sustainability

MDPI

Article

A Study on Temporal and Spatial Differences in Women's Well-Being in an Ecologically Vulnerable Area in Northwest China

Jinjing Ma, Min Lei *, Huan Yu and Rui Li

College of Urban and Environmental Science, Northwest University, Xi'an 710127, China
* Correspondence: xdleimin@nwu.edu.cn; Tel.: +86-15829261881

Abstract: As an important driving force for economic development and social progress, women have become an important subject of well-being research. Human well-being is the state of physical and mental health as well as material affluence and includes a variety of factors, such as wealth, education, health, safety, amenities, way of life, and happiness. Based on the established research framework of the Women's Development Index (WDI) in Northwest China, this paper first measured the objective well-being level of women in Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang from 2003 to 2020 under the influence of ecological factors. In addition, spatial disaggregation and comparative analyses of the spatial imbalance of women's well-being in Northwest China were carried out using the Theil index and Dagum Gini coefficient. The results show that (1) the WDI in ecologically vulnerable areas in Northwest China increased from 0.525 in 2003 to 0.690 in 2020, indicating an overall increase in well-being. (2) The WDI in the five provinces gradually increased with fluctuations. Among them, Shaanxi always remained in first place in terms of the WDI. (3) From 2003 to 2020, the spatial imbalance of women's well-being as measured according to the WDI in Northwest China first increased and then decreased. However, the gap in women's well-being in Northwest China was smaller than the economic gap. (4) From 2003 to 2020, the well-being gap measured by the WDI among the 10 groups of provinces in Northwest China gradually decreased, and the development gap between the provinces and Shaanxi was the largest.

Keywords: Northwest China; ecologically vulnerable areas; objective well-being; Women's Development Index; unbalanced space

Citation: Ma, J.; Lei, M.; Yu, H.; Li, R. A Study on Temporal and Spatial Differences in Women's Well-Being in an Ecologically Vulnerable Area in Northwest China. *Sustainability* **2023**, *15*, 2324. https://doi.org/10.3390/su15032324

Academic Editor: Giuseppe T. Cirella

Received: 25 December 2022
Revised: 18 January 2023
Accepted: 24 January 2023
Published: 27 January 2023

1. Introduction

Clear waters and green mountains are as good as mountains of gold and silver. The improvement in human well-being is the ultimate objective of sustainable development [1]. The essential objective of enhancing the well-being of Chinese citizens entails the promotion of gender equality and the all-around development of women's welfare. The improvement in women's well-being along with a focus on women's developmental environments have gained importance in China since the Outline for Women's Development in China (2021–2030) was published in 2021. The ecologically sensitive regions of Northwest China benefit from national development plans thanks to the promotion of national strategies such as the Western Development Strategy and the Silk Road Economic Belt, resulting in a significant increase in the economy and improvement in human well-being. Scientific problems that must be addressed include how to quantify human well-being objectively, with a particular emphasis on the development status of women and geographical differences, as well as how to increase the well-being of women in Northwest China.

Human well-being has many different meanings and is frequently used to assess and develop human lifestyles. It is sometimes referred to as happiness, human welfare, the standard of living, or quality of life [2]. The study of human well-being has advanced significantly. Previous scholars used the Physical Quality of Life Index (PQLI) [3], the

Human Development Index (HDI) [4], and multidimensional indicators [5] to measure the level of well-being in various regions, considering, for example, urban and rural areas within different regions [6–8] or economic belts. Women's well-being is a part of the study of human well-being, which is often associated with education, work, physical health, and mental health. To further investigate the content and focus of the study on women's well-being, literature-analysis applications such as VOSviewer and Pajek were used to conduct a visual clustering analysis on the keywords.

First, we conducted a comprehensive search of the literature on "women well-being" in the Web of Science's core database from 2000 to 2023, yielding 31,836 items. We searched the literature connected to this study in order to analyze it. The screening criteria for literature were paper, review paper, and online publication, and the screening topic areas were Geography, Humanities Multidisciplinary, Environmental Sciences, Sociology, Environmental Studies, Urban Studies, Geography Physical, and Social Issues. A total of 1801 articles and 1805 keywords were screened out. We carried out keyword-co-occurrence analysis on the keywords that appeared five times or more in each article to analyze keyword clustering. The threshold was fulfilled by 603 keywords. The research themes were characterized as gender, health, mental health, family and work, personality, psychological well-being, and pregnancy, with eight key-word clusters of female well-being acquired. These addressed psychological, physiological, and social well-being. The current research on women's well-being is an exploration of gender perspectives, focusing on the health problems of various groups, such as the elderly, pregnant women, and working women, and taking into account the influence of family, employment, children, and other factors on women's well-being. We discovered that the health and employment characteristics of various groups of women were highly connected to women's well-being through a thorough study of key phrases in the literature relevant to women's well-being. There were indices developed for measuring women's well-being. The California Budget & Policy Center, for example, has developed the California Women's Well-Being Index, which is a multifaceted, composite measure consisting of five "dimensions" including health, personal safety, employment & earning, economic security, and political empowerment [9]. The United Nations has created the Gender Disparity Index, which encompasses variables including, the freedom of movement, property rights, freedom to work, and financial rights [10] A recent study has developed a set of indicators on women's health and well-being, such as women's living conditions, decision making power, reproductive health, fertility, and issues related to domestic violence [11] (Figure 1).

Sociologists also gave attention to research on women's well-being in addition to the diverse indicator systems developed by various international organizations for measuring women's well-being in the current study [12]. Those who have explored influencing factors from the perspective of gender equality [13] have also conducted research on gender well-being differentiation. Researchers have utilized methods such as emotional balance scales [14], life satisfaction scales [15], and mathematical models [16–19] to measure the well-being levels of women in various age groups [20], with different employment statuses [21,22] and different health statuses [23]. Nevertheless, spatial and temporal expressions of women's well-being status in the regional dimension were lacking. Scholars have advanced the indicators by incorporating ecological aspects into the HDI in response to the environment's growing effect on human existence [24,25]. Both domestic and international scholars have developed indicator systems to measure the level of well-being of residents in accordance with the status of ecosystem services in various natural regions [26–30] since the Millennium Ecosystem Assessment report proposed the contribution of ecosystem services to human well-being. A review of related studies elucidated the following: ① Currently, studies on well-being have developed a variety of indicator systems that cover health well-being [31–35], psychological well-being [36–41], social well-being [42–46], and other aspects [47,48]. There has also been some exploration into the perspective of ecological impacts [49–51]. Although all individuals, without distinction by gender, were research subjects in the bulk of these studies, these studies gave less attention to female

groups and neglected the effects of ecological variables. ② The study of women's objective well-being has not yet developed a complete system due to a lack of analysis of temporal and spatial changes from a geographical perspective and of the comparison of disparities among geographical areas. In recent years, the well-being measurement of female groups has primarily focused on the exploration of subjective well-being and influencing factors in qualitative research [52–55].

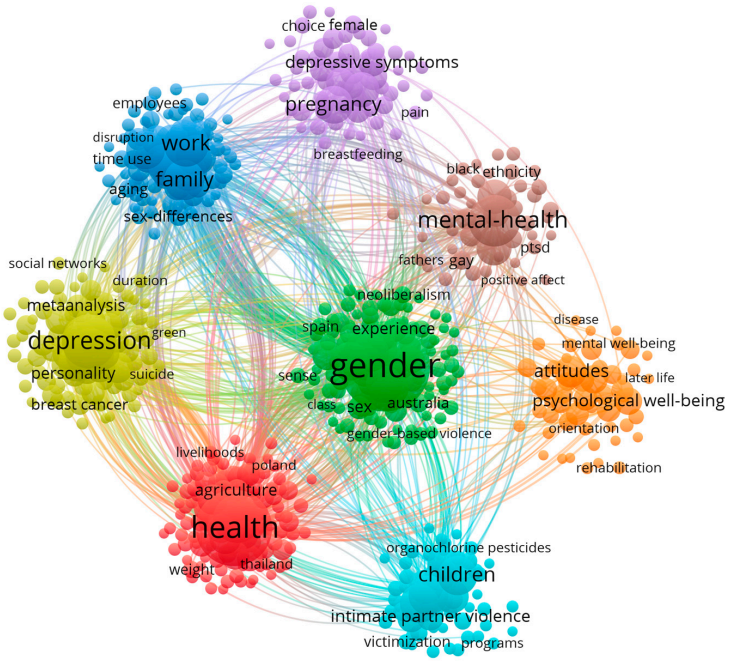


Figure 1. Hotspot-Label View of Women's Well-being Research from 2000 to 2023.

With the degree of social and economic development being lower than that of eastern China, Northwest China is a fragile environmental area. At the county and provincial levels, some researchers have already explored the ecological vulnerability of Northwest China using data on nighttime illumination and the construction of multidimensional indicators [56]. However, there are few studies on human well-being in this ecologically vulnerable area that assess the regional development level, and there is no attention given to the residents of this area. The Blue Book of Western Region of China was extended on the development status and institutional factors of women in Northwest China, pointing out that the main factors restricting the development of women in Northwest China were health, education, employment, and unbalanced regional development [57]. The majority of studies on women in Northwest China at the moment concentrate on pregnant women [58], liushou women, etc., assessing their physical health from a medical perspective. The region's present water crisis is a topic of interest for certain academics. In Northwest China [59], there is currently a lack of macro-measurements as well as temporal and spatial changes in women's well-being. The degree of women's development and well-being in this region should be given more consideration because the majority of men in Northwest China have moved to the east of the nation due to a lack of work opportunities and poor wages [60]. In view of China's widening east-west developmental divide, it is crucial to investigate and assess the study of women's well-being in ecologically vulnerable areas.

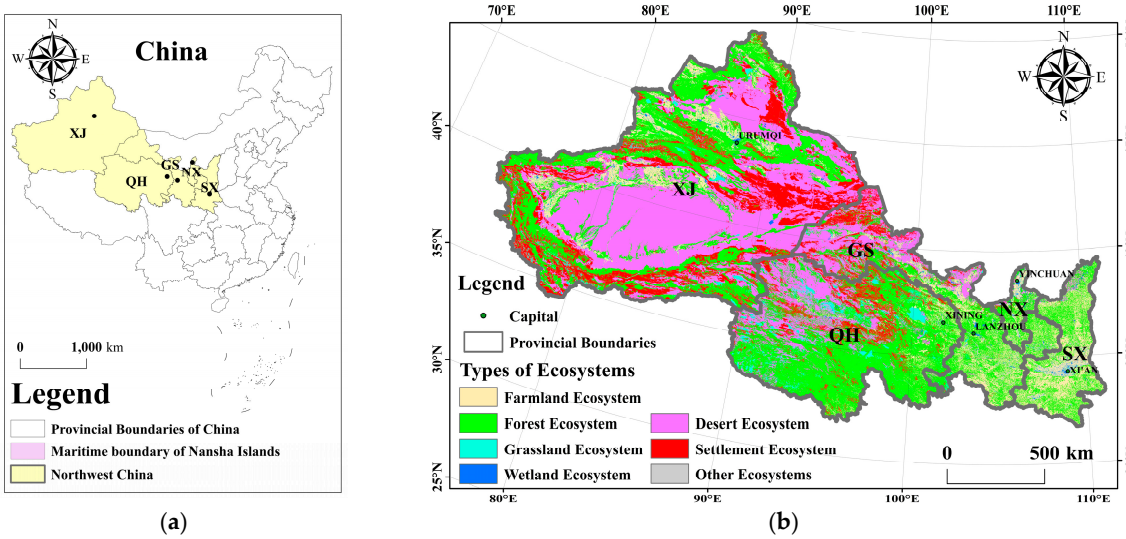
The three dimensions of the HDI, namely, health, income, and education, were used in this study, along with data from five provinces in Northwest China from 2003 to 2020. The indicator layer of the HDI was further enhanced using the gender-equality and women's advancement indicators developed by previous researchers [61]. The special section of the Human Growth Report on the 40th Anniversary of Reform and Opening Up notes that the low level of industry, limited production efficiency, excessive resource consumption, and pollution emissions were additional significant factors impeding Northwest

China's development. Therefore, in this paper, ecological conditions were added as a significant influencing factor to the study of well-being. To provide guidance for high-quality transformative development in Northwest China from a gender perspective and to provide reference and empirical evidence for improving the well-being of women in less-economically developed regions, the changes in the objective well-being of women in Northwest China and the degree of regional imbalance were measured.

2. Materials and Methods

2.1. Study Area

Northwest China (73°15′–111°15′ E, 31°32′–49°10′ N) includes five provinces and autonomous regions, namely, the Shaanxi, Gansu, Qinghai, Ningxia Hui, and Xinjiang Uygur Autonomous Regions, and it is an important area and strategic focus of China's Western Development Strategy [62] and the Silk Road Economic Belt [63]. To depict the location status and the types of ecosystems of Northwest China, we created Figure 2 using information from the Resource and Environment Science and Data Center [64]. Northwest China covers an area of 3,083,900 square kilometers, accounting for approximately one-third of China's land area, with an average altitude of 3,200 meters, rich mineral resources, scarce precipitation, low forest coverage, fragile ecological environment, and sensitivity to climate change [65]. To show the natural environment and socioeconomic economy in Northwest China in 2020, we created Table 1 based on data from the China Statistical Yearbook [66]. The population of the five provinces exceeded 100 million in 2020, with clusters of Hui, Uyghur, and other ethnic minorities. The male population represented a slightly higher proportion than the female population; 7.18% of the female population aged 15 and above were illiterate, a much higher figure than the national level of 4.95%; and approximately 43% of the female population were employed. Among them, the education level of employed women was concentrated at the primary and junior high school levels, which was lower than that of employed women in the developed eastern regions of China. In 2020, the gross domestic product of Northwest China was 5592.256 billion yuan, and the proportion of secondary and tertiary industries accounted for approximately 90% of the regional GDP (Table 1). In the new period of rapid economic transformation and development, Northwest China has been characterized by sluggish industrial development, poor guidance of advanced technologies, heavy resource consumption, and pollution emissions, in addition to prominent human-land conflicts. The level of and changes in people's well-being in the region were scientific issues that need urgent attention; in particular, disadvantaged groups, including women, should be given more extensive attention.



(**a**) (**b**)

Figure 2. Study Area. (**a**) The location of Northwest China in China; (**b**) Types of Ecosystems in Northwest China.

Table 1. Natural Environment and Social Economy in Northwest China in 2020.

	Total Land Area (10,000 km^2)	Terrain	Hydrological Conditions	Climate Type	Average Annual Precipitation (mm)	Forest Cover (%)
Shaanxi	20.56	Highlands, plains, and mountains	Yellow River, Yangtze River	Temperate, subtropical monsoon climate	760.50	43.06
Gansu	42.58	Highland	Yellow River, Yangtze River, and Inland rivers	Monsoonal climate, continental climate, highland mountain climate	450.30	11.28
Qinghai	72.12	Highland	Yangtze River, Yellow River, and The origin of the Lancang River	Highland continental climate	338.90	6.30
Ningxia	6.64	Highlands, plains, and mountains	Yellow River	Temperate continental climate	331.60	11.89
Xinjiang	166.49	Basin, mountains	Glacial snow, in-stream, and out-stream rivers	Temperate continental climate	192.40	4.24
	Total production value (billion yuan)	**The proportion of primary industry**	**The proportion of secondary and tertiary industries**	**Secondary and tertiary industry employment (10,000 people)**	**Per capita disposable income (yuan)**	
Shaanxi	26181.86	8.66%	91.34%	1473	26226.0	
Gansu	9016.70	13.29%	86.71%	734	20335.1	
Qinghai	3005.9	11.12%	88.88%	208	24037.4	
Ningxia	3920.5	8.62%	91.38%	261	25734.9	
Xinjiang	13797.6	14.36%	85.64%	896	23844.7	
Total	55922.56			3572		
	Year-end Population (10,000 persons)	**Male population share (%)**	**Female population share (%)**	**Urban Population Density (People/km^2)**	**Code**	
Shaanxi	3955	51.2	48.8	4985	SX/S	
Gansu	2502	50.76	49.8	3235	GS/G	
Qinghai	592	50.3	49.7	2930	QH/Q	
Ningxia	720	50.94	49.06	3153	NX/N	
Xinjiang	2585	48.3	51.7	3627	XJ/X	
Total	10354				NC	

2.2. Framework and Methods

This study employs a provincial scale to assess the well-being of women in the Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang Provinces between 2003 and 2020, focusing on the environmentally vulnerable region in Northwest China. To assess the degree of women's well-being in this region, this study created the Women's Development Index (WDI) in Northwest China (Figure 3). It was then compared with the women's HDI, which only uses 3 indicators (Health: Life expectancy, Income: Disposable income, Education: Average years of education) in this region and used to analyze their differences. The three aspects of health, income, and education from the HDI were employed in this article under the WDI index to ensure the scientific proportion of each dimension of the index. The three dimensions' index levels are enriched in this study. We searched and analyzed the gender indicators used by 32 major developed and developing countries or cities, 5 international organizations (the United Nations, the World Bank, the United Nations Economic Commission for Europe, the International Labor Organization, and the European Union), and Chinese scholars' methods to measure the status of female development and gender equality in order to choose the most appropriate indicators. Indicators used more frequently in the health dimension included the life expectancy according to sex, maternal mortality rate, detection rate of women's diseases, and percentage of smokers by sex; those in the income dimension included female disposable income, female unemployment rate, and female employment rate in other units; and those in the education dimension included the female college-enrollment percentage, literacy rate, and illiteracy rate. Considering the present state of

women's advancement in Northwest China, regional development restrictions, and data accessibility, the following three dimensions were used to enrich the three HDI dimensions of health, income, and education: The health index (HI) assesses women's life expectancy at birth (X1), the maternal mortality rate (X2), and detection rate of gynecological diseases (X3). The employment index (EMI) assesses the employment rate of urban women in other ownership units (X4) and female unemployment rate. The education index (EI) assesses the average years of education for women (X13), the illiteracy rate of women over 15 years old (X14), and the percentage of women among college students.

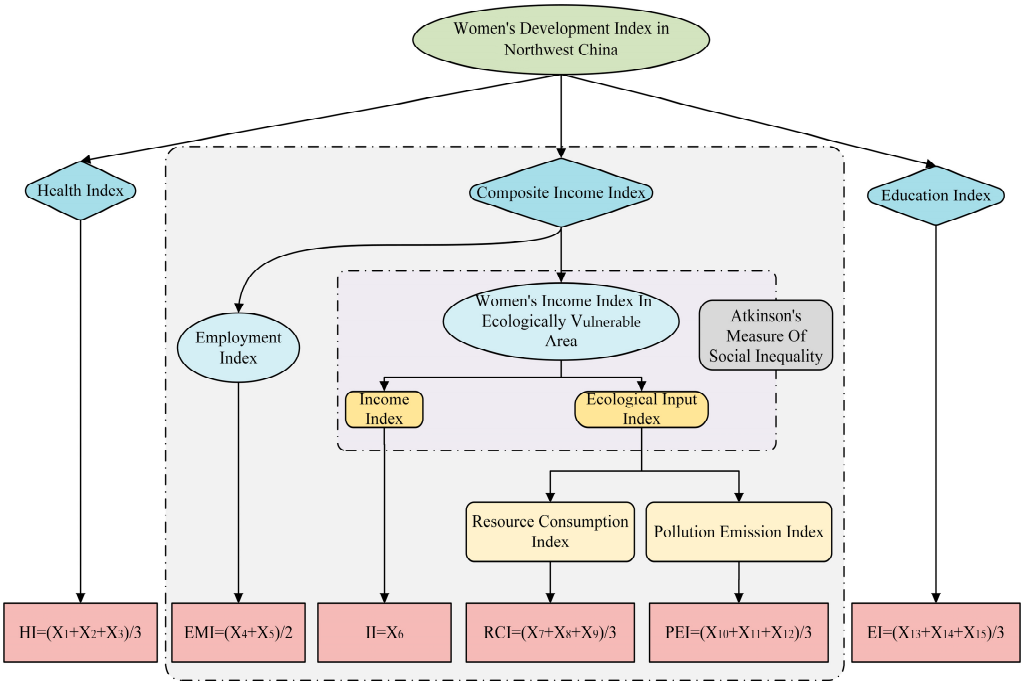


Figure 3. The Framework of the WDI Under the Influence of Ecological Factors in Northwest China.

This study took into account Northwest China's extensive development and ecological vulnerability. The region's serious resource consumption and pollution discharge were significant development-restraining issues [67]. We penalized the revenue component by factoring in the environmental costs of production. Income has typically been included in the HDI because it offers access to basic necessities of life as well as other products and services that help people realize their full potential. However, it is widely accepted that this potential must be ensured not just for the current generation, but also for future generations. Human, physical, and environmental capital must all be replenished. Current income figures do not account for the costs of manufacturing, such as pollution and decreased quality of life. The values used to compute income were simply added together; nothing was deducted. Per capita carbon emission was once employed by academics as a measurement or index of ecological input. The ecological input index (EII) was enriched in this study. The resource consumption index (RCI) took into account the water resource consumption index, land resource consumption index, and energy consumption index, and was measured by assessing women's water consumption (X7), the female per capita built-up area (X8) and carbon emissions per woman (X9), respectively. The pollution emission index(PEI)takes into account the water pollution discharge index, land pollution discharge index, and air pollution discharge index, using female per capita wastewater discharge (X10), the solid waste per woman (X11), and exhaust emissions per woman (X12), respectively. As a result, this research alters the previous study, which exclusively calculated regional well-being according to positive indicators by using resource consumption and pollution emissions as environmental indicators and including them in the income component as the expense (cost) of output growth. The income-index dimension

incorporates environmental-effect variables as production costs into the income index using the approach of Atkinson's measure of inequality, combining the women's income index in ecologically vulnerable areas and EI to create the composite income index (CII) [68].

This study makes reference to the methodical basis of index assignment used by scholars such as Yibin S. and Yunzhu J. [69] to measure the gender equality and women's development in China. By maintaining the stability of the indicators and abiding by the scientific percentage of the HDI, subjective values were assigned to each indication during the weighting of the WDI indicators. According to the value assignment principle, the three aspects of health, income, and education each have a sum of values that equals 1. From the level of the HI in WDI, to maintain the importance of female life expectancy (X1) in the HDI, we assigned it a value of 0.5, supplemented by other indicators with a total weighting of 0.5 and, thus, contributing 0.25 to maternal mortality rate (X2) and 0.25 to the rate of detection rate of gynecological diseases (X3). From the index layer of EI in WDI, in order to maintain the importance of average years of education for women (X13) in the HDI, we assigned it a value of 0.5 and, supplementarily, the total empowerment value of other indicators a value of 0.5. Therefore, the Illiteracy rate of females over 15 years old (X14) and the percentage of women among college students (X15) were both assigned the value of 0.25. From the index layer of CII in WDI, the original value of female disposable income should be 0.5 in order to maintain the importance of female disposable income per capita (X6) in HDI. However, the measurement of ecological factors were added in the calculation of the CII in this paper. To highlight the importance of ecological factors to the CII, we assigned a value of 0.7 and a value of 0.3 to the EI. The employment rate of urban women in other ownership units and female unemployment rate should both be assigned the value of 0.15, respectively. It should be noted that in WDI, the higher the value of X2 and X3 in HI, X5 in CII, and X14 in EI, the lower the corresponding value of HI, CII, and EI. Therefore, for convenience of calculation, we subtracted the normalized value from 1 after the standardized calculation of indicators to get the specific value in this index system.

Data for each index from 2003 to 2020 were sorted. In this study, the maximum and minimum values of indicators were set in accordance with the principle of HDI. The minimum value was set as the minimum value not reached by the development of each province, and their maximum values were set at the highest unreached and nearest values for each year. The human development report provided the maximum and lowest ranges for X1, X6, and X13. The maximum and minimum values for X2-X5, X7-X12 and X14-X15 were then defined. From the point of view of the minimum value setting, the per capita CO_2 emission index [67] was used in the dimension of ecological input with reference to Lasso when measuring the pollution sensitive HDI of each country, and the minimum value was defined as 0. Obviously, the social production in Northwest China already has a certain degree of resource consumption and pollution emission, but in recent years, the emission of all indicators has shown a downward trend. We forecasted the future development of the region in the direction of sustainable green development from the perspective of ideal development. The value of RCI and PEI may be getting closer and closer to 0. We undoubtedly did not exclude the possibility of a green-manufacturing method in the future to reduce resource usage and environmental emissions. Hence, the minimum values of X7-X12 were set as 0. The minimum values of X2-X5 and X14-X15 were set as 0 according to the definition of minimum value in HDI. When determining the maximum value, we looked at each indicator's change and trend in each of the five provinces, determined each indicator's peak value, and forecasted the future in light of the state of regional development. We chose a maximum value that was just a little bit higher than the peak value since the maximum likelihood would not go above the peak value. Therefore, the maximum values of X2-X5, X7-X12, and X14-X15 from 2003 to 2020 are as follows: XJ:138.55(2003); NX:54(2008); SX:53(2020); QH:23.2(2003); XJ:2787(2012); NX:271396(2018); NX:29(2019); NX:33(2009); XJ/QH:59(2006)/28473(2016); NX:245407(2010);QH:33(2005); and SX:58(2017). Then, we set the maximum of X2-X5, X7-X12, and X14-X15 for 140, 60, 60, 30, 2850, 300000, 30, 35, 70/30000, 260000, 35, 30 (Table 2).

Table 2. The Range of Each Indicator Layer.

Dimensional Layer		Indicator Layer	Weight	Minimum Value	Maximum Value
Long and Healthy Life	X_1	Life expectancy for women/year	0.5	20	85
	X_2	Maternal mortality rate 1/100,000	0.25	0	140
	X_3	Detection rate of gynecological diseases (%)	0.25	0	60
Standard of living	X_4	Employment rate of urban women in other ownership units (%)	0.15	0	60
	X_5	Female unemployment rate (%)	0.15	0	30
	X_6	Female disposable income per capita/yuan		352.4	264,300
Resource Consumption	X_7	Women's water consumption (m^3/person)	0.7	0	2850
	X_8	Female per capita built-up area (m^2/person)		0	300,000
	X_9	Carbon emissions per woman (tons/person)		0	30
Pollution Emission	X_{10}	Female per capita wastewater discharge (tons/person)		0	35
	X_{11}	Solid waste per woman (kg/person)		0	70/30,000
	X_{12}	Exhaust emissions per woman (m^3/person)		0	260,000
Knowledge	X_{13}	Average years of education for women/year	0.5	0	15
	X_{14}	Illiteracy rate of females over 15 years old (%)	0.25	0	35
	X_{15}	Percentage of women among college students (%)	0.25	0	30

2.3. Research Methods and Calculations

The key algorithms used in this research involved, separately, the techniques of Atkinson's measure of inequality [70], the Theil index [71], and the Dagum Gini coefficient [72] in the calculation of the environmental income index and the estimation of geographical imbalance.

2.3.1. Calculation of the WDI

(1) Calculation of each indicator

Standardization of indicators. Just as in the index of HDI, to construct WDI, it is necessary to convert the value of different combinations into an index and then obtain the geometric mean of HI, CII, and EI. To unify all indicators to the same scale, the first step was to calculate the values of all factors from 2003 to 2020 to 0–1 in a unified way. According to the maximum value and minimum value range stipulated in this paper, the calculation formula of each dimension's index is as follows:

$$VALUE = \frac{Actual\ value - min}{max - min} \tag{1}$$

$$Income\ index = \frac{\ln X6 - \ln X6_{min}}{\ln X6_{max} - \ln X6_{min}} \tag{2}$$

The values of the indicators X1–X5; X7–X15 were calculated according to Equation (1). The X6 was calculated by the Equation (2).

(2) Calculation of the Women's Income Index in an Ecologically Vulnerable Area

The EII, which ranges in value from 0 to 1, was created by the arithmetic-average processing of the six indicators of resource consumption and pollution emissions. The lower the value is, the lower the ecological cost of regional development; the higher the value is, the greater the ecological consumption and burden.

$$EII = \frac{RCI + PEI}{6} \tag{3}$$

$$EBI = 1 - EII \tag{4}$$

(3) EII is an environmental damage index that was created using the same methodology as the Environmental Behavior Index (EBI) by Lasso et al. We chose to change the EII and create an EBI in order to produce a positive assessment of the good management of nature

because the indicators used in the HDI place a positive value on development, whereas this index does the reverse (which in this case means not consuming resources and polluting the environment). The negative index (EII) should be adjusted to the positive index (EBI).

After II and EBI were calculated, we combined them into a single index as part of the CII, which we called M_3P. In areas with high levels of RCI and PEI, EBI was close to 0, so there was a large negative impact on income, and thus, WDI values are sacrificed. Similarly, if a province's EII close to 0, it must have a positive impact on the assessment of income. To incorporate measures of EBI into II, we referred to Atkinson's measure of inequality.

$$M_3P(e) = \left[\frac{(M_3)^{1-e}}{2} + \frac{(EBI)^{-1}}{2}\right]^{\frac{1}{1-e}} \quad (5)$$

The value of e changes between 0 to infinite, reflecting the extent of the dislike of inequality. If e = 0, there is no penalty (loss), and the result is a simple arithmetic average of Equation (5). As e increased, the women's income index in an ecologically vulnerable area decreased, and the II and EII of inequality increased. At the other extreme, where e is equal to infinity, income is quite sensitive to the environment, and the two values both reach the minimum. In any case, where the two components have the same value, the M_3P result is the arithmetic average, which means no inequality.

Since the harmonic mean is lower than the arithmetic mean when the income index is inconsistent with the environmental behavior index, the harmonic mean of the two indexes was taken for the calculation in this paper. According to this standard, e was set as 2, and the calculation formula of M_3P was as follows:

$$M_3P = \left[\frac{(M_3)^{-1}}{2} + \frac{(EBI)^{-1}}{2}\right]^{-1} \quad (6)$$

This calculation may seem complicated, but the basic principle is simple. In this research study, it was assumed that people have a neutral aversion to environmental damage. The method of synthesizing the various components into an index with a weight of $\varepsilon = 2$ has also been used in Human Development reports (for example, in the Human Poverty Index and Gender Empowerment Index measurements of the Gender Development Index).

2.3.2. Spatial Imbalance Measurement

Theil's index calculates inequality and differences based on entropy and information-quantity concepts. It breaks down the overall difference into differences between and within subregions, which has several applications in the analysis and study of differences and imbalance. To address the limitations of both the classic Gini coefficient and the Theil index, Dagum suggested a novel approach (the Dagum Gini coefficient) to further deconstruct the Gini coefficient of inequality [73]. When used to calculate regional differences, the Dagum Gini coefficient solves the cross-overlap problem among the samples and fully takes into account the particular distribution of subsamples [74]. This study used the Theil index and the Dagum Gini coefficient to calculate the regional imbalance between the provinces based on the time-series change and the level of women's development in Northwest China.

(1) Theil index

The Theil index, which can be geographically decomposed, is frequently used to quantify regional differences. The total income under the women's ecological factor in Northwest China was calculated by multiplying the total population of Northwest China by the women's ecological factor income index. Similarly, the total WDI in Northwest China was calculated by multiplying the total population of Northwest China by the WDI.

Based on the degree of women's development (income) in Northwest China, the Theil index was calculated according to the following formula:

$$Theil_i = \frac{y_j}{Y} \lg \frac{\left(\frac{y_j}{Y}\right)}{\left(\frac{x_j}{X}\right)} \tag{7}$$

$$Theil = \sum_{i=1}^{n} \left(\frac{y_j}{Y}\right) lg \frac{\left(\frac{y_j}{Y}\right)}{\left(\frac{x_j}{X}\right)} \tag{8}$$

For Northwest China, each province and district's Theil index level is represented by Equation (7), while the total Theil index level is represented by Equation (8). The total women's development (income) level index and the total population of the j_{th} province, accordingly, are denoted by y_j and x_j, while Northwest China's entire population is denoted by y and x. For each province in Northwest China, the Theil index's positive value correlates inversely with the proportion of total regional development to the total population. Conversely, the Theil index's negative value correlates inversely with the proportion of total development to the total population.

(2) Dagum Gini coefficient

The Dagum Gini coefficient was presented to investigate the fluctuation of the Gini coefficient among provinces. In contrast to the conventional Gini coefficient and Theil index, Dagum proposed a measure of the Gini coefficient decomposed by subgroups, which divides the overall Gini coefficient into three components: the intraregional-variation contribution (G_w), the interregional net-variation contribution (G_{nb}), and the supervariable-density contribution (G_t). Given the benefits and features of the Dagum Gini coefficient decomposition, this approach was chosen to characterize the regional differences in the degree of women's development in Northwest China. The formulae are presented in Equations (5)–(15).

$$G = G_w + G_{rb} + G_t \tag{9}$$

$$G = \frac{\sum_{j=1}^{k} \sum_{h=1}^{k} \sum_{i=1}^{n_j} \sum_{r=1}^{n_h} |y_{ji} - y_{hr}|}{2un^2} \tag{10}$$

$$\overline{Y}_1 \le \overline{Y}_h \le \ldots \overline{Y}_j \le \ldots \overline{Y}_k \tag{11}$$

$$G_w = \sum_{j=1}^{k} G_{jj} p_j s_j \tag{12}$$

$$G_{jj} = \frac{\sum_{i=1}^{n_j} \sum_{r=1}^{n_h} |y_{ji} - y_{jr}|}{2\overline{Y}_j n_j^2} \tag{13}$$

$$G_{nb} = \sum_{j=2}^{k} \sum_{h=1}^{j-1} G_{jh} \left(p_j s_h + p_h s_j\right) D_{jh} \tag{14}$$

$$G_{jh} = \frac{\sum_{i=1}^{n_j} \sum_{r=1}^{n_k} |y_{ji} - y_{jr}|}{n_j n_h \left(\overline{Y}_j + \overline{Y}_h\right)} \tag{15}$$

$$G_t = \sum_{j=2}^{k} \sum_{h=1}^{j-1} G_{jh} \left(p_j s_h + p_h s_j\right) \left(1 - D_{jh}\right) \tag{16}$$

$$D_{jh} = \frac{d_{jh} - p_{jh}}{d_{jh} + p_{jh}} \tag{17}$$

$$d_{jh} = \int_0^{\infty} dF_j(y) \int_0^{y} (y - x) dF_h(x) \tag{18}$$

$$p_{jh} = \int_0^{\infty} dF_h(y) \int_0^{y} (y - x) dF_j(x) \tag{19}$$

When separating the subregions, the cross-term is what contributes to the overall disparity (hypervariable density or G_t), which in this case is zero, as there is no cross-

term. The province serves as the smallest unit of measurement; hence, G_w is also 0. This measurement is focused on calculating the Gini coefficient between provinces. To make the computation easier, each province's development level was taken into account while determining the Gini coefficient breakdown, as shown in Equation (11). In the formula above, u represents the level of overall development of women in the five provinces, y_{ji} (y_{hr}) represents the level of the development of women in any city in region j(h), n represents the total number of provinces, k represents the number of regions, and n_j (n_h) represents the number of provinces in region j(h). G_{jj} stands for the Gini coefficient within region j, G_{jh} for the Gini coefficient between regions j and h, and D_{jh} for the relative degree of women's development between regions j and h(h). D_{jh} represents the degree of impact of the contribution rate of WDI between the j(h) areas; d represents the difference in the contribution rate of WDI between regions; and p_{jh} represents the hypervariance first-order matrix.

2.4. Data Sources

The China Statistical Yearbook for the Regional Economy and the China Statistical Yearbook on the Environment provide information on the indicators used for this study, including the per capita water supply, urban built-up area, wastewater emissions, industrial waste gas emissions, and general solid waste emissions. The IPCC subsectoral technique was used to calculate the carbon emissions statistics, which were taken from the China Carbon Accounting Database. The information on the subsectors of the HI, EI, and income index was gathered from the China Population & Employment Statistical Yearbook, China Health Statistical Yearbook, China Health and Family Planning Statistical Yearbook, and the Statistical Yearbooks of each province. The China General Social Survey covers all provinces and regions in China and includes micro-research data from five provinces in Northwest China, and the first survey was carried out in 2003. The starting year of this study was 2003 for the convenience of calculating the comprehensive well-being of women in Northwest China at a later stage. The ranges of average life expectancy, average years of education, and per capita disposable income indicators were derived from the Human Development Report (2019). The minimum values of maternal mortality, the detection rate of women's diseases, the illiteracy rate of women over 15 years old, the proportion of women among university students, the employment rate of urban women in other units, women's unemployment rate, resource consumption, and pollution emissions were set to 0, and the maximum values were set to the maximum values not reached in each province. Due to the absence of carbon emission data for 2020 and wastewater emission data for 2018–2020 in the statistical yearbook and the fact that the growth rates of these two sets of data have changed little in the last five years, the average growth rates of previous years were used to estimate the value. There was a change in the statistical caliber of solid waste in 2011, so the maximum value was set in segments.

3. Results

3.1. Spatial and Temporal Changes in the Level of Women's Development in Northwest China

We measured the level of women's development in Northwest China using the algorithm of the WDI under the influence of ecological factors, analyzed its spatial and temporal-change characteristics, and classified the WDI into low, medium, and high levels. The years 2003, 2012, and 2020 were chosen as research-time nodes, and the ArcGIS software was used to visualize and express the level of women's development in Northwest China. The HDI for women in Northwest China was chosen as the control group to which to compare the effects of each element on the degree of the development of women.

3.1.1. Time Variation

From observing the WDI in Northwest China under the influence of ecological factors (Table 3, Figure 4, first row), the overall trend of WDI in Northwest China from 2003 to 2020 increased from 0.525 in 2003 to 0.629 in 2012, showing an increase of 0.105 (19.95%), and by

a further 0.061 from 2012 to 2020, an increase of 9.61%. The degree of variation between provinces shows a trend of first increasing and then decreasing, with the range and standard deviation increasing from 0.163 and 0.058 in 2003 to 0.134 and 0.046 in 2012 and to 0.147 and 0.050 in 2020, respectively, and the year with the largest range and standard deviation was 2016, with values of 0.181 and 0.058, respectively. Due to ecological considerations, the provinces showed the largest difference of WDI in 2016. In contrast to Qinghai, where WDI's level were at their lowest in 2003, and Ningxia, where they were at their lowest in 2020, the WDI values were maintained at a reasonably high level in Shaanxi Province and rose consistently. With the exception of Ningxia, the lowest value in every province was recorded in 2003, the highest value in Shaanxi, Qinghai, and Xinjiang was recorded in 2020, and the highest value in Gansu and Ningxia was recorded in 2016.

Looking at the women's HDI in Northwest China (Table 4, Figure 4, second row), the overall trend uniformly increased between 2003 and 2020 from 0.554 in 2003 to 0.650 in 2012, with an increase of 0.096 (17.34%), and further increased by 0.059 (9.08%) from 2012 to 2020. The degree of difference between provinces showed a trend of first expanding and then decreasing, with the range and standard deviation increasing from 0.059 and 0.024 in 2003 to 0.065 and 0.024 in 2012, and to 0.078 and 0.028 in 2015, and then decreasing to 0.058 and 0.022 in 2020, with the greatest difference in the HDI among women in each province in 2015. In all 5 Northwest Chinese provinces, there was a consistent upward trend in the degree of women's well-being. Among them, the province of Shaanxi consistently maintained a high degree of well-being throughout the years. Both Gansu and Qinghai had lower well-being ratings in 2003, while Qinghai had the lowest level in 2020. In each province, the women's HDI score peaked in 2020 after reaching its maximum point in 2003.

Table 3. Effects of Ecological Factors on WDI in Northwest China from 2003 to 2020.

Year	SX	GS	QH	NX	XJ	Standard Deviation	Range	NC
2003	0.605	0.510	0.442	0.575	0.492	0.058	0.163	0.525
2004	0.602	0.517	0.475	0.584	0.532	0.046	0.126	0.542
2005	0.607	0.492	0.474	0.507	0.530	0.046	0.133	0.522
2006	0.633	0.512	0.515	0.575	0.551	0.045	0.121	0.557
2007	0.642	0.541	0.536	0.541	0.577	0.040	0.106	0.567
2008	0.665	0.570	0.551	0.568	0.594	0.040	0.114	0.589
2009	0.676	0.574	0.578	0.557	0.636	0.045	0.119	0.604
2010	0.696	0.611	0.583	0.545	0.618	0.050	0.151	0.611
2011	0.709	0.606	0.598	0.603	0.639	0.042	0.111	0.631
2003–2012	0.110	0.114	0.160	0.049	0.090	0.036	0.112	0.105
2012	0.716	0.623	0.603	0.623	0.582	0.046	0.134	0.629
2013	0.734	0.645	0.607	0.655	0.596	0.049	0.138	0.648
2014	0.729	0.658	0.640	0.638	0.630	0.036	0.099	0.659
2015	0.750	0.658	0.599	0.660	0.639	0.050	0.151	0.661
2016	0.759	0.679	0.578	0.670	0.659	0.058	0.181	0.669
2017	0.765	0.679	0.633	0.653	0.681	0.045	0.132	0.682
2018	0.764	0.652	0.651	0.622	0.687	0.049	0.142	0.675
2019	0.771	0.664	0.650	0.592	0.688	0.058	0.179	0.673
2020	0.780	0.676	0.661	0.633	0.700	0.050	0.147	0.690
2012–2020	0.065	0.052	0.058	0.010	0.118	0.034	0.108	0.061

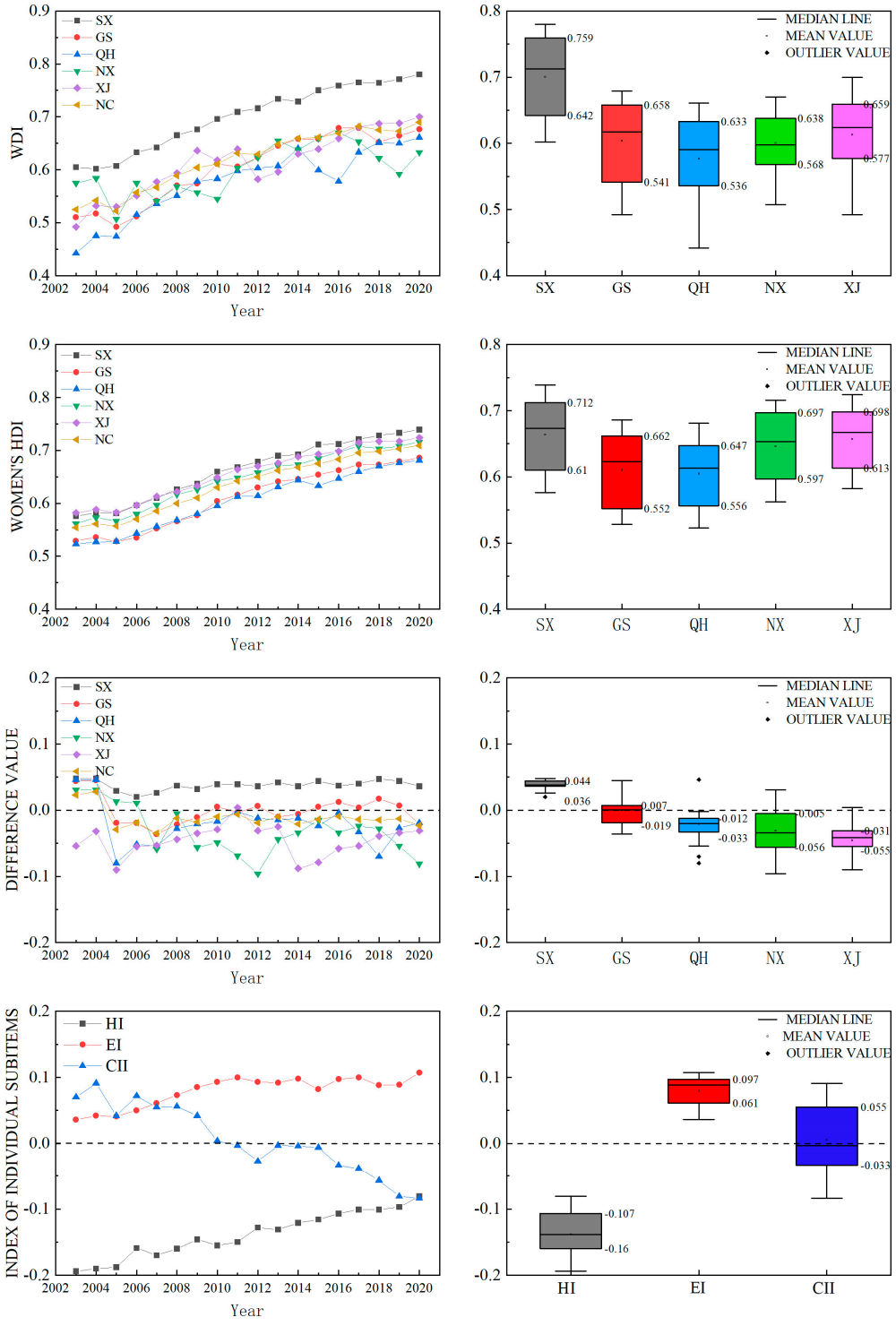


Figure 4. Temporal Changes in WDI and Women's HDI, and the Difference Between Them in Northwest China and in the 5 Provinces from 2003 to 2020.

Table 4. Women's HDI in Northwest China from 2003 to 2020.

	SX	GS	QH	NX	XJ	Standard Deviation	Range	NC
2003	0.576	0.529	0.523	0.562	0.582	0.024	0.059	0.554
2004	0.582	0.536	0.527	0.573	0.588	0.025	0.061	0.561
2005	0.581	0.528	0.528	0.566	0.583	0.025	0.056	0.557
2006	0.596	0.535	0.543	0.580	0.596	0.026	0.061	0.570
2007	0.610	0.552	0.556	0.597	0.613	0.026	0.061	0.585
2008	0.626	0.566	0.568	0.617	0.622	0.027	0.060	0.600
2009	0.637	0.577	0.580	0.626	0.633	0.026	0.059	0.610
2010	0.660	0.604	0.595	0.642	0.649	0.026	0.065	0.630
2011	0.668	0.616	0.613	0.648	0.664	0.023	0.055	0.642
2003–2012	0.103	0.101	0.092	0.096	0.088	0.005	0.015	0.096
2012	0.679	0.630	0.614	0.658	0.670	0.024	0.065	0.650
2013	0.690	0.641	0.631	0.671	0.676	0.022	0.060	0.662
2014	0.692	0.646	0.644	0.673	0.688	0.020	0.048	0.668
2015	0.711	0.654	0.633	0.685	0.693	0.028	0.078	0.675
2016	0.712	0.662	0.647	0.697	0.698	0.024	0.064	0.683
2017	0.721	0.673	0.660	0.708	0.715	0.024	0.061	0.695
2018	0.728	0.673	0.670	0.703	0.717	0.023	0.058	0.698
2019	0.733	0.679	0.676	0.708	0.717	0.022	0.057	0.703
2020	0.739	0.686	0.681	0.716	0.724	0.022	0.058	0.709
2012–2020	0.060	0.057	0.066	0.058	0.054	0.004	0.012	0.059

Women's HDI and each subitem were deducted from the WDI and from the health, education, and income subitems in each province from 2003 to 2020 to more thoroughly examine the impact of each aspect of the WDI under the influence of ecological variables in Northwest China. The findings are displayed in the third and fourth row plots of Figure 4. While Shaanxi's WDI was higher than the women's HDI level from the point of view of each province, Qinghai and Xinjiang's WDI continued to be below the women's HDI level, and Gansu and Ningxia's WDI were typically lower than the women's HDI. The overall level of WDI in Northwest China was lower than the level of women's HDI. The EI level in the WDI was consistently lower than the education subindex of the HDI for women in terms of the differences in health, education, and income because maternal mortality and the rate of gynecological disease detection lowered the level of the index measured using only female life expectancy. Although the level of the EI in the WDI was initially greater than the EI of the female HDI, the addition of the factors, percentage of female college students and the illiteracy rate of women over 15 years old, to the development index raised the level of the index, calculated using only years of schooling, and made the measurement more accurate. The CII in WDI subcomponent fluctuated slightly, and its indicator layer showed slower changes in X4, X5, and X6, which made the EII the main determinant of the difference in the CII. According to comparative analysis and differential research, the growth in RCI and PEI had a significant impact on each province's WDI, while the women's HDI disregarded the importance of ecological factors and did not properly gauge women's well-being levels. As a result, the variations in the degree of women's well-being in each province in Northwest China may be better described by the WDI in each area under the effect of ecological variables.

3.1.2. Spatial Variation

In terms of the WDI in Northwest China under the influence of ecological factors, except for Shaanxi, which reached a medium level of WDI in 2003, the other four provinces were at the low level, while in 2012, Gansu, Ningxia, and Qinghai reached the medium level of WDI, Xinjiang was still at the low level, and Shaanxi improved to a high level and reached the overall WDI in Northwest China. By 2020, Xinjiang had surpassed Qinghai, Gansu, and Ningxia in terms of WDI.

The women's HDI in all of the provinces in Northwest China tended to increase. Northwest China had a low level of HDI overall in 2003; by 2012, all of its provinces had achieved a medium level; and by 2020, all provinces in the area had attained a high level of development, with the exception of Gansu, and Qinghai maintained a medium level (Figure 5).

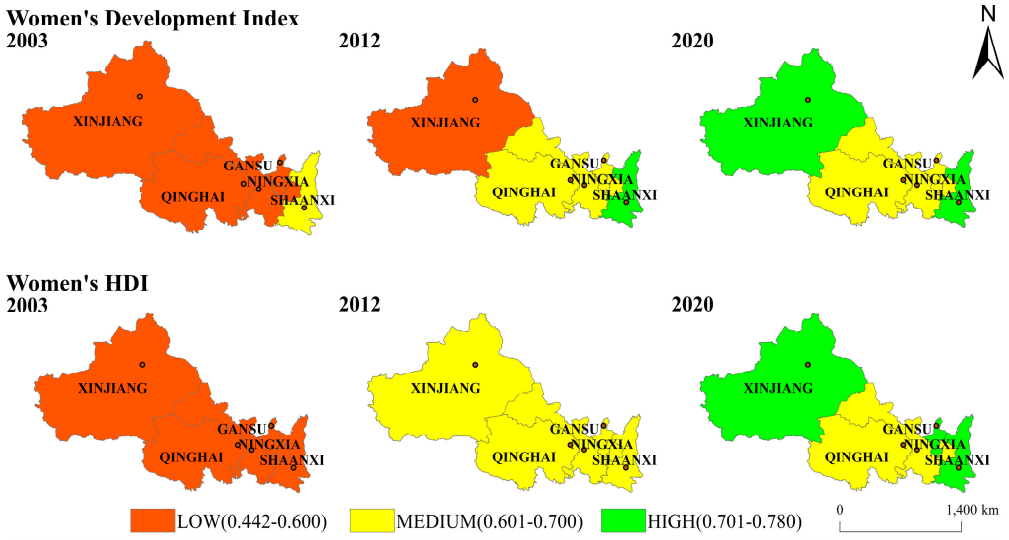


Figure 5. Comparison of WDI and Women's HDI in Northwest China in Space Variation.

We discovered that ecological variables had a significant impact on the level of WDI in Northwest China by comparing and evaluating the WDI in Northwest China under the influence of ecological factors with the women's HDI in each province. With the inclusion of ecological elements, the total WDI in Northwest China varied significantly, and there were significant variations across provinces. Due to its low EII values for resource consumption and pollution emissions, Shaanxi was the only one of the provinces to attain a medium level of development in 2003. By 2011, it had become the only high-level province among the five northwest Chinese provinces. As a result of higher values of RCI and PEI in the EII, Gansu, Qinghai, and Ningxia fell behind other provinces in terms of WDI, while Xinjiang maintained its low level of WDI in 2012 and advanced to a high level in 2020 as a result of a high value of EII from 2003 to 2012 and a considerable drop in the EII from 2012 to 2020. Income level was the primary factor impacting the unequal level of well-being among provinces, along with the environmental effect factor.

3.2. Analysis of the Spatial Imbalance of Women's Well-Being in Northwest China

3.2.1. Imbalance Analysis of the WDI and CII Based on the Theil Index

The degree of regional well-being is significantly influenced by the income element. In this subsection, we utilized the Theil index to examine the degree of imbalance and changes in the WDI and CII across Northwest China and the 5 provinces under the impact of EII. Figure 6 compares the degrees of WDI imbalance and CII imbalance for Northwest China and the five provinces, and their cumulative WDI and CII imbalances under the Theil index, from 2003 to 2020.

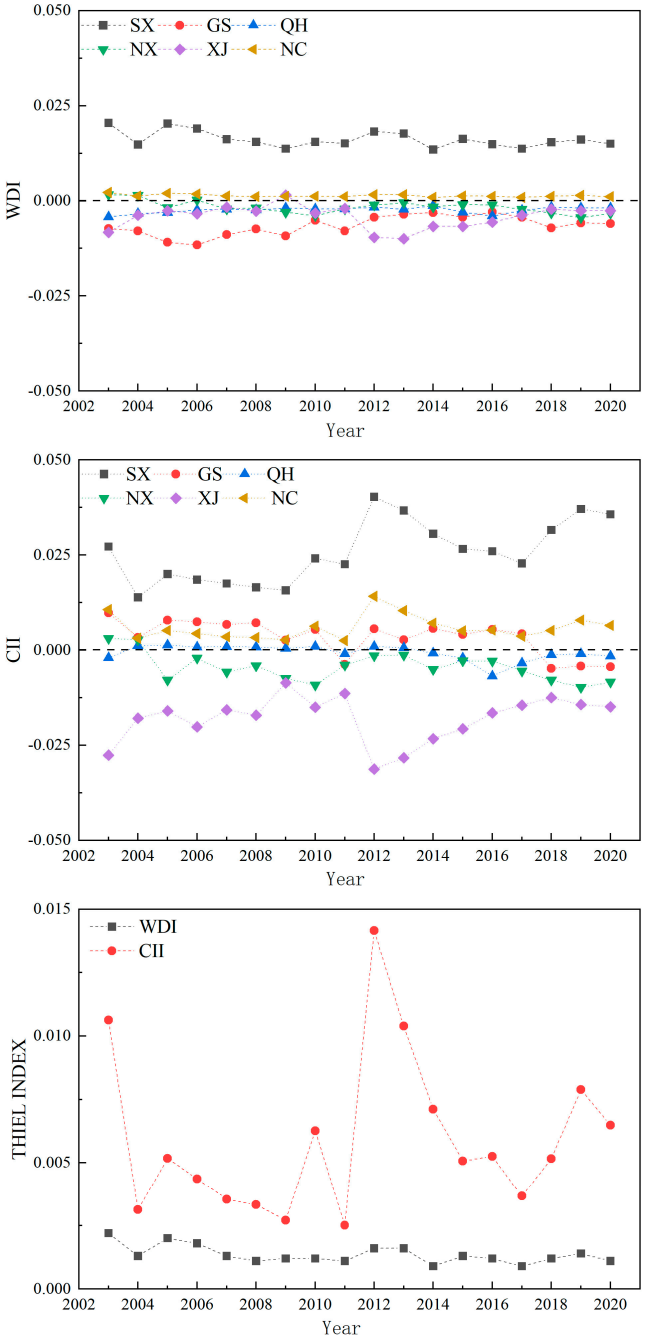


Figure 6. The Degree of Inequality in the Development and Income Indices of Northwest China and the Five Provinces According to the Theil Index from 2003 to 2020.

The degree of change in the WDI and the fluctuation range was noticeably smaller than that of the CII, and the imbalance level of the WDI and CII in Shaanxi was higher than the overall level of Northwest China according to the changes in the imbalance of WDI and CII across the provinces. In terms of the degree of WDI imbalance, Shaanxi had the highest value, peaking at 0.0182 in 2012, while Gansu, Qinghai, and Xinjiang maintained negative values. Xinjiang had the lowest value, and its imbalance value stayed negative from 2003 to 2020, falling to its lowest value of -0.0313 in 2012. Shaanxi still had reached the highest value among the five provinces in terms of income level imbalance, climbing to the maximum value of 0.0403 in 2012.

The Theil index was used to compare the WDI and CII of Northwest China in terms of the environmental effect, and the results reveal that both of these indices trended up

and then down from 2003 to 2020, with the WDI being much lower than the CII. The CII fluctuated, increasing from 2003 to 2012 and peaking at 0.0142 in 2012, which demonstrated that the disparity in female income level reached its highest under the effect of ecological variables in Northwest China. The index then steadily declined with fluctuations, reaching 0.0065 in 2020, which was lower than the value of 0.0106 in 2003. The greatest value of 0.0016 was recorded in 2012, indicating a more moderate overall shift in the degree of imbalance. Fewer value changes occurred from 2003 to 2020, changing from 0.0022 to 0.0011.

The Theil index was used to analyze the disparity between the WDI and the CII in Northwest China. The results revealed that, while there were ups and downs in all provinces, the degree of imbalance tended to stabilize. The degree of CII disparity was much larger than the degree of WDI disparity. The year with the greatest income level disparity between regions as a result of WDI and ecological variables was 2012.

3.2.2. Gap Analysis of WDI Based on the Dagum Gini Coefficient

Table 5 illustrates the extent and trend of interregional variations in WDI under the effect of ecological variables among the five provinces in Northwest China. Overall, there was a decreasing tendency in the interprovincial gap between provinces, with the highest interprovincial gap between provinces occurring in 2003 and the smallest interprovincial gap occurring in 2014. The largest difference between provinces was found between Shaanxi and Qinghai in 2003, while the smallest difference was found between Gansu and Qinghai in 2018.

Table 5. Interregional Gini coefficient of the WDI of Five Provinces in Northwest China from 2003 to 2020.

Year	Overall G	(G-S)	(Q-S)	(Q-G)	(N-S)	(N-G)	(N-Q)	(X-S)	(X-G)	(X-Q)	(X-N)
2003	0.0623	0.0859	0.1555	0.0706	0.0261	0.0599	0.1299	0.1036	0.0179	0.0528	0.0777
2004	0.0471	0.0754	0.1174	0.0423	0.0152	0.0603	0.1023	0.0611	0.0144	0.0567	0.0459
2005	0.0466	0.1043	0.1231	0.0190	0.0891	0.0153	0.0344	0.0675	0.0370	0.0560	0.0217
2006	0.0434	0.1056	0.1030	0.0026	0.0475	0.0583	0.0558	0.0690	0.0368	0.0343	0.0215
2007	0.0351	0.0853	0.0903	0.0050	0.0854	0.0001	0.0049	0.0529	0.0326	0.0375	0.0326
2008	0.0345	0.0766	0.0939	0.0174	0.0786	0.0020	0.0154	0.0567	0.0200	0.0374	0.0220
2009	0.0397	0.0813	0.0781	0.0032	0.0965	0.0154	0.0186	0.0301	0.0513	0.0481	0.0666
2010	0.0443	0.0657	0.0890	0.0234	0.1218	0.0565	0.0332	0.0594	0.0063	0.0297	0.0628
2011	0.0328	0.0786	0.0851	0.0066	0.0807	0.0022	0.0044	0.0521	0.0267	0.0332	0.0288
2012	0.0366	0.0688	0.0854	0.0168	0.0689	0.0001	0.0167	0.1029	0.0344	0.0176	0.0343
2013	0.0401	0.0645	0.0951	0.0308	0.0568	0.0077	0.0385	0.1037	0.0395	0.0086	0.0471
2014	0.0264	0.0518	0.0655	0.0137	0.0666	0.0148	0.0011	0.0731	0.0213	0.0076	0.0065
2015	0.0391	0.0654	0.1119	0.0469	0.0640	0.0014	0.0483	0.0800	0.0147	0.0322	0.0161
2016	0.0457	0.0550	0.1353	0.0809	0.0623	0.0073	0.0736	0.0704	0.0154	0.0656	0.0081
2017	0.0341	0.0592	0.0941	0.0351	0.0786	0.0195	0.0156	0.0579	0.0013	0.0364	0.0208
2018	0.0379	0.0790	0.0796	0.0006	0.1026	0.0239	0.0233	0.0533	0.0258	0.0264	0.0497
2019	0.0470	0.0745	0.0848	0.0103	0.1314	0.0575	0.0472	0.0570	0.0176	0.0279	0.0750
2020	0.0386	0.0719	0.0829	0.0111	0.1038	0.0321	0.0210	0.0542	0.0178	0.0289	0.0499

When comparing the 10 pairs of provinces, the disparity in WDI between Shaanxi and the other four was more than the gap in development between other provinces, although the distance between Gansu, Qinghai, and the other three provinces, except for Shaanxi, was smaller. Between 2003 and 2020, there was progressively less variation in the distance between Xinjiang and the other four provinces, and all of the gap levels were lower in 2020 than in 2003.

The total Dagum Gini coefficient for Northwest China decreased continuously from 2003 to 2008 and then fluctuated gradually from 2008 to 2020, with the lowest value of 0.0345 occurring in 2008 and the greatest value of 0.0457 occurring in 2016. The Gini coefficient decreased by 38.09%, from 0.0623 in 2003 to 0.0386 in 2020. After 2010, the Gini

coefficient maintained a consistent value of 0.04. This shows that the variation in the WDI gap among the five provinces, as affected by ecological factors, was steadily decreasing.

4. Discussion

Women's well-being has developed into a significant study issue in geography and sociology as a group-research component of well-being research [73,74]. Creating an index system, is a typical mathematical technique to assess the level of regional growth and well-being. Ecological elements, nevertheless, were not always seen to be sufficient for the well-being of local women. The HDI's three-dimensional measures of health, education, and income were used in this essay. This study created the Northwest WDI to assess the degree of regional women's well-being by enriching the index layers of health, education, and income index and incorporating the environmental impact component as the cost consumption of social production into the income index dimension. Due to the large proportion of industrial production among the three industries in the study area, industrial production has the highest contribution value to regional development. However, due to the extensive social-production mode, serious resource consumption, and pollution emission, the regional development is restricted [62,63]. Therefore, the change in production level in this area can be reflected by the change in the environmental impact factor, which adds a scientific component to the evaluation of environmental impact factors in the income index dimension. As the HDI faces the problem of having too few indicators, this article focused on enhancing the indicators of health, education, and income to prevent limitations from determining the degree of regional development based only on the three positive indicators of life expectancy, average years of schooling, and income level. It also performed a comparison analysis and difference calculation between the study findings and the results of the HDI. Hence, the calculation results better reflect the differences between the method constructed in this paper and the HDI, and measure the regional WDI in a more scientific and comprehensive way. This research provides a way to measure regional levels of women's well-being. When measuring the WDI Northwest China, this paper considers not only the changes in time but also the changes in space, which can more intuitively reveal the differences in regional WDI. Moreover, the index method in this research is unique and regionally applicable. Since all of the variables chosen were the most significant to women's growth in Northwest China, the index system described in this work is appropriate for measuring women's development in areas with fragile and extensive ecological production and regressive female education, income, and health.

Regional-development inequalities, imbalanced circumstances, and regional geographic polarization are frequently related to regional development. This paper employed a measurement method widely used in the School of Economics to calculate the WDI in Northwest China, as well as the Theil Index to calculate unbalanced development in Northwest China, analyzing the development gap between the five provinces and regions using the Dagum Gini coefficient [64,71]. The development gap between provinces in Northwest China is enormous, which will make it impossible to realize the region's overall growth if the regional imbalance is not adjusted. It is beneficial to further increase the well-being level of women in Northwest China by measuring regional inequalities and changes in Northwest China's well-being. The ratio found in earlier research was used to choose the women's calculation RCI and the PEI in Northwest China for this study. The annual per capita water consumption of women was 10% higher than that of men [75], the gender ratio in China had a 1% influence on pollutant emissions, and the higher the gender ratio is, the higher the emissions of pollutants [76]. The carbon dioxide emissions in China increased by 1.394% for every unit increase in the gender ratio [77]. In this study, the model was slightly modified to calculate the per capita emissions of the Northwest China when the sex ratio is 100 because previous calculations of pollution emissions using the ratio of CO_2 emissions result in positive emissions for men and negative emissions for women, which is not consistent with the actual situation. In contrast, no quantitative research has been undertaken regarding the built-up area per capita for urban women,

which was determined by taking into account the total number of urban households, the urban sex ratio, and the typical number of urban family members per household.

We looked for plausible explanations for the temporal and geographic variability in WDI across Northwest China. Overall, regional development is greatly influenced by how national policies and initiatives were carried out. The State Council of China issued the Notice on Policies and Measures for the Implementation of the Large-Scale Development of the Western Region on 26 October 2000. The 11th Five-Year Plan for the Large-scale Development of the Western Region was implemented in 2006, and the 12th Five-Year Plan for the Large-scale Development of the Western Region was implemented in 2012. In general, the western area has begun and expedited the development of infrastructure, the natural environment, research, technology, and education. The capital demand of the development of northwest China was safeguarded through national debt investment. Highway Construction of major national highways was accelerated. They made steady progress in converting farming to forest and grassland, as well as in afforestation and grass-planting on barren slopes and wastelands from an ecological standpoint. China put forward the "Belt and Road" Initiative in 2013. "The Belt and Road" (B&R) is short for "Silk Road Economic Belt" and "21st Century Maritime Silk Road". Its economic meaning was of vital importance. Northwest China held the following position: It would serve as a commerce and logistics center, an important industry, and as a basis for cultural interchange for nations in Central, South, and West Asia, which had given the region's economic growth new life. The health of women in Northwest China is gradually increasing, according to the HI. The relevance of physical exams for women and expectant mothers was steadily increased throughout all provinces and regions, as was the standard of women's medical security. The Shaanxi Women's Health Promotion Program and other provincial initiatives sought to increase the health of women while lowering the death rates for breast and cervix cancer. The major strategy was to encourage young women to take advantage of free gynecological exams. The project had a 5-year cycle, and the target population's examination coverage rate was capable of exceeding 80% to 85%. In locations where the circumstances allow, this rate may be steadily increased. Over 90% of cervical cancer cases were detected early. More than 95% of aberrant or suspicious cases were managed in the following manner. The capacity of the women's health services had increased, and over 95% of the inspectors in the project regions had received training. As a consequence, from 2003 to 2020, the women's health index had grown annually.

According to the II, the growth of the secondary and tertiary sectors heavily influences the production mode of the five provinces. According to this analysis, between 2003 and 2020, women's per capita disposable income increased along with the growth of the GDP. The government helped women launch enterprises and get jobs from the standpoint of female employment. It decided to use strategies such as providing women with small, guaranteed loans, teaching them labor-market skills, building up demonstration bases for reducing women's poverty, and providing impoverished women with breeding and planting facilities. Online e-commerce and Internet Plus have increased local women's job opportunities in recent years thanks to the advancement of Internet technology. In Northwest China, women were increasingly choosing a job outside of the government system.

RCI and PEI were the key determinants of CII. From 2009 to 2016, the largest concentrations of resource use and environmental emissions occurred in Qinghai, Ningxia, and Xinjiang. The primary industrial sectors in Qinghai, Ningxia, and Xinjiang were non-ferrous metal smelting and rolling processing industry, electricity and heat production and supply, and oil and gas exploitation. The industrial products in these regions were mostly natural crude oil, natural gas, and raw salt. The objective of regional development has changed from raising GDP to conserving regional ecology with a focus on the conservation of the ecological environment in western China. The government has started to limit the growth of industries with high pollution and high consumption, to introduce green production technology, promote regional ecological development beforehand, promote regional industrial transformation, and upgrade in order to create a strong national ecological security

barrier. RCI and PEI have thus gradually decreased in the provinces of Northwest China in recent years. In WDI, there was a significant disparity between the provinces, and the overall trend was upward. The guarantee of educational funds and the system of awards and subsidies for operating schools in other places have been continuously improved, the safety projects and standardization construction of primary and secondary schools have been gradually completed, and the conditions for operating schools had been significantly improved, according to the EI. During the nation's drive to combat poverty, the China Women's Federation and other groups actively encouraged literacy in rural regions. The percentage of illiterate women has been falling annually, and all pupils received better educations with time. In order to increase the number of women who can attend college, we would encourage the building of colleges and institutions in the western area. Therefore, the women's EI increased year by year from 2003 to 2020.

At present, studies on regional women's well-being often focus on the exploration of factors affecting women's well-being and life satisfaction. However, there are few studies on the spatial and temporal changes in regional women's well-being in a macro-sense. The key to improving women's well-being in Northwest China and reducing the imbalance of women's well-being among regions is to protect the local ecology, improve the local economy, and realize the balance of well-being among regions by means of component complementarity. Based on the analysis of the current situation of women's development in Northwest China and the actual situation of politics, social economy and education in each province, the following suggestions are put forward from the perspectives of ecology, health, education, and income from different subjects such as government, society and family:

1. Protecting the local environment, modernizing and restructuring the industrial structure, switching the regional development model, and raising the regional development level are the essential steps that need to be taken to increase the well-being of women in Northwest China. By utilizing national strategic initiatives such as the Great Western Development and the Silk Road to jump onto the new era's wave of fast development, we will cut resource consumption and pollution emissions. We also plan to bring sophisticated science and technology as well as green and energy-saving businesses, and to encourage the growth of regional traditions, distinctive landforms, and a sense of place.
2. By implementing a systematic and effective gender budgeting system and other measures, the nation will update the social security funding model, raise social security spending, and create a social security system with the overarching objective of achieving gender equality and ending gender segregation. We will strengthen the protections offered to women in the areas of unemployment insurance, health insurance, maternity insurance, old age insurance, and medical insurance.
3. Education is a critical tool for women seeking equality and advancement. A woman's knowledge of the world and level of professional engagement in social activities are both influenced by their degree of education. In addition to the fundamental requirement that women in Northwest China have equal access to education, it is important to encourage women to pursue higher education and to increase their general awareness through financial aid and increased enrollment quotas. However, women might earn more money in line with their degree of education after completing a higher education.
4. When women work in the social sphere, they may convert the labor force that has been primarily focused on the home sphere into economic revenue, which can raise individual income levels and strengthen family relationships. The expansion of women's employment sectors, the addition of women's employment positions, the reasonable arrangement of employment training, the optimization of women's employment structures, the promotion of women's employment level, and the improvement of women's employment quality can all be done against the background of the growing

proportion of tourism and other tertiary industries in the ecologically vulnerable provinces of Northwest China.

This article still has some limitations. There may be some discrepancies between the measurement results and the actual situation as a result of the lack of specific male and female resource consumption and pollution-emission ratio data in the calculation of the index system. We acknowledge that the use of the EII in this study does have some limits. The data on women's ecological input in Northwest China were scarce, and data collection was challenging due to the broad measurement area and the lengthy time series. Furthermore, resource consumption and pollutant emissions have a significant influence on regional development in Northwest China due to its delicate natural environment. Some scholars [67,75] have studied the resource consumption and pollution emissions caused by gender differences in the past, so the indicators in this study can reflect the impact of EII on regional female development to a certain extent. The six EII variables were taken into account in this study's income subcategory as a cost and loss to social production utilizing Atkinson's inequality assessment approach. They were the temporary alternative indicators that we used to assess the influence of ecological variables on the development of women. Future small-scale regional study may use questionnaires and other tools to gather more pertinent data. In the future, more precise objective indicators will be chosen and calculated. To examine the gender disparity in well-being, the region's male and female well-being indicators will be chosen. This measurement encompasses a large and extensive area, and it lacks microdata on a micro scale; therefore, its practical reference relevance for the growth of different provinces and regions is unclear. The sole objective well-being of female groups in Northwest China is the focus of this measurement. The data collected from the China General Social Survey and China Family Tracking Survey will be used in future research to improve the comprehensive measurement of women's well-being in Northwest China and provide a more proper examination of women's well-being in the area.

5. Conclusions

To explore the degree of spatial inequality and changes in women's well-being under the effect of ecological factors in Northwest China, this article considered women from five provinces as the research subject. The Theil index and Dagum Gini coefficient were then used to examine the data to build an index of the development of women in Northwest China under the effect of ecological variables. The conclusions are as follows.

From the temporal perspective, the overall trend of women's well-being measured by WDI under the influence of ecological factors increased from 2003 to 2020 in Northwest China, with the exception of Shaanxi. The other four provinces had fluctuating changes, and the addition of ecological factors increased the fluctuation degree of WDI in Northwest China, which was more suitable for the actual situation. The addition of other indicators in the education, health, and income indices made the well-being measurement more comprehensive and scientific.

From the spatial perspective, the degree of variation in women's well-being among the five provinces of the Northwest China WDI was stronger than that of the HDI. Among the five provinces, Shaanxi Province maintained the highest level of women's development, and in 2012, Shaanxi was the only province and region with a high level of WDI, while Xinjiang had the greatest change in development, rapidly improving from a low level of WDI in 2012 to a high level of WDI in 2020.

Among in the five provinces in Northwest China, the women's well-being's imbalance between WDI and CII from 2003 to 2020 was the largest in Shaanxi and the smallest in Xinjiang, while the imbalance between WDI and CII in Qinghai and Ningxia was relatively stable, and the level of imbalance in each province and region gradually decreased and stabilized during the fluctuations. In the future, the unbalanced development in Northwest China will show a decreasing trend, and the difference in WDI will be lower than the CII.

The gap in women's well-being as calculated by WDI under the influence of ecological factors among 10 pairs of provinces in Northwest China from 2003 to 2020 showed a decreasing trend with fluctuations. The gap between Shaanxi and the remaining four provinces in terms of WDI was relatively large, and the gap in WDI in Gansu, Qinghai and the remaining three provinces was smaller. The overall Dagum Gini coefficient gradually stabilized at approximately 0.04.

Author Contributions: J.M. designed the research, analyzed the data, and wrote the paper. M.L. revised the paper. H.Y. methodology and software. R.L. data collection. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments: Thanks to the experts and scholars who have provided suggestions for revisions to this article.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Huang, G.; Jiang, Y.; Liu, Z.; Nie, M.; Liu, Y.; Li, J.; Bao, Y.; Wang, Y.; Wu, J. Advances in human well-being research: A sustainability science perspective. *Acta Ecol. Sin.* **2016**, *36*, 7519–7527.
2. Li, Q.; Chen, H. The Relationship between Human Well-Being and Carbon Emissions. *Sustainability* **2021**, *13*, 547. [CrossRef]
3. Ray, A.K. Measurement of social development: An international comparison. *Soc. Indic. Res.* **2008**, *86*, 1–46. [CrossRef]
4. Mirahmadizadeh, A.; Ghelichi-Ghojogh, M.; Vali, M.; Jokari, K.; Ghaem, H.; Hemmati, A.; Jafari, F.; Dehghani, S.S.; Hassani, A.H.; Jafari, A.; et al. Correlation between human development index and its components with COVID–19 indices: A global level ecologic study. *BMC Public Health* **2022**, *22*, 1. [CrossRef]
5. Zhai, C.; Wang, S. Spatio-temporal difference evolution and scenario simulation of multi-dimensional well-being in Poyang Lake area based on system dynamics. *Acta Ecol. Sin.* **2021**, *41*, 2954–2967.
6. Nugroho, T.W.; Hanani, N.; Toiba, H.; Sujarwo, S. Promoting Subjective Well-Being among Rural and Urban Residents in Indonesia: Does Social Capital Matter? *Sustainability* **2022**, *14*, 4.
7. Rahman, M.S.; Andriatmoko, N.D.; Saeri, M.; Subagio, H.; Malik, A.; Triastono, J.; Oelviani, R.; Kilmanun, J.C.; da Silva, H.; Pesireron, M.; et al. Climate Disasters and Subjective Well-Being among Urban and Rural Residents in Indonesia. *Sustainability* **2022**, *14*, 6.
8. Song, M.; Huntsinger, L.; Han, M. How does the Ecological Well-Being of Urban and Rural Residents Change with Rural-Urban Land Conversion? The Case of Hubei, China. *Sustainability* **2018**, *10*, 2.
9. Women's Well-Being Index. Available online: https://calbudgetcenter.org/resources/womens-well-being-index/ (accessed on 12 December 2022).
10. Gender Disparity Index. Available online: https://womenandprogress.org/ (accessed on 12 December 2022).
11. Belmin, C.; Hoffmann, R.; Elkasabi, M.; Pichler, P. LivWell: A sub-national dataset on the living conditions of women and their well-being for 52 countries. *Sci. Data* **2022**, *9*, 719. [CrossRef] [PubMed]
12. Panday, P. Women's Empowerment and the Well-being of Children in Nepal. *J. Dev. Soc.* **2020**, *36*, 129–154.
13. Roseboom, T.J. Why achieving gender equality is of fundamental importance to improve the health and well-being of future generations: A DOHaD perspective. *J. Dev. Orig. Health Dis.* **2020**, *11*, 101–104. [CrossRef]
14. Chen, F.; Bao, L.; Shattuck, R.M.; Borja, J.B.; Gultiano, S. Implications of Changes in Family Structure and Composition for the Psychological Well-Being of Filipino Women in Middle and Later Years. *Res. Aging* **2017**, *39*, 275–299. [CrossRef]
15. Strange, J.M. In Full Possession of Her Powers: Researching and Rethinking Menopause in early Twentieth-century England and Scotland. *Soc. Hist. Med.* **2012**, *25*, 685–700. [CrossRef]
16. Schulte, P.; Vainio, H. Well-being at work—Overview and perspective. *Scand. J. Work Environ. Health* **2010**, *36*, 422–429. [CrossRef]
17. Gilbert-Ouimet, M.; Brisson, C.; Vezina, M. Psychosocial work stressors, high family responsibilities, and psychological distress among women: A 5-year prospective study. *Am. J. Ind. Med.* **2020**, *63*, 170–179. [CrossRef]
18. Gur, R.E.; White, L.K.; Waller, R.; Barzilay, R.; Moore, T.M.; Kornfield, S.; Njoroge, W.F.M.; Duncan, A.F.; Chaiyachati, B.H.; Parish-Morris, J.; et al. The Disproportionate Burden of the COVID–19 Pandemic Among Pregnant Black Women. *Psychiatry Res.* **2020**, *293*, 113475. [CrossRef]

19. Padrosa, E.; Vanroelen, C.; Muntaner, C.; Benach, J.; Julia, M. Precarious employment and mental health across European welfare states: A gender perspective. *Int. Arch. Occup. Environ. Health* **2022**, *95*, 1463–1480. [CrossRef]
20. Pitchforth, J.; Fahy, K.; Ford, T.; Wolpert, M.; Viner, R.M.; Hargreaves, D.S. Mental health and well-being trends among children and young people in the UK, 1995–2014: Analysis of repeated cross-sectional national health surveys. *Psychol. Med.* **2019**, *49*, 1275–1285. [CrossRef]
21. Damaske, S.; Bratter, J.L.; Frech, A. Single mother families and employment, race, and poverty in changing economic times. *Soc. Sci. Res.* **2017**, *62*, 120–133. [CrossRef] [PubMed]
22. Trzcinski, E.; Holst, E. Gender Differences in Subjective Well-Being in and out of Management Positions. *Soc. Indic. Res.* **2012**, *107*, 449–463. [CrossRef]
23. Emerson, E.; Hatton, C. Self-reported well-being of women and men with intellectual disabilities in England. *Am. J. Ment. Retard.* **2008**, *113*, 143–155. [CrossRef] [PubMed]
24. Torchio, M.F.; Lucia, U.; Grisolia, G. Economic and Human Features for Energy and Environmental Indicators: A Tool to Assess Countries' Progress towards Sustainability. *Sustainability* **2020**, *12*, 9716. [CrossRef]
25. Ture, C.; Ture, Y. A model for the sustainability assessment based on the human development index in districts of Megacity Istanbul (Turkey). *Environ. Dev. Sustain.* **2021**, *23*, 3623–3637. [CrossRef]
26. Biggs, R.; Clements, H.S.; Cumming, G.S.; Cundill, G.; de Vos, A.; Hamann, M.; Luvuno, L.; Roux, D.J.; Selomane, O.; Blanchard, R.; et al. Social-ecological change: Insights from the Southern African Program on Ecosystem Change and Society. *Ecosyst. People* **2022**, *18*, 447–468. [CrossRef]
27. Pereira, E.; Queiroz, C.; Pereira, H.M.; Vicente, L. Ecosystem services and human well-being: A participatory study in a mountain community in Portugal. *Ecol. Soc.* **2005**, *10*, 2. [CrossRef]
28. Smith, L.M.; Case, J.L.; Smith, H.M.; Harwell, L.C.; Summers, J.K. Relating ecoystem services to domains of human well-being: Foundation for a US index. *Ecol. Indic.* **2013**, *28*, 79–90. [CrossRef]
29. Yang, J.; Ma, X.; Zhao, X.; Li, W. Spatiotemporal of the Coupling Relationship between Ecosystem Services and Human Well-Being in Guanzhong Plain Urban Agglomeration. *Int. J. Environ. Res. Public Health* **2022**, *19*, 12535. [CrossRef]
30. Yee, S.H. Contributions of Ecosystem Services to Human Well-Being in Puerto Rico. *Sustainability* **2020**, *12*, 9625. [CrossRef]
31. Heywood, I.; Sammut, D.; Bradbury-Jones, C. A qualitative exploration of 'thriversh ip' among women who have experienced domestic violence and abuse: Development of a new model. *BMC Womens Health* **2019**, *19*, 1. [CrossRef]
32. Bell, R.J.; Donath, S.; Davison, S.L.; Davis, S.R. Endogenous androgen levels and well-being: Differences between premenopausal and postmenopausal women. *Menopause-J. N. Am. Menopause Soc.* **2006**, *13*, 65–71. [CrossRef]
33. Bilgic, G.; Citak Bilgin, N. Relationship Between Fear of Childbirth and Psychological and Spiritual Well-Being in Pregnant Women. *J. Relig. Health* **2021**, *60*, 295–310. [CrossRef] [PubMed]
34. Coty, M.-B.; Wallston, K.A. Roles and well-being among healthy women and women with rheumatoid arthritis. *J. Adv. Nurs.* **2008**, *63*, 189–198. [CrossRef] [PubMed]
35. Jradi, H.; Abouabbas, O. Well-Being and Associated Factors among Women in the Gender-Segregated Country. *Int. J. Environ. Res. Public Health* **2017**, *14*, 1573. [CrossRef]
36. Kyrolainen, A.-J.; Gillett, J.; Karabin, M.; Sonnadara, R.; Kuperman, V. Cognitive and social well-being in older adulthood: The CoSoWELL corpus of written life stories. *Behav. Res. Methods* **2022**, 1–25. [CrossRef]
37. Alcaniz, M.; Riera-Prunera, M.-C.; Sole-Auro, A. "When I Retire, I'll Move Out of the City": Mental Well-being of the Elderly in Rural vs. Urban Settings. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2442. [CrossRef] [PubMed]
38. Ali, S.F.; Semma, B.; Thornhill, C.W.; Castillo, L.G. Eudaimonic Well-Being for Lesbian and Bisexual Women: The Roles of Religion and Social Connectedness. *J. Homosex.* **2022**, *69*, 1066–1080. [CrossRef] [PubMed]
39. Mir, S.; Naz, F. Spousal Psychological Violence, Coping Strategies and Psychological Well-Being in Married Women. *FWU J. Soc. Sci.* **2017**, *11*, 242–253.
40. Pilar Matud, M.; Lopez-Curbelo, M.; Fortes, D. Gender and Psychological Well-Being. *Int. J. Environ. Res. Public Health* **2019**, *16*, 19.
41. Tan, W.H.; Sheffield, J.; Khoo, S.K.; Byrne, G.; Pachana, N.A. Influences on Psychological Well-Being and Ill-Being in Older Women. *Aust. Psychol.* **2018**, *53*, 203–212. [CrossRef]
42. Joshanloo, M.; Sirgy, M.J.; Park, J. Directionality of the relationship between social well-being and subjective well-being: Evidence from a 20-year longitudinal study. *Qual. Life Res.* **2018**, *27*, 2137–2145. [CrossRef]
43. Alawiyah, T.; Held, M.L. Social Capital: Promoting Health and Well-Being Among Indonesian Women. *Affil.-J. Women Soc. Work* **2015**, *30*, 352–362. [CrossRef]
44. Kettlewell, N.; Lam, J. Retirement, social support and mental well-being: A couple-level analysis. *Eur. J. Health Econ.* **2022**, *23*, 511–535. [CrossRef] [PubMed]
45. Khan, A.; Husain, A. Social Support as A Moderator of Positive Psychological Strengths and Subjective Well-Being. *Psychol. Rep.* **2010**, *106*, 534–538. [CrossRef] [PubMed]
46. Yu, E.; Kim, H.-C. Is she really happy? A dual-path model of narcissistic self-presentation outcomes for female facebook users. *Comput. Hum. Behav.* **2020**, *108*, 106328. [CrossRef]
47. Chapman, B.; Guven, C. Revisiting the Relationship Between Marriage and Wellbeing: Does Marriage Quality Matter? *J. Happiness Stud.* **2016**, *17*, 533–551. [CrossRef]

48. Lim, S.; Raymo, J.M. Marriage and Women's Health in Japan. *J. Marriage Fam.* **2016**, *78*, 780–796. [CrossRef]
49. Hu, M.; Sarwar, S.; Li, Z. Spatio-Temporal Differentiation Mode and Threshold Effect of Yangtze River Delta Urban Ecological Well-Being Performance Based on Network DEA. *Sustainability* **2021**, *13*, 4550. [CrossRef]
50. Song, X.; Tian, Z.; Ding, C.; Liu, C.; Wang, W.; Zhao, R.; Xing, Y. Digital Economy, Environmental Regulation, and Ecological Well-Being Performance: A Provincial Panel Data Analysis from China. *Int. J. Environ. Res. Public Health* **2022**, *19*, 11801. [CrossRef]
51. Verhofstadt, E.; Van Ootegem, L.; Defloor, B.; Bleys, B. Linking individuals' ecological footprint to their subjective well-being. *Ecol. Econ.* **2016**, *127*, 80–89. [CrossRef]
52. Gu, M.K.; Sok, S.R. Influence of Leisure Activity Participation Between Genders Among Korean Older Adults. *J. Gerontol. Nurs.* **2018**, *44*, 51–58. [CrossRef]
53. Furuya, S.; Raymo, J.M. Living arrangements, intergenerational support, and married women's subjective well-being. *Asian Popul. Stud.* **2022**, *18*, 87–107. [CrossRef] [PubMed]
54. You, S.; Shin, K. Relationships among exercise beliefs, physical exercise, and subjective well-being: Evidence from Korean middle-aged adults. *Health Care Women Int.* **2017**, *38*, 1263–1274. [CrossRef] [PubMed]
55. Lee, D.M.; Nazroo, J.; O'Connor, D.B.; Blake, M.; Pendleton, N. Sexual Health and Well-being Among Older Men and Women in England: Findings from the English Longitudinal Study of Ageing. *Arch. Sex. Behav.* **2016**, *45*, 133–144. [CrossRef] [PubMed]
56. Cai, X.; Li, Z.; Liang, Y. Tempo-spatial changes of ecological vulnerability in the arid area based on ordered weighted average model. *Ecol. Indic.* **2021**, *133*, 108398. [CrossRef]
57. Ren., B.; Ru, S.; Yao., C. *The Blue Book of Western Region of China: Annual Report on Development in Western Region of China*; Social Sciences Academic Press: Beijing, China, 2013; p. 2021.
58. Fang, C.; Xin, F.; Yi, Z. Prevalence of depressive symptoms and correlated factors among pregnant women during their second and third trimesters in northwest rural China: A cross-sectional study. *BMC Pregnancy Childbirth* **2022**, *22*.
59. Xiao, J.; You, C.; Yong, J. Integrated water resources management and water users' associations in the arid region of northwest China: A case study of farmers' perceptions. *J. Environ. Manag.* **2014**, *145*, 162–169.
60. Liang, H.; Tang, Y.; Huo, X. Liushou Women's Happiness and its Influencing Factors in Rural China. *Soc. Indic. Res.* **2014**, *117*, 907–918. [CrossRef]
61. Yingchun, J.; Zhenzhen, Z. China's Low Fertility Rate from the Perspective of Gender and Development. *Soc. Sci. China* **2020**, *41*, 169–184. [CrossRef]
62. Fuxia, Y.; Mian, Y.; Bing, X.; Qiaoling, L. The effects of China's western development strategy implementation on local ecological economic performance. *J. Clean. Prod.* **2018**, *202*, 925–933.
63. Xinhua Silk Road Information Service. Available online: https://en.imsilkroad.com/p/312941.html (accessed on 12 December 2022).
64. Resource and Environment Science and Data Center. Available online: https://www.resdc.cn/ (accessed on 12 December 2022).
65. Yu, M.; Li, Q.; Hayes, M.J.; Svoboda, M.D.; Heim, R.R. Are droughts becoming more frequent or severe in China based on the Standardized Precipitation Evapotranspiration Index: 1951–2010? *Int. J. Climatol.* **2014**, *34*, 545–558. [CrossRef]
66. China Statistical Yearbook. Available online: http://www.stats.gov.cn/tjsj/ndsj/2020/indexch.htm. (accessed on 12 December 2022).
67. Lasso, M.C.; Urrutia, A.M. HDPI: A Framework for Pollution-Sensitive Human Development Indicators. *Environ. Dev. Sustain.* **2001**, *3*, 199–215.
68. Hsu, C.-C.; Zhang, Y.; Ch, P.; Aqdas, R.; Chupradit, S.; Nawaz, A. A step towards sustainable environment in China: The role of eco-innovation renewable energy and environmental taxes. *J. Environ. Manag.* **2021**, *299*, 113609. [CrossRef] [PubMed]
69. Yibin, S.; Suping, Y. The price index system construction of gender equality. *Stat. Decis.* **2005**, *4*, 58–60.
70. Kobus, M. Polarization measurement for ordinal data. *J. Econ. Inequal.* **2015**, *13*, 275–297. [CrossRef]
71. Li, H. In Theil Index Measurement and Analysis of the Household Income Distribution Gap in China. In Proceedings of the 2010 International Symposium on Labor Employment and Income Distribution Studies, Beijing, China, 13–14 November 2010; pp. 199–205.
72. Kakamu, K. Simulation Studies Comparing Dagum and Singh-Maddala Income Distributions. *Comput. Econ.* **2016**, *48*, 593–605. [CrossRef]
73. Atefoe, E.A.; Kugbey, N. Psychological functioning and well-being among Ghanaian women: A brief report. *J. Psychol. Afr.* **2018**, *28*, 73–76. [CrossRef]
74. Chawla, S.; Sharma, R.R. Enhancing Women's Well-Being: The Role of Psychological Capital and Perceived Gender Equity, with Social Support as a Moderator and Commitment as a Mediator. *Front. Psychol.* **2019**, *10*, 1377. [CrossRef]
75. Yu, M.; Wang, C.; Liu, Y.; Olsson, G.; Bai, H. Water and related electrical energy use in urban households-Influence of individual attributes in Beijing, China. *Resour. Conserv. Recycl.* **2018**, *130*, 190–199. [CrossRef]
76. Cao, L.; Li, L.; Wu, Y. How does population structure affect pollutant discharge in China? Evidence from an improved STIRPAT model. *Env. Sci. Pollut. Res. Int.* **2021**, *28*, 2765–2778. [CrossRef]
77. Li, S.; Zhou, C. What are the impacts of demographic structure on CO_2 emissions? A regional analysis in China via heterogeneous panel estimates. *Sci. Total Environ.* **2019**, *650*, 2021–2031. [CrossRef]