual cumulative temperature of each county as the natural factor inputs for the SLCP (Table 1).

2.3.2. Output Indexes of EEoFERP

In the selection of output indicators of FERPs, we need to follow the following two principles. First, we need to consider the lag of forestry outputs relative to inputs [37]. Secondly, in order to accurately measure the ecological effects of FERPs, we should mainly focus on the marginal benefits brought by FERPs in terms of ecological effects [41]. Considering that the implementation of the FERP in the following year does not remove the afforestation results of the FERP implemented in the previous year, the marginal benefit obtained from the implementation of the FERP is essentially a cumulative amount. Specifically, the ecological effect after the implementation of FERP minus the ecological effect that can be produced before the implementation of FERP, the difference between the two is the cumulative marginal increment of the ecological effect obtained by the implementation of FERP.

In our study, first, considering that the new afforestation cannot produce ecological effect immediately, we must consider the lag of ecological effect output relative to input of the SLCP. Li et al. [42] pointed out in his research that the biological production of tree species used in the SLCP in the Loess Plateau will reach its peak in five years, and then begin to decline. Qian et al. [43] further pointed out in his research that three years after the implementation of the SLCP, it is the best cycle for new afforestation to produce ecological effects in the Loess Plateau. Therefore, we set the lag of output relative to input in the SLCP in the Loess Plateau as three years. For example, in the Loess Plateau, the input of SLCP in 2002 corresponds to the output in 2005, and the input of SLCP in 2003 corresponds to the output in 2006. The pattern continues in subsequent years and so on, until 2015 inputs correspond to 2018 outputs. Second, the output of the SLCP in a certain year on the Loess Plateau should be the ecological effect produced in that year after the implementation of the SLCP on the Loess Plateau minus the existing ecological effect at the beginning of the SLCP in 2002. That is, the increment of ecological effect in that year compared with 2002 is the output of the SLCP. In summary, a total of five indicators were selected to characterize the output of the SLCP in our study. First of all, the original purpose of the SLCP is to reduce soil erosion and increase soil conservation by planting trees. Based on this, we selected two items, vegetation fraction cover (VFC) and soil retention (SR), as output indicators. Second, the SLCP also promotes the increase of ecosystem carbon sequestration [44,45], water conservation [46], and biodiversity [47]. Based on this, we selected three more items as output indicators, namely vegetation carbon sequestration (VCS), water conservation (WC), and biodiversity service (Biod).

2.4. Methods

2.4.1. Ecological Effects Calculation of SLCP

Firstly, based on the multi-source remote sensing data such as NDVI, NPP, and meteorology, this study, with the technical support of GIS, calculated the VFC of the Loess Plateau from 2002–2018 according to the literature [48]; calculated the VCS of the Loess Plateau from 2002–2018 according to the literature [49], and validated the VCS results by referring to the literature [50–52]; calculated the SR of the Loess Plateau from 2002–2018 according to the literature [53–58], and validated the SR results by referring to the literature [59–61]; calculated the Biod and WC of Loess Plateau from 2002–2018 according to literature [62–65], respectively. Secondly, five ecological effect outputs were obtained statistically for 314 counties in the Loess Plateau from 2002 to 2018 using ArcGIS 10.7 software. The detailed calculation process for the five ecological effects can be found in the Supplementary Materials.

2.4.2. DEA Model

DEA is a linear programming method to construct the production frontier of the observed data, and then calculate the relative efficiency of the Decision Making Unit (DMU). The DEA model does not need to know or give the weights of each input factor and output factor in advance, and does not need to deal with the data index dimensionless, it is one of the ideal methods to evaluate the allocation efficiency of multi-input and multi-output resources. The DEA model can be divided into CCR model and BCC model. CCR model is the first DEA model proposed by Charnes et al. [66] on the basis of Farrell's [67] production performance measurement theory. Subsequently, in Banker et al. [68], based on the CCR model, the scale return invariance setting of CCR model is improved, and the BCC model with variable scale return is proposed. That is, when not all decision units are at optimal scale, the variable returns to scale (VRS) model allows the measurement of technical benefits without being influenced by scale benefits. The BCC model can be decomposed into pure technical efficiency (PTE) and scale efficiency (SE) while measuring the technical efficiency (TE), The decomposition formula is: TE = PTE × SE. While TE reflects the comprehensive efficiency level of each DMUs, PTE reflects the level of efficiency of each DMUs in utilizing and managing inputs under a certain production technology, and SE reveals the scale level of each DMUs. The range of these three efficiencies is all between (0, 1). A larger efficiency score means higher efficiency. Taking into account the actual situation of the implementation of SLCP and the characteristics of the EEoSLCP with more inputs, more outputs, and variable returns to scale, the DEA–BCC model is used to calculate the EEoSLCP. The specific model is as follows:

$$\min\theta_z - \varepsilon\left(\sum_{i=1}^{m} s_i^{\,-} + \sum_{r=1}^{s} s_r^{\,+}\right) \tag{1}$$

$$s.t.\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^{\,-} = \theta_z i x_{rz}, i = 1,2,\cdots,m \tag{2}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} - s_i^{\,+} = y_{rz}, r = 1,2,\cdots,s \tag{3}$$

$$\sum_{j=1}^{n} \lambda_j = 1 \tag{4}$$

$$\theta_0, \lambda_j, s_i^{\,-}, s_i^{\,+} \geq 0 \tag{5}$$

where θ_z is the EEoSLCP in the Loess Plateau under VRS, where n = 314 is the number of counties in the Loess Plateau, j represents the j county, which can also be called the j DMU, m and s respectively represent the number of input–output indicators of SLCP, x_{ij} represents the input of the i factor in the j county, y_{rj} represents the r output in the j county, and λ_j is the weight coefficient of the input index of a certain factor in the j county. When the sum of S_i^- and S_r^+ is 0, all input and output are in a relaxed state, θ_z = 1, and the EEoSLCP is in complete efficiency. When the sum of S_i^- and S_r^+ is not 0, θ_z < 1, the EEoSLCP is in incomplete efficiency, and the complete efficiency can be achieved again by adjusting the level of input or output.

In our study, the EEoSLCP of the Loess Plateau from 2002 to 2015 was calculated by using the DEA–BCC model solving tool in MAXDEA 8.0 software, and the TE, PTE, and SE values of EEoSLCP were obtained by further decomposition. Meanwhile, based on the average values of TE, PTE, and SE of 314 counties in the Loess Plateau from 2002 to 2015, according to the actual situation of eco-efficiency distribution, we classified the EEoSLCP into the following four levels: high efficiency (0.75 ≤ efficiency value < 1), medium-high efficiency (0.5 ≤ efficiency value < 0.75), medium-low efficiency (0.25 ≤ efficiency value < 0.5), and low efficiency (efficiency value < 0.25). Then, using ArcGIS 10.7 software, the spatial distribution of counties with different efficiency levels in the Loess Plateau was visualized.

2.4.3. Malmquist Index Model

Because the DEA–BCC model can only compare the efficiency of DMUs horizontally at the same point in time and cannot compare cross-period panel data, it is difficult to find the dynamic changes and trends of efficiency. To solve this problem, Färe et al. [69] constructed a DEA-based MI model to measure the dynamic changes of production efficiency in different periods based on the MI proposed by Malmquist [70], and it has been widely used in the empirical analysis.

The MI from time t to $t + 1$ can be expressed as:

$$M_t\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = \frac{D^t\left(x^{t+1}, y^{t+1}\right)}{D^t\left(x^t, y^t\right)}, M_{t+1}\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = \frac{D^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D^{t+1}\left(x^t, y^t\right)} \quad (6)$$

where (x^t,y^t) is the input–output vector in time t and (x^{t+1},y^{t+1}) is the input–output vector in time $t + 1$. The change from (x^t,y^t) to (x^{t+1},y^{t+1}) represents the productivity change in the input–output relationship, and the main reason for the change is because of the change in the level of technology and technical efficiency. $D^t(x^t,y^t)$ and $D^{t+1}(x^{t+1},y^{t+1})$ are distance functions. $D^t(x^t,y^t)$ is the level of technical efficiency in time t expressed in terms of the technology in time t. $D^{t+1}(x^{t+1},y^{t+1})$ is the level of technical efficiency in time $t + 1$ expressed in terms of the technology in time t. $D^{t+1}(x^t,y^t)$ is the technical efficiency level in time t expressed in terms of technology in time $t + 1$, and $D^{t+1}(x^{t+1},y^{t+1})$ indicates the technical efficiency level in time $t + 1$ expressed in terms of technology in time $t + 1$.

The change in MI efficiency over adjacent periods is measured as the geometric mean of two indices.

$$M\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = \left[\frac{D^t\left(x^{t+1}, y^{t+1}\right)}{D^t\left(x^t, y^t\right)} \times \frac{D^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D^{t+1}\left(x^t, y^t\right)}\right]^{1/2} \quad (7)$$

If MI < 1, it indicates that the total efficiency decreases from period t to time $t + 1$, MI > 1 indicates that the total efficiency increases from time t to time $t + 1$, and if MI = 1, it indicates that the total efficiency does not change from time t to time $t + 1$. MI can be decomposed into technical efficiency change (EFCH) and technical progress change (TECH). The formula is:

$$M_{t+1}\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = \left[\frac{D^{t+1}\left(x^{t+1},y^{t+1}\right)}{D^t\left(x^t,y^t\right)}\right] \times \left[\frac{D^t\left(x^{t+1},y^{t+1}\right)}{D^{t+1}\left(x^{t+1},y^{t+1}\right)} \times \frac{D^t\left(x^t,y^t\right)}{D^{t+1}\left(x^t,y^t\right)}\right]^{1/2} \quad (8)$$

where EFCH = $\frac{D^{t+1}\left(x^{t+1},y^{t+1}\right)}{D^t\left(x^t,y^t\right)}$, represents the technical efficiency change from time t to $t + 1$, and TECH = $\left[\frac{D^t\left(x^{t+1},y^{t+1}\right)}{D^{t+1}\left(x^{t+1},y^{t+1}\right)} \times \frac{D^t\left(x^t,y^t\right)}{D^{t+1}\left(x^t,y^t\right)}\right]^{1/2}$, represents the technical progress change from time t to $t + 1$.

EFCH measures whether inputs are being wasted in the production process and whether resources are being allocated efficiently. If EFCH > 1, it means that the EEoSLCP is closer to the production frontier at time $t + 1$ than at time t, which indicates an increase in technical efficiency. If EFCH < 1, it means that the EEoSLCP is further away from the production frontier at time $t + 1$ than at time t. This indicates that there are problems in the production process, such as unreasonable resource allocation, that lead to lower technical efficiency.

TECH can measure the technological innovation degree. If TECH > 1, it means that the technology of the SLCP at time $t + 1$ has improved than at time t, thus prompting an increase in output; if TECH < 1, it means that the technology of the SLCP at time $t + 1$ has regressed than at time t, thus leading to a decrease in output.

In our study, the MI of EEoSLCP in Loess Plateau from 2002 to 2015 was calculated by using Malmquist index tool in MAXDEA 8.0 software, and the values of EFCH and TECH were further decomposed. Meanwhile, based on the average values of MI, TECH, and EFCH for all 314 counties during the period 2002 to 2015, the spatial discrepancies of MI, TECH, and EFCH are displayed by using ArcGIS 10.7 software.

2.5. Data Sources

The data source of this study contains two main parts, one is multi-source remote sensing data and the other is SLCP statistics. Among them, the raster resolution of remote sensing data is uniformly processed to 500 m × 500 m. The coordinate system used in this study is uniformly Krasovsky_1940_Albers. The data details are shown in Table 2.

Table 2. Data sources and descriptions.

Category	Descriptions	Spatial Resolution	Time Scale	Data Sources and Related References
Land use map	The data were verified by field investigation, and the accuracy of interpretation was more than 90%	30 × 30 m	2000, 2005, 2010, 2018	Data Center for Resources and Environmental Sciences, Chinese Academy of Sciences (https://www.resdc.cn/Datalist1.aspx?FieldTyepID=1,3) [71,72].
Climate data	Precipitation, temperature, and ≥10 °C accumulated temperature	Point scale	2002–2018	Chinese National Meteorological Science Data Service Center (http://data.cma.cn/); Chinese Ecosystem Research Network (http://www.doi.org/10.11922/sciencedb.664)
DEM (Digital Elevation Model)	SRTM DEM (Shuttle Radar Topography Mission Digital Elevation Model)	90 × 90 m	2000	OpenTopography (https://portal.opentopography.org/dataSearch?search=SRTM)
NDVI (Normalized Difference Vegetation Index)	MODIS (Moderate-resolution Imaging Spectroradiometer) MOD13A3 and MOD17A3HGF product	1 × 1 km	2002–2018	LAADS DAAC (https://ladsweb.modaps.eosdis.nasa.gov/)
NPP (Net primary productivity)		500 × 500 m		
Soil data	soil sand fraction (%), soil silt fraction (%), soil clay fraction (%), soil organic carbon content (%)	1 × 1 km	2014	Harmonized World Soil Database (HWSD) version 1.2 (https://www.fao.org/soils-portal/data-hub/soil-maps-and-databases/)
Basic Geographic Information Data	Administrative Boundaries, Loess Plateau Boundary	Shapefile	-	China Geographic Information Monitoring Platform (https://www.webmap.cn/commres.do?method=result100W); Data Center for Resources and Environmental Sciences, Chinese Academy of Sciences (https://www.resdc.cn/data.aspx?DATAID=140)
SLCP data	Financial, area, and labor input for SLCP	Text data	2002–2015	South-Central Forestry Survey Planning and Design Institute of the National Forestry and Grassland Administration of China (http://www.forestry.gov.cn/sites/zny/zny/) and China Forestry Statistical Yearbook (https://data.cnki.net/yearbook/Single/N2021060073)

3. Results

3.1. Static Efficiency Based on DEA–BCC Model

3.1.1. The Annual Difference in Static Efficiency

As can be seen from Figure 3, from the change in TE, it can be concluded that the overall EEoSLCP is on the rise, increasing from 0.260 in 2002 to 0.465 in 2015, with an average annual growth rate of 5.6%. However, from the overall change in the EEoSLCP over time, the overall EEoSLCP on the Loess Plateau is low, with an average value of only 0.357 during 2002–2015, indicating that the EEoSLCP in most counties on the Loess Plateau is far from the relatively effective production frontier, and there is great room for improving the EEoSLCP. Specifically, compared to a relatively effective production frontier, DEA ineffective counties on the Loess Plateau can increase the ecological effects of SLCP by 65% without increasing inputs, or can reduce fallowing financial, area, and labor inputs by 65% while maintaining the established ecological effects of SLCP outputs.

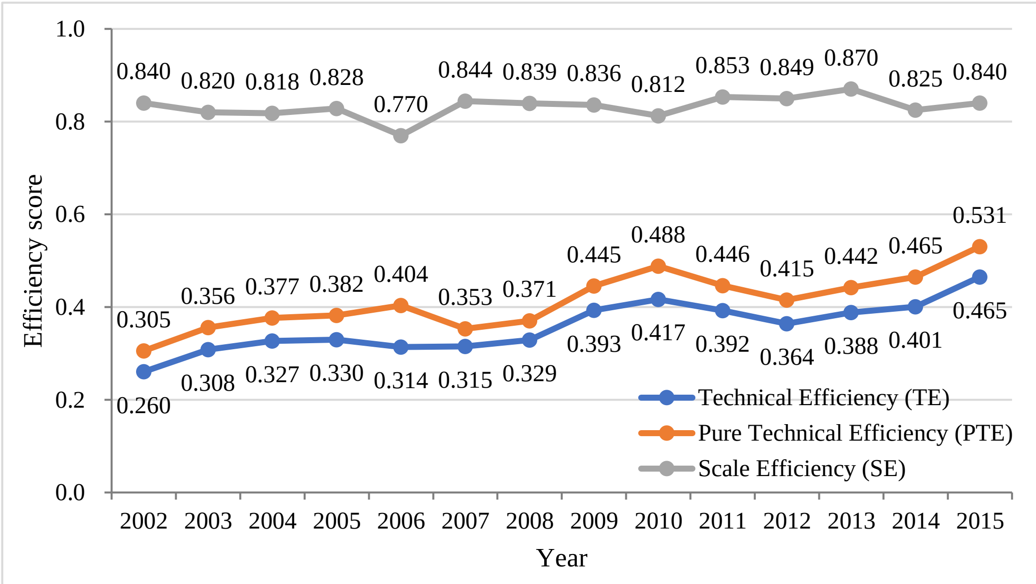

Figure 3. The annual change trends of TE, PTE, and SE of SLCP from 2002 to 2015.

The PTE and SE obtained from the decomposition of the BCC model show that the interannual trend of PTE is basically the same as TE, increasing from 0.305 in 2002 to 0.531 in 2015, with an average annual growth rate of 5.27%, indicating that PTE is the most important factor affecting TE. In addition, SE fluctuated less between 2002 and 2015, with the average value remaining around 0.832 over the 14-year period, generally higher than TE and PTE, which again suggests that the lower TE is mainly due to the influence of the lower PTE.

To further investigate the contribution of PTE and SE to TE more specifically, we used TE as the dependent variable and PTE and SE as the independent variables and plotted scatter plots separately using Stata 17.0 software to explore the correlation between them. As reflected in Figure 4, the scatter points representing SE are concentrated on the right side of the 45-degree diagonal line (Figure 4a), while the scatter points representing PTE are concentrated near the 45-degree diagonal line (Figure 4b), indicating that the number of counties with higher SE values in the Loess Plateau is more than the number of counties with higher PTE values, which further verified that PTE is the main contributing factor for the low TE.

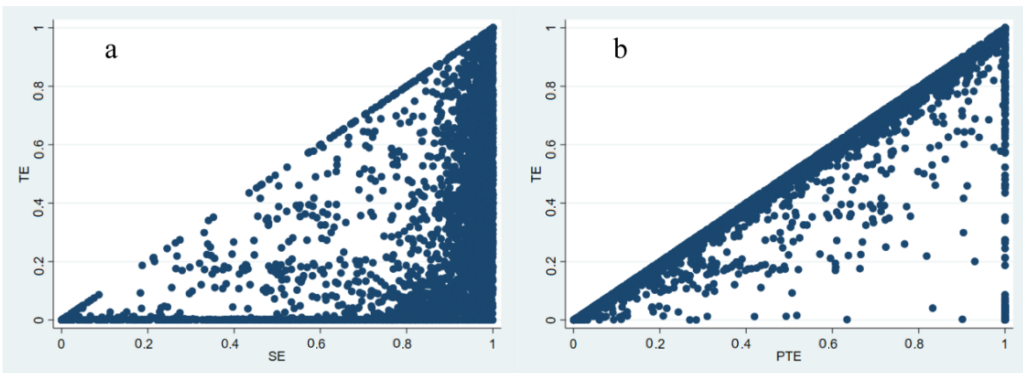

Figure 4. The contribution of (**a**) PTE to TE and (**b**) SE to TE.

3.1.2. County Difference in Static Efficiency

As shown in Figure 5a, there are 108 counties with TE values higher than 0.5, accounting for 33.44%, while the remaining 206 counties with TE values lower than 0.5, accounting for 65.61%. In terms of spatial distribution, counties with medium-high TE values are concentrated in the southern and eastern parts of the Loess Plateau, while counties with medium-low TE values are concentrated in the western, central, and northern parts of the Loess Plateau, and overall, the TE values of the Loess Plateau counties are decreasingly distributed from south to north and from southeast to northwest. The above results indicate that the EEoSLCP in most counties of the Loess Plateau is low, and there is still more room to improve the eco-efficiency.

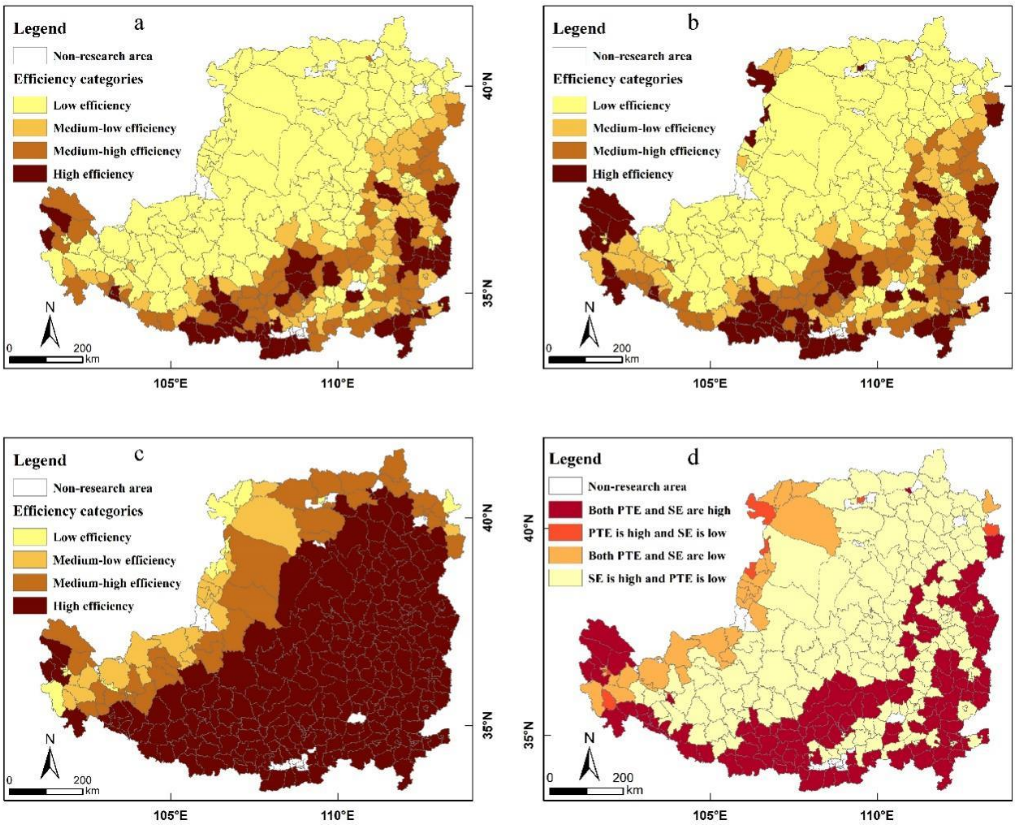

Figure 5. The average value of (**a**) TE, (**b**) PTE, and (**c**) SE for 314 counties from 2002 to 2015. (**d**) The contribution of PTE and SE to TE for 314 counties from 2002 to 2015.

As shown in Figure 5b, 125 counties in the Loess Plateau have PTE values higher than 0.5, accounting for 39.81%, while the remaining 189 counties have PTE values lower than 0.5, accounting for 60.19%. The spatial distribution of county PTE values is basically the same as that of TE, but there are more counties with high PTE values than those with high TE values, and correspondingly fewer counties with low PET values than those with low TE values, and the increased counties with high PTE values are mainly distributed in the southern and western parts of the Loess Plateau.

However, as shown in Figure 5c, the distribution of SE values was different from TE efficiency and PTE values. Firstly, in terms of quantity, there are as many as 278 counties with SE values greater than 0.5, accounting for 88.54%, and the remaining counties with SE values less than 0.5 are only 36, accounting for 11.46%. This indicates that the majority of counties in the Loess Plateau are at a high level of SE. Secondly, in terms of spatial distribution, different from TE and PTE variations, SE shows an overall increasing distribution from south to north and from southeast to northwest in spatial terms.

To further explore the contribution of PTE and SE to TE in different counties, all the 314 counties are classified into four categories: (1) Both PTE and SE are high, and both PTE and SE are greater than 0.5 in this category of counties, indicating that TE is main source of growth by both PTE and SE. From Figure 5d, a total of 115 counties belong to this category and are concentrated in the southern and southeastern regions of the Loess Plateau. (2) PTE is high and SE is low. These counties have PTE greater than 0.5 and SE less than 0.5, indicating that PTE is the main source of growth in TE, while SE has weakened the increases in TE. From Figure 5d, only 10 counties belong to this category, sporadically distributed in the western, northwestern, and northeastern regions of the Loess Plateau, indicating that in SE is not an obstacle weakens the growth of most counties in the Loess Plateau. (3) SE is high and PTE is low. These counties have SE greater than 0.5 and PTE less than 0.5, indicating that SE is the main source of promoting TE growth, while PTE has weakened the increases in TE. From Figure 5d, 163 counties belong to this category, accounting for 51.91%, which indicates that the inputs of the SLCP are not effectively utilized in these counties, resulting in wasted inputs and insufficient outputs. Therefore, these counties should improve PTE by accelerating technological innovation, which will ultimately contribute to TE growth. (4) Both SE and PTE are low, and both SE and PTE in these counties are less than 0.5, indicating that SE and PTE together weaken the growth of TE. From Figure 5d, 26 counties belong to this category and are mainly located on the southwest-northwest edge of the Loess Plateau.

3.2. Dynamic Efficiency Based on the Malmquist Index Method

3.2.1. The Annual Difference in Dynamic Efficiency

From Table 3, it can be obtained that the MI of the EEoSLCP increased by 17.7% on average, the EFCH increased by 16.8% on average, and the TECH increased by 1.8% on average from 2002 to 2015. This indicates that the improvement in technical efficiency was the main reason for the improvement in the EEoSLCP during this period, and the contribution of technical progress was small. Further analysis shows that MI is less than 1 in the three time periods of 2005–2006, 2010–2011, and 2013–2014, which indicates that the EEoSLCP has a decreasing trend in the above three time periods. The main reason for the decrease is due to the combined decrease of EFCH and TECH, and it is mainly due to the decrease of TECH. In addition, MI is greater than 1 in the rest of the time periods, indicating that the EEoSLCP is on an increasing trend, with an increase of 12.3%, 28.5%, 7.1%, 11.9%, 17.3%, 54.6%, 12.8%, 6.5%, 23.3%, and 72.1%, in that order. The increase is mainly contributed to by the combined improvement of EFCH and TECH, but the contribution of EFCH is much larger than that of TECH.

Table 3. Annual differences of the MI and its decomposition from 2002 to 2015.

Years	MI	EFCH	TECH
2002–2003	1.133	1.600	0.708
2003–2004	1.285	1.044	1.230
2004–2005	1.071	1.224	0.875
2005–2006	0.969	0.987	0.982
2006–2007	1.119	1.033	1.083
2007–2008	1.173	1.040	1.127
2008–2009	1.546	1.454	1.063
2009–2010	1.128	1.206	0.935
2010–2011	0.878	1.016	0.864
2011–2012	1.065	0.877	1.215
2012–2013	1.233	1.196	1.031
2013–2014	0.987	1.040	0.949
2014–2015	1.721	1.469	1.172
Mean	1.177	1.168	1.018

3.2.2. County Difference in Dynamic Efficiency

As displayed in Figure 6a, there are 305 counties with MI values greater than 1, indicating that 97.13% of counties have been making good improvements in EEoSLCP during the period from 2002 to 2015. Among them, 214 counties have an MI improvement range of (0, 24.32%), 66 counties have an improvement range of (24.33%, 49.05%), and 25 counties have an improvement range of (49.05%, 109.92%). The counties with larger MI improvement are mainly located in the western, central, northeastern, and northwestern regions of the Loess Plateau. However, there are still 9 counties with MI values less than 1 during the period 2002–2015, indicating that these 9 counties did not make good use of the various factors invested in the implementation of the SLCP during the period 2002–2015, with a decreasing range of (0, 34.28%) for the EEoSLCP. Its spatial distribution is mainly in the northeastern part of the Loess Plateau.

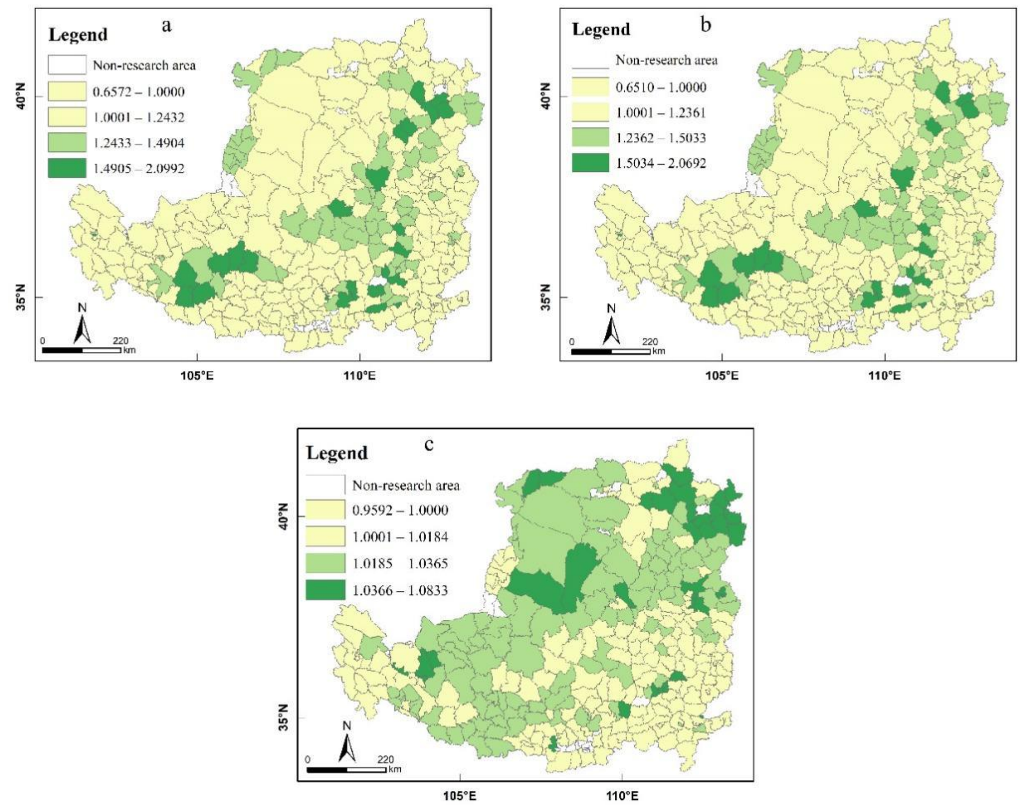

Figure 6. The average value of (**a**) MI, (**b**) EFCH, and (**c**) TECH for 314 counties from 2002 to 2015.

As shown in Figure 6b, 298 of the 314 counties in the Loess Plateau have EFCH values greater than 1. This indicates that during the period 2002–2015, the management level of the SLCP in the majority of counties on the Loess Plateau improved and the allocation structure of the input factors of the SLCP was continuously optimized. Among them, 213 counties have an EFCH value improvement range of (0, 23.62%), 63 counties have an improvement range of (23.63%, 53.88%), and 22 counties have an improvement range of (53.89%, 106.92%). However, 11 counties still showed a decrease in EFCH values between 2002 and 2015, with a decrease range of (0, 34.9%). The spatial distribution of EFCH values is basically consistent with the distribution of MI, and the increase range is also basically the same, which once again indicates that the MI values of the Loess Plateau counties are mainly influenced by EFCH changes.

As shown in Figure 6c, among the 314 counties in the Loess Plateau, 286 counties have TECH values greater than 1, indicating that the majority of counties in the Loess Plateau have made technical progress in the implementation of the SLCP between 2002 and 2015, but the progress increase is small. Among them, 141 counties have a TECH improvement range of (0, 1.84%), 108 counties have an improvement range of (1.85%, 3.65%), and 37 counties have an improvement range of (3.66%, 8.33%). TECH is mainly spatially distributed from southeast to northwest and from south to north in an increasing manner. The counties with large TECH increases are mainly concentrated in the northeast corner region of the Loess Plateau. However, 28 counties still showed a decrease in TECH between 2002 and 2015, with a decrease range of (0, 4.08%), spatially distributed mainly in the northwest, southeast, and parts of the west.

4. Discussion

According to the evaluation results of DEA model, the EEoSLCP in the Loess Plateau has been at a low level, and the average value from 2002 to 2015 is only 0.357, which may be closely related to the fact that the SLCP is a top-down and government-led FERP [73,74]. First, SLCP adopts a "top-down" implementation model. After the central government determines the task indicators of SLCP, the provincial, municipal, and county forestry departments allocate the task indicators at each level, which has significant characteristics of a socialist state planning system and has certain compulsory aspects [74]. Before the implementation of SLCP, farmers did not participate in the discussion and planning of SLCP implementation, but were only passively included in the implementation of SLCP, which made SLCP unable to precisely select compensation targets (identify the largest potential ecosystem service providing farmers), coupled with the high compensation standard of SLCP, thus leading to the low EEoSLCP. Second, the implementation of the SLCP was promoted too quickly, coupled with the lack of historical experience, leading to the general problem of poor planning quality and imperfect supervision and management mechanisms [75,76], resulting in low EEoSLCP. This was also confirmed by the results of our study. From Section 3.1, it can be obtained that PTE is the most important factor affecting TE in both time and space, while the low PTE indicates that the management and technical level are the main factors limiting the EEoSLCP. Furthermore, from Figure 3, we can see that the EEoSLCP grows with the growth of PTE, which benefits from the fact that the SLCP continuously learns from the pre-program experience during the implementation process, which prompts the improvement of technology and management, which is consistent with the conclusion of previous studies [75,77].

The EEoSLCP in 314 counties of the Loess Plateau decreased from south to north and from southeast to northwest in spatial distribution, which is not only affected by PTE in each county, but also closely related to natural factors. Previous studies have shown that climatic factors such as precipitation and temperature are important factors that dominate the vegetation growth on the Loess Plateau [38–40]. The counties with high EEoSLCP are concentrated in semi-humid areas (Figures 1c and 5a), where the precipitation and accumulated temperature conditions suitable for vegetation growth are better, and the PTE of each county is higher (Figure 5b), so the EEoSLCP is higher. The low EEoSLCP is concentrated in arid and semi-arid desert areas and arid desert areas (Figures 1c and 5a), where precipitation is scarce and the accumulated temperature is relatively insufficient, coupled with the inappropriate selection of tree species, resulting in a low survival rate of afforestation, and even some trees have died or are dying, making it difficult to produce the expected ecological effect of afforestation in arid and semi-arid desert areas [78]. Coupled with the low level of management and technology here, the improper planning and design of reforestation is another important reason for the poor ecological effect. For example, within the arid desert region in the northwestern part of the Loess Plateau, to reduce plant water consumption and maintenance costs, Cao (2008) [79] observed that the planting density is usually low within this region. This not only achieves the afforestation goal from the surface, but also saves money and achieves a win-win situation. However, the low density of afforestation has led to an increase in the area of land degradation and exacerbating local desertification. The reason for this is that the sparse trees that appear due to the low density of afforestation are not only unable to block strong winds, but also make the airflow between trees become more concentrated, which further strengthens the degree of soil desiccation and the intensity of soil wind erosion [80]. However, the low EEoSLCP in the central part of the Loess Plateau is related to the high density of afforestation in the region, resulting in excessive consumption of a large amount of groundwater and soil moisture [38]. Specifically, the amount of water required for tree growth increases over time, resulting in a decline in the regional groundwater table [81–83]. Although the region receives more precipitation than the arid desert areas in the northwest, the high density of afforestation causes natural precipitation to be unable to meet the required recharge demand for groundwater and deep soil water consumed by vegetation growth [38]. The above phenomenon is undoubtedly an important reason for the increased desiccation of regional soil layers [84], and as the drying of the soil layer increases, it leads to the formation of barriers to water circulation between vegetation and underground water, which in turn limits the establishment and growth of vegetation [85]. For example, dwarf trees, which are locally called "old-man small-trees", have been observed throughout reforestation regions in the Loess Plateau [86]. This metaphor vividly describes the low growth rate and poor health of trees in a man-made forest due to insufficient moisture in the soil layer, which makes it difficult for these trees to produce the expected ecological functions of soil retention, water conservation and carbon sequestration [85]. In summary, the EEoSLCP in the middle counties of Loess Plateau is lower.

From the MI results, it can be concluded that the MI of EEoSLCP in the Loess Plateau has a fluctuating growth trend, and the change of MI can be divided into two stages in terms of time change. In the first stage, from 2002 to 2009, MI showed fluctuating growth, and the main source of growth was technical efficiency improvement. Specifically, although in the early stage of the SLCP due to the rapid implementation, lack of experience, coupled with the low quality of project planning and the level of government management [75,76], the MI decreased (2002–2006). However, with the accumulation of experience in the implementation of SLCP, the program management, and technical level have been continuously improved [87], and the Chinese central government decided to increase the subsidy standard and extend the subsidy cycle after 2006 [88], so a combination of factors contributed to the significant increase of MI after 2006. In the second stage, from 2010 to 2015, MI showed a decline and then an increase, with both the decline and the increase influenced by EFCH. Specifically, the SLCP entered the consolidation stage after 2010, and the potential for efficiency improvement brought about by the early implementation of the SLCP has basically been released, coupled with serious corruption in most counties [89], resulting in the lack of subsidy payment and lack of government supervision, leading to the frequent occurrence of deforestation and overgrazing. In addition, the government and farmers only pay attention to afforestation but ignore management, coupled with poor management techniques, so that some trees gradually die [90], resulting in a decline in MI (2010–2011). After 2012, in order to further consolidate the achievements of SLCP, some local governments began to raise their own funds to subsidize farmers who participated in the SLCP [91] and strengthened the guidance to farmers in the management of afforestation, coupled with the decision of the Chinese central government to start a new round of the SLCP after 2014, which promoted the improvement and consolidation of the achievements of SLCP, making MI rising again (2012–2015).

Our study has several limitations. First, socio-economic development has a certain impact on FERPs [16]. The socio-economic development of the 314 counties in the Loess Plateau has a large spatial difference, but we have not yet studied its possible impact on the EEoSLCP. Therefore, in future research, we can explore the influence of socio-economic development on the EEoFERPs by establishing an econometric model. Second, the evaluation index system of EEoFERPs still needs to be improved. The input indicators should also consider the inputs of other natural factors, such as soil, topography, and other natural resource endowments. In terms of output indicators, more indicators of ecosystem services should be included. However, due to the difficulty of measuring ecosystem services, we only selected commonly used and easy-to-measure ecosystem service indicators, while ignoring ecosystem service indicators such as wind and sand control, water purification, and climate regulation. Therefore, in future studies, if the above-mentioned input and output indicators can be incorporated into the evaluation index system of EEoFERPs, it will further reduce the assessment bias and obtain more accurate eco-efficiency assessment results. Third, because we had difficulty in obtaining specific information on afforestation, especially on afforestation tree species, the ecological effects of SLCP we obtained in our study were actually the result of all tree species acting together. However, the ecological effects produced by different tree species are distinctly different [92]. Therefore, in the future evaluation of the EEoFERPs, we should collect as much information as possible on the tree species planted, and then measure the contribution of different tree species to the ecological effect, and thus evaluate the EEoFERPs under different tree species selection, which will not only improve the evaluation of EEoFERPs, but also provide more detailed and specific guidance for the future implementation or design of EEoFERPs.

5. Conclusions and Policy Implications

5.1. Conclusions

As the largest FERP in the world, the research on the ecological performance of SLCP has always been the focus of scholars' research. However, most of the previous studies have focused on the evaluation of ecological effects of FERPs, while very few scholars have evaluated their eco-efficiency. Although some studies have also started to pay attention to this issue and attempted to evaluate the eco-efficiency of SLCP, problems such as research methods and scales may have led to some bias in the research results and have been unable to provide policy recommendations for large-scale implementation of FERPs. In this context, from a macro perspective, we focus on the basic unit (counties) of the implementation of the SLCP and evaluate the static and dynamic efficiency of the SLCP based on the panel data of 314 counties in the Loess Plateau for a long time series from 2002 to 2015 using the DEA model and Malmquist index model, respectively. The main conclusions obtained are as follows: (1) From 2002 to 2015, the EEoSLCP in the Loess Plateau was at a low level, with an average value of only 0.357 in 14 years. (2) From 2002 to 2015, the EEoSLCP in the Loess Plateau showed an overall upward trend, and the growth of pure technical efficiency was the most important reason to promote the growth of comprehensive efficiency. (3) There is a significant spatial difference in the EEoSLCP in the counties of the Loess Plateau, with higher eco-efficiency levels in the southern and southeastern counties, lower eco-efficiency levels in the northern and northwestern counties, and overall decreasing distribution of the EEoSLCP in the Loess Plateau from south to north and from southeast to northwest. Natural conditions such as precipitation and pure technical efficiency are important in determining the spatial distribution of EEoSLCP in the Loess Plateau. (4) The Malmquist index of Loess Plateau showed fluctuating growth from 2002 to 2015, and the EEoSLCP increased by 17.7% per year on average, with the Malmquist index being more influenced by changes in technical efficiency and less influenced by technological progress. In terms of spatial distribution, 97.13% of counties in the Loess Plateau have improved the EEoSLCP, and the counties with greater improvement are mainly located in the western, central, northeastern, and some parts of the northwestern parts of the Loess Plateau.

5.2. Policy Implications

The policy implications of this study for FERPs are two main points. (1) When designing FERPs, it is important to do a top-level design and scientific implementation. FERP should adhere to the combination of government policy guidance and voluntary farmers, and jointly solve the problem of "where to implement FERP" and "what tree species to choose when implementing FERP". Specifically, in the implementation of the FERP, we must take science and technology as the guide, determine the implementation area of the FERP, plant trees in places suitable for afforestation, choose afforestation species according to the farmers' wishes and the principle of suitable trees in suitable places, carry out the applicable technology of forestry science and technology in the whole process of FERP implementation, and effectively improve the quality and efficiency of the FERP. (2) Improve the management level of FERPs. Improve the government monitoring and accountability system, introduce a third-party evaluation and supervision mechanism, improve the openness and transparency of FERPs in the planning and implementation management process, and ensure that program implementation achieves a win-win situation in terms of effectiveness and efficiency.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land11050712/s1, Figure S1: Vegetation fraction cover of Loess Plateau, 2002–2018; Figure S2: Vegetation carbon sequestration of Loess Plateau, 2002–2018; Figure S3: (a) Distribution of sampling sites on the Loess Plateau; (b) Carbon density of above–ground biomass on the Loess Plateau; (c) Average Vegetation carbon sequestration of Loess Plateau, 2002–2018; Figure S4: Soil retention of Loess Plateau, 2002–2018; Figure S5: (a) Distribution of hydrological stations on the Loess Plateau; (b) Average sand transport modulus of Loess Plateau, 1987–2015; (c) Average soil erosion modulus of Loess Plateau, 2002–2018; Figure S6: Biodiversity service of Loess Plateau, 2002–2018; Figure S7: Water conservation service of Loess Plateau, 2002–2018.

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Data Availability Statement: The data used in this study are described in detail in Section 2.5 Data sources, and all data are available for download through the URL link provided in that section, or please contact the author of this article.

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References

1. Dao, H.; Peduzzi, P.; Friot, D. National Environmental Limits and Footprints Based on the Planetary Boundaries Framework: The Case of Switzerland. *Glob. Environ. Chang.* **2018**, *52*, 49–57. [CrossRef]
2. Millennium Ecosystem Assessment. *Ecosystems and Human Well-Being*; Island Press: Washington, DC, USA, 2005.
3. Mbow, H.-O.P.; Reisinger, A.; Canadell, J.; O'Brien, P. *Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems (SR2)*; IPCC: Ginevra, Switzerland, 2017; Volume 650.
4. Georgescu-Roegen, N. The Entropy Law and the Economic Process. In *The Entropy Law and the Economic Process*; Harvard University Press: Cambridge, CA, USA, 2013.
5. Georgescu-Roegen, N. Energy Analysis and Economic Valuation. *South. Econ. J.* **1979**, *45*, 1023–1058. [CrossRef]
6. Meadows, D.H.; Meadows, D.H.; Randers, J.; Behrens, W.W., III. The Limits to Growth: A Report to the Club of Rome (1972). *Google Sch.* **1972**, *91*.
7. Daly, H.E.; Farley, J. *Ecological Economics: Principles and Applications*; Island Press: Washington, DC, USA, 2011.
8. Waltham, N.J.; Elliott, M.; Lee, S.Y.; Lovelock, C.; Duarte, C.M.; Buelow, C.; Simenstad, C.; Nagelkerken, I.; Claassens, L.; Wen, C.K.-C.; et al. UN Decade on Ecosystem Restoration 2021–2030—What Chance for Success in Restoring Coastal Ecosystems? *Front. Mar. Sci.* **2020**, *7*, 71. [CrossRef]
9. Dahl, J. Progress and Development of the Prairie States Forestry Project. *J. For.* **1940**, *38*, 301–306. [CrossRef]
10. Darier, É. Environmental Governmentality: The Case of Canada's Green Plan. *Environ. Politics* **1996**, *5*, 585–606. [CrossRef]

11. Mirzabaev, A.; Sacande, M.; Motlagh, F.; Shyrokaya, A.; Martucci, A. Economic Efficiency and Targeting of the African Great Green Wall. *Nat. Sustain.* **2022**, *5*, 17–25. [CrossRef]
12. Resosudarmo, B.P. *The Politics and Economics of Indonesia's Natural Resources*; ISEAS Publishing: Singapore, 2005; ISBN 978-981-230-549-7.
13. Park, M.S.; Lee, H. Forest Policy and Law for Sustainability within the Korean Peninsula. *Sustainability* **2014**, *6*, 5162–5186. [CrossRef]
14. Wil, D.J.; Do, D.S.; Trieu, V.H. *Forest Rehabilitation in Vietnam: Histories, Realities and Future*; Center for International Forestry Research (CIFOR): Bogor, Indonesia, 2006; ISBN 978-979-24-4652-4.
15. Bryan, B.A.; Gao, L.; Ye, Y.; Sun, X.; Connor, J.D.; Crossman, N.D.; Stafford-Smith, M.; Wu, J.; He, C.; Yu, D.; et al. China's Response to a National Land-System Sustainability Emergency. *Nature* **2018**, *559*, 193–204. [CrossRef]
16. Lu, G.; Yin, R. Evaluating the Evaluated Socioeconomic Impacts of China's Sloping Land Conversion Program. *Ecol. Econ.* **2020**, *177*, 106785. [CrossRef]
17. Chen, C.; Park, T.; Wang, X.; Piao, S.; Xu, B.; Chaturvedi, R.K.; Fuchs, R.; Brovkin, V.; Ciais, P.; Fensholt, R.; et al. China and India Lead in Greening of the World through Land-Use Management. *Nat. Sustain.* **2019**, *2*, 122–129. [CrossRef] [PubMed]
18. Qiu, S.; Peng, J.; Zheng, H.; Xu, Z.; Meersmans, J. How Can Massive Ecological Restoration Programs Interplay with Social-Ecological Systems? A Review of Research in the South China Karst Region. *Sci. Total Environ.* **2022**, *807*, 150723. [CrossRef] [PubMed]
19. Countries Commit to Restore Global Land Area the Size of China. Available online: http://www.unep.org/news-and-stories/story/countries-commit-restore-global-land-area-size-china (accessed on 10 April 2022).
20. Restoration Call for Area 'the Size of China' to Protect Falling Biodiversity and Food Insecurity. Available online: https://news.un.org/en/story/2021/06/1093272 (accessed on 10 April 2022).
21. Birch, J.C.; Newton, A.C.; Aquino, C.A.; Cantarello, E.; Echeverría, C.; Kitzberger, T.; Schiappacasse, I.; Garavito, N.T. Cost-Effectiveness of Dryland Forest Restoration Evaluated by Spatial Analysis of Ecosystem Services. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 21925–21930. [CrossRef] [PubMed]
22. Molin, P.G.; Chazdon, R.; Frosini de Barros Ferraz, S.; Brancalion, P.H.S. A Landscape Approach for Cost-Effective Large-Scale Forest Restoration. *J. Appl. Ecol.* **2018**, *55*, 2767–2778. [CrossRef]
23. Schiappacasse, I.; Nahuelhual, L.; Vásquez, F.; Echeverría, C. Assessing the Benefits and Costs of Dryland Forest Restoration in Central Chile. *J. Environ. Manag.* **2012**, *97*, 38–45. [CrossRef]
24. Newton, A.C.; del Castillo, R.F.; Echeverría, C.; Geneletti, D.; González-Espinosa, M.; Malizia, L.R.; Premoli, A.C.; Benayas, J.M.R.; Smith-Ramírez, C.; Williams-Linera, G. Forest Landscape Restoration in the Drylands of Latin America. *Ecol. Soc.* **2012**, *17*, 1. [CrossRef]
25. Wang, X.; Bennett, J. Policy Analysis of the Conversion of Cropland to Forest and Grassland Program in China. *Environ. Econ. Policy Stud.* **2008**, *9*, 119–143. [CrossRef]
26. Xian, J.; Xia, C.; Cao, S. Cost–Benefit Analysis for China's Grain for Green Program. *Ecol. Eng.* **2020**, *151*, 105850. [CrossRef]
27. Li, K.; Hou, Y.; Andersen, P.S.; Xin, R.; Rong, Y.; Skov-Petersen, H. Identifying the Potential Areas of Afforestation Projects Using Cost-Benefit Analysis Based on Ecosystem Services and Farmland Suitability: A Case Study of the Grain for Green Project in Jinan, China. *Sci. Total Environ.* **2021**, *787*, 147542. [CrossRef]
28. Neto, J.Q.F.; Walther, G.; Bloemhof, J.; Van Nunen, J.; Spengler, T. A Methodology for Assessing Eco-Efficiency in Logistics Networks. *Eur. J. Oper. Res.* **2009**, *193*, 670–682. [CrossRef]
29. Wang, Y.; Zhang, T.; Yao, S.; Deng, Y. Spatio-Temporal Evolution and Factors Influencing the Control Efficiency for Soil and Water Loss in the Wei River Catchment, China. *Sustainability* **2019**, *11*, 216. [CrossRef]
30. Wu, X.; Wang, S.; Fu, B.; Liu, J. Spatial Variation and Influencing Factors of the Effectiveness of Afforestation in China's Loess Plateau. *Sci. Total Environ.* **2021**, *771*, 144904. [CrossRef] [PubMed]
31. Zhang, Y.; Zhang, D. Efficiency Measurement and Influencing Factors of Ecological Compensation: A Case Study from Wuqi and Zhidan on the Loess Plateau. *Nat. Resour. Res.* **2021**, *30*, 4905–4921. [CrossRef]
32. Li, G.; Sun, S.; Han, J.; Yan, J.; Liu, W.; Wei, Y.; Lu, N.; Sun, Y. Impacts of Chinese Grain for Green Program and Climate Change on Vegetation in the Loess Plateau during 1982–2015. *Sci. Total Environ.* **2019**, *660*, 177–187. [CrossRef]
33. Wu, X.; Wei, Y.; Fu, B.; Wang, S.; Zhao, Y.; Moran, E.F. Evolution and Effects of the Social-Ecological System over a Millennium in China's Loess Plateau. *Sci. Adv.* **2020**, *6*, eabc0276. [CrossRef] [PubMed]
34. Zhao, G.; Mu, X.; Wen, Z.; Wang, F.; Gao, P. Soil Erosion, Conservation, and Eco-Environment Changes in the Loess Plateau of China. *Land Degrad. Dev.* **2013**, *24*, 499–510. [CrossRef]
35. Chen, Y.; Wang, K.; Lin, Y.; Shi, W.; Song, Y.; He, X. Balancing Green and Grain Trade. *Nature Geosci.* **2015**, *8*, 739–741. [CrossRef]
36. Wang, S.; Zhao, D.; Chen, H. Government Corruption, Resource Misallocation, and Ecological Efficiency. *Energy Econ.* **2020**, *85*, 104573. [CrossRef]
37. Amacher, G.S.; Ollikainen, M.; Koskela, E. *Economics of Forest Resources*; Mit Press Cambridge: Cambridge, CA, USA, 2009.
38. He, L.; Guo, J.; Jiang, Q.; Zhang, Z.; Yu, S. How Did the Chinese Loess Plateau Turn Green from 2001 to 2020? An Explanation Using Satellite Data. *Catena* **2022**, *214*, 106246. [CrossRef]
39. Jin, F.; Yang, W.; Fu, J.; Li, Z. Effects of Vegetation and Climate on the Changes of Soil Erosion in the Loess Plateau of China. *Sci. Total Environ.* **2021**, *773*, 145514. [CrossRef]

40. Li, J.; Peng, S.; Li, Z. Detecting and Attributing Vegetation Changes on China's Loess Plateau. *Agric. For. Meteorol.* **2017**, *247*, 260–270. [CrossRef]
41. Zhang, D.; Pearse, P.H. *Forest Economics*; UBC Press: Vancouve, BC, Canada, 2011.
42. Li, J.; Wang, X.; Shao, M.; Zhao, Y.; Li, X.; Wu, S.; Li, J.; Zhang, R. Simulation of Biomass and Soil Desiccation of Robinia Pseudoacacia Forestlands on Semi-Arid and Semi-Humid Regions of China's Loess Plateau. *Chin. J. Plant Ecol.* **2010**, *34*, 330–339. [CrossRef]
43. Qian, C.; Shao, L.; Hou, X.; Zhang, B.; Chen, W.; Xia, X. Detection and Attribution of Vegetation Greening Trend across Distinct Local Landscapes under China's Grain to Green Program: A Case Study in Shaanxi Province. *Catena* **2019**, *183*, 104182. [CrossRef]
44. Deng, L.; Liu, S.; Kim, D.G.; Peng, C.; Sweeney, S.; Shangguan, Z. Past and Future Carbon Sequestration Benefits of China's Grain for Green Program. *Glob. Environ. Chang.* **2017**, *47*, 13–20. [CrossRef]
45. Feng, X.; Fu, B.; Lu, N.; Zeng, Y.; Wu, B. How Ecological Restoration Alters Ecosystem Services: An Analysis of Carbon Sequestration in China's Loess Plateau. *Sci. Rep.* **2013**, *3*, 2846. [CrossRef]
46. Wang, Y.; Zhao, J.; Fu, J.; Wei, W. Effects of the Grain for Green Program on the Water Ecosystem Services in an Arid Area of China-Using the Shiyang River Basin as an Example. *Ecol. Indic.* **2019**, *104*, 659–668. [CrossRef]
47. Hua, F.; Wang, X.; Zheng, X.; Fisher, B.; Wang, L.; Zhu, J.; Tang, Y.; Yu, D.W.; Wilcove, D.S. Opportunities for Biodiversity Gains under the World's Largest Reforestation Programme. *Nat. Commun.* **2016**, *7*, 12717. [CrossRef]
48. Wang, F.; Pan, X.; Gerlein-Safdi, C.; Cao, X.; Wang, S.; Gu, L.; Wang, D.; Lu, Q. Vegetation Restoration in Northern China: A Contrasted Picture. *Land Degrad. Dev.* **2020**, *31*, 669–676. [CrossRef]
49. Chen, J.; Fan, W.; Li, D.; Liu, X.; Song, M. Driving Factors of Global Carbon Footprint Pressure: Based on Vegetation Carbon Sequestration. *Appl. Energy* **2020**, *267*, 114914. [CrossRef]
50. Peng, S.; Wen, D.; He, N.; Yu, G.; Ma, A.; Wang, Q. Carbon Storage in China's Forest Ecosystems: Estimation by Different Integrative Methods. *Ecol. Evol.* **2016**, *6*, 3129–3145. [CrossRef]
51. Xu, L.; Yu, G.; He, N.; Wang, Q.; Gao, Y.; Wen, D.; Li, S.; Niu, S.; Ge, J. Carbon Storage in China's Terrestrial Ecosystems: A Synthesis. *Sci. Rep.* **2018**, *8*, 2806. [CrossRef] [PubMed]
52. Xu, L.; He, N.; Yu, G. *A Dataset of Carbon Density in Chinese Terrestrial Ecosystems (2010s)*; Science Data Bank: Beijing, China, 29 July 2018. [CrossRef]
53. Renard, K.G. *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)*; United States Government Printing: Washington, DC, USA, 1997.
54. Wischmeier, W.H.; Smith, D.D. *Predicting Rainfall Erosion Losses: A Guide to Conservation Planning*; Department of Agriculture, Science and Education Administration: Washington, DC, USA, 1978.
55. Williams, J.R.; Renard, K.G.; Dyke, P.T. EPIC: A New Method for Assessing Erosion's Effect on Soil Productivity. *J. Soil Water Conserv.* **1983**, *38*, 381–383.
56. Zhang, H.; Yang, Q.; Li, R.; Liu, Q.; Moore, D.; He, P.; Ritsema, C.J.; Geissen, V. Extension of a GIS Procedure for Calculating the RUSLE Equation LS Factor. *Comput. Geosci.* **2013**, *52*, 177–188. [CrossRef]
57. Cai, C.; Ding, S.; Shi, Z.; Huang, L.; Zhang, G. Study of applying USLE and geographical information system IDRISI to predict soil erosion in small watershed. *J. Soil Water Conserv.* **2000**, *14*, 19–24.
58. Yan, R.; Zhang, X.; Yan, S.; Chen, H. Estimating Soil Erosion Response to Land Use/Cover Change in a Catchment of the Loess Plateau, China. *Int. Soil Water Conserv. Res.* **2018**, *6*, 13–22. [CrossRef]
59. Wu, X.; Wang, S.; Fu, B.; Liu, Y.; Zhu, Y. Land Use Optimization Based on Ecosystem Service Assessment: A Case Study in the Yanhe Watershed. *Land Use Policy* **2018**, *72*, 303–312. [CrossRef]
60. Kong, L.; Zheng, H.; Rao, E.; Xiao, Y.; Ouyang, Z.; Li, C. Evaluating Indirect and Direct Effects of Eco-Restoration Policy on Soil Conservation Service in Yangtze River Basin. *Sci. Total Environ.* **2018**, *631–632*, 887–894. [CrossRef]
61. Liu, W.; Liu, J.; Kuang, W. Spatiotemporal patterns of soil protection effect of the Grain for Green Project in northern Shaanxi. *Acta Geogr. Sin.* **2019**, *74*, 1835–1852.
62. Carreño, L.; Frank, F.C.; Viglizzo, E.F. Tradeoffs between Economic and Ecosystem Services in Argentina during 50 Years of Land-Use Change. *Agric. Ecosyst. Environ.* **2012**, *154*, 68–77. [CrossRef]
63. Liu, Y.; Lü, Y.; Jiang, W.; Zhao, M. Mapping Critical Natural Capital at a Regional Scale: Spatiotemporal Variations and the Effectiveness of Priority Conservation. *Environ. Res. Lett.* **2020**, *15*, 124025. [CrossRef]
64. Duan, Y.; Di, B.; Ustin, S.L.; Xu, C.; Xie, Q.; Wu, S.; Li, J.; Zhang, R. Changes in Ecosystem Services in a Montane Landscape Impacted by Major Earthquakes: A Case Study in Wenchuan Earthquake-Affected Area, China. *Ecol. Indic.* **2021**, *126*, 107683. [CrossRef]
65. Barral, M.P.; Oscar, M.N. Land-Use Planning Based on Ecosystem Service Assessment: A Case Study in the Southeast Pampas of Argentina. *Agric. Ecosyst. Environ.* **2012**, *154*, 34–43. [CrossRef]
66. Charnes, A.; Cooper, W.W.; Rhodes, E. Measuring the Efficiency of Decision Making Units. *Eur. J. Oper. Res.* **1978**, *2*, 429–444. [CrossRef]
67. Farrell, M.J. The Measurement of Productive Efficiency. *J. R. Stat. Soc. Ser. A Gen.* **1957**, *120*, 253–281. [CrossRef]
68. Banker, R.D.; Charnes, A.; Cooper, W.W. Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Manag. Sci.* **1984**, *30*, 1078–1092. [CrossRef]

69. Färe, R.; Grosskopf, S.; Norris, M.; Zhang, Z. Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries. *Am. Econ. Rev.* **1994**, *84*, 66–83.
70. Malmquist, S. Index Numbers and Indifference Surfaces. *Trab. Estad.* **1953**, *4*, 209–242. [CrossRef]
71. Liu, J.; Kuang, W.; Zhang, Z.; Xu, X.; Qin, Y.; Ning, J.; Zhou, W.; Zhang, S.; Li, R.; Yan, C.; et al. Spatiotemporal Characteristics, Patterns, and Causes of Land-Use Changes in China since the Late 1980s. *J. Geogr. Sci.* **2014**, *24*, 195–210. [CrossRef]
72. Ning, J.; Liu, J.; Kuang, W.; Xu, X.; Zhang, S.; Yan, C.; Li, R.; Wu, S.; Hu, Y.; Du, G.; et al. Spatiotemporal Patterns and Characteristics of Land-Use Change in China during 2010–2015. *J. Geogr. Sci.* **2018**, *28*, 547–562. [CrossRef]
73. Bennett, M.T. China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual? *Ecol. Econ.* **2008**, *65*, 699–711. [CrossRef]
74. Xu, J.; Tao, R.; Xu, Z.; Bennett, M.T. China's Sloping Land Conversion Program: Does Expansion Equal Success? *Land Econ.* **2010**, *86*, 219–244. [CrossRef]
75. Xu, J.; Yin, R.; Li, Z.; Liu, C. China's Ecological Rehabilitation: Unprecedented Efforts, Dramatic Impacts, and Requisite Policies. *Ecol. Econ.* **2006**, *57*, 595–607. [CrossRef]
76. Yin, R.; Yin, G. China's Primary Programs of Terrestrial Ecosystem Restoration: Initiation, Implementation, and Challenges. *Environ. Manag.* **2010**, *45*, 429–441. [CrossRef] [PubMed]
77. Grosjean, P.; Kontoleon, A. How Sustainable Are Sustainable Development Programs? The Case of the Sloping Land Conversion Program in China. *World Dev.* **2009**, *37*, 268–285. [CrossRef]
78. Jiang, G.; Han, X.; Wu, J. Restoration and Management of the Inner Mongolia Grassland Require a Sustainable Strategy. *AMBIO A J. Hum. Environ.* **2006**, *35*, 269–270. [CrossRef]
79. Cao, S. Why Large-Scale Afforestation Efforts in China Have Failed To Solve the Desertification Problem. *Environ. Sci. Technol.* **2008**, *42*, 1826–1831. [CrossRef]
80. Cao, S.; Tian, T.; Chen, L.; Dong, X.; Yu, X.; Wang, G. Damage Caused to the Environment by Reforestation Policies in Arid and Semi-Arid Areas of China. *Ambio* **2010**, *39*, 279–283. [CrossRef]
81. Cao, S. Impact of China's Large-Scale Ecological Restoration Program on the Environment and Society in Arid and Semiarid Areas of China: Achievements, Problems, Synthesis, and Applications. *Crit. Rev. Environ. Sci. Technol.* **2011**, *41*, 317–335. [CrossRef]
82. Wang, X.M.; Zhang, C.X.; Hasi, E.; Dong, Z.B. Has the Three Norths Forest Shelterbelt Program Solved the Desertification and Dust Storm Problems in Arid and Semiarid China? *J. Arid Environ.* **2010**, *74*, 13–22. [CrossRef]
83. Zhang, G.; Dong, J.; Xiao, X.; Hu, Z.; Sheldon, S. Effectiveness of Ecological Restoration Projects in Horqin Sandy Land, China Based on SPOT-VGT NDVI Data. *Ecol. Eng.* **2012**, *38*, 20–29. [CrossRef]
84. Cheng, Y.; Zhan, H.; Yang, W.; Dang, H.; Li, W. Is Annual Recharge Coefficient a Valid Concept in Arid and Semi-Arid Regions? *Hydrol. Earth Syst. Sci.* **2017**, *21*, 5031–5042. [CrossRef]
85. Cao, S.; Chen, L.; Shankman, D.; Wang, C.; Wang, X.; Zhang, H. Excessive Reliance on Afforestation in China's Arid and Semi-Arid Regions: Lessons in Ecological Restoration. *Earth-Sci. Rev.* **2011**, *104*, 240–245. [CrossRef]
86. McVicar, T.R.; Van Niel, T.G.; Li, L.; Wen, Z.; Yang, Q.; Li, R.; Jiao, F. Parsimoniously Modelling Perennial Vegetation Suitability and Identifying Priority Areas to Support China's Re-Vegetation Program in the Loess Plateau: Matching Model Complexity to Data Availability. *For. Ecol. Manag.* **2010**, *259*, 1277–1290. [CrossRef]
87. Delang, C.O.; Wang, W. Chinese Forest Policy Reforms after 1998: The Case of the Natural Forest Protection Program and the Slope Land Conversion Program. *Int. For. Rev.* **2013**, *15*, 290–304. [CrossRef]
88. He, J.; Sikor, T. Notions of Justice in Payments for Ecosystem Services: Insights from China's Sloping Land Conversion Program in Yunnan Province. *Land Use Policy* **2015**, *43*, 207–216. [CrossRef]
89. Yu, X. Central–Local Conflicts in China's Environmental Policy Implementation: The Case of the Sloping Land Conversion Program. *Nat. Hazards* **2016**, *84*, 77–96. [CrossRef]
90. Qu, M.; Liu, G.; Lin, Y.; Driedger, E.; Peter, Z.; Xu, X.; Cao, Y. Experts' Perceptions of the Sloping Land Conversion Program in the Loess Plateau, China. *Land Use Policy* **2017**, *69*, 204–210. [CrossRef]
91. China National Forestry Administration. *National Report on Monitoring the Ecological Benefits of the Sloping Land Conversion Program*; Chinese Forestry Publishing House: Beijing, China, 2014.
92. Erskine, P.D.; Lamb, D.; Bristow, M. Tree Species Diversity and Ecosystem Function: Can Tropical Multi-Species Plantations Generate Greater Productivity? *For. Ecol. Manag.* **2006**, *233*, 205–210. [CrossRef]