

# Dataset Development of Grain Self-sufficiency Capacity on the Tibetan Plateau and Its Adjacent Area (1985–2016)

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**Abstract:** The security of grain supply and demand on the Tibetan Plateau is related to the stability of the border region and is an important foundation for regional sustainable development. Based on the statistical data from 1985 to 2016, the grain self-sufficiency rate and supply-demand gap were used to analyze the spatial and temporal patterns of grain supply and demand at regional, provincial, and county scales on the Tibetan Plateau and its adjacent area. The results showed that the grain self-sufficiency of the Tibetan Plateau showed an upward trend from 1985 to 2016, but the spatial distribution of the balance of grain supply and demand was quite different. The dataset includes: (1) annual capacity for grain self-sufficiency on the Tibetan Plateau and its adjacent area during 1985–2016; (2) capacity for grain self-sufficiency in each province of the Tibetan Plateau in different periods from 1985 to 2016; (3) average capacities for grain self-sufficiency at the county level on the Tibetan Plateau and its adjacent area from 2010 to 2016. The dataset is archived in .xlsx and .shp data formats, and consists of 8 data files with data size of 20.3 MB (compressed into one single data file with 6.58 MB).

**Keywords:** Tibetan Plateau; grain; self-sufficiency; county-level

**DOI:** <https://doi.org/10.3974/geodp.2022.03.10>

**CSTR:** <https://cstr.escience.org.cn/CSTR:20146.14.2022.03.10>

## Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: <https://doi.org/10.3974/geodb.2021.11.09.V1> or <https://cstr.escience.org.cn/CSTR:20146.11.2021.11.09.V1>.

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**Received:** 28-12-2022; **Accepted:** 26-07-2022; **Published:** 25-09-2022

**Foundations:** Chinese Academy of Sciences (XDA20040301, XDA20010202, XDA23100202)

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**Data Citation:** [1] Shi, W. J., Ding, R., Cui, J. Y., *et al.* Dataset development of grain self-sufficiency capacity on the Tibetan Plateau and its adjacent area (1985–2016) [J]. *Journal of Global Change Data & Discovery*, 2022, 6(3): 402–408. <https://doi.org/10.3974/geodp.2022.03.10>. <https://cstr.escience.org.cn/CSTR:20146.14.2022.03.10>.

[2] Shi, W. J., Ding, R., Cui, J. Y. Dataset of grain self-sufficiency capacity on the Tibet Plateau and its Adjacent Area (1985–2016) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2021. <https://doi.org/10.3974/geodb.2021.11.09.V1>. <https://cstr.escience.org.cn/CSTR:20146.11.2021.11.09.V1>.

## 1 Introduction

Food security is related to national security and social stability<sup>[1,2]</sup>. The Tibetan Plateau (TP) has less cultivated land with poor quality and low yield, and the agriculture is sensitive to climate change. These characteristics have limited the development of plateau agriculture and social economy<sup>[3–5]</sup>. The agricultural production and the level of food security of the TP are relatively low, and it is one of the areas with the most food shortage in China<sup>[6,7]</sup>. The research on the balance of grain supply and demand on the TP is related to regional sustainable development strategies<sup>[8]</sup>. Therefore, it is of great significance to assess the food security situation and improve the balance of grain supply and demand on the TP.

Grain supply and demand is the relationship between grain consumption and production, and is a key component for ensuring food security<sup>[9]</sup>. The grain self-sufficiency rate is an important indicator to measure the degree of grain self-sufficiency and reflect the level of food security<sup>[10]</sup>. Most of the existing researches calculate the self-sufficiency rate at the national or provincial scales, and there are few researches at the county scale on the TP. This dataset is based on the data of county-level population, grain production, and provincial per capita grain consumption of urban and rural residents from 1985 to 2016 to obtain the spatial and temporal patterns of grain supply and demand at the regional, provincial, and county scales on the TP. Our study aims to provide data support and reference for the sustainable development and the spatial regulation strategy of regional agriculture and animal husbandry on the TP.

## 2 Metadata of the Dataset

We summarized the metadata of the Dataset of grain self-sufficiency capacity on the Tibetan Plateau and its adjacent area (1985–2016)<sup>[11]</sup> (Table 1). The metadata includes the dataset name, authors, geographical region, year range, temporal resolution, spatial resolution, data files, data publisher, and data sharing policy, etc.

## 3 Methods

Statistical data in the study area include county-level grain production, provincial-level per capita annual consumption of urban and rural residents, and county-level population of urban and rural residents from 1985 to 2016. The above data were extracted from Qinghai Statistical Yearbook (1986–2017)<sup>[13]</sup>, Tibet Statistical Yearbook (1993–2017)<sup>[14]</sup>, Sichuan Statistical Yearbook (1987–2017)<sup>[15]</sup>, Gansu Development Yearbook (1986–2017)<sup>[16]</sup>, Yunnan Statistical Yearbook (1986–2017)<sup>[17]</sup>, Xinjiang Statistical Yearbook (1989–2017)<sup>[18]</sup>, China Statistical Yearbook (County-level) (2000–2017)<sup>[19]</sup>, China Population & Employment Statistics Yearbook<sup>[20]</sup> and Tabulation on the Population Census of the People's Republic of China by County<sup>[21]</sup>.

The dataset covers 202 counties (districts) on the TP. There are 6 counties without any residential areas, including Ruoqiang county, Qira county, Hotan county, Pishan county, Yecheng county and Akto county in Xinjiang. The boundary of the study area in Yutian county, Minfeng county, Qiemo county, Minle county and Shandan county was clipped according to the 2,500 m contour line. We removed the outliers, and replaced the missing data with the mean value of adjacent years.

### 3.1 Algorithm

Based on the population and grain production in the county-level, and provincial per

**Table 1** Metadata summary of the Dataset of grain self-sufficiency capacity on the Tibetan Plateau and its adjacent area (1985–2016)

Items	Description
Dataset full name	Dataset of grain self-sufficiency capacity on the Tibetan Plateau and its adjacent area (1985–2016)
Dataset short name	GrainSS_QTP_1985-2016
Authors	Shi, W. J. S-3255-2018, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, shiwj@lreis.ac.cn Ding, R., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, dingrui_1998@163.com Cui, J. Y., School of Geographical Sciences, Hebei Normal University, cuijiaying115@163.com
Geographical region	The Qinghai-Tibet Plateau and its adjacent area
Year	1985–2016
Temporal resolution	Annual
Spatial resolution	County scale
Data format	.xlsx, .dbf, .prj, .sbn, .shp, .shx, .xml, .kml
Data size	20.3 MB (6.58 MB after compression)
Data files	The dataset consists of eight files, stored in .shp and .xlsx formats. The table data includes 3 sheet tables: (1) annual capacity for grain self-sufficiency on the Tibetan Plateau and its adjacent area during 1985–2016; (2) capacity for grain self-sufficiency in each province of the Tibetan Plateau and its adjacent area in different periods from 1985 to 2016; (3) average capacities for grain self-sufficiency at the county level on the Tibetan Plateau and its adjacent area from 2010 to 2016
Foundations	Chinese Academy of Sciences (XDA20040301, XDA20010202, XDA23100202); National Natural Science Foundation of China (41771111)
Data publisher	Global Change Research Data Publishing & Repository, <a href="http://www.geodoi.ac.cn">http://www.geodoi.ac.cn</a>
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	<b>Data</b> from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the <i>Digital Journal of Global Change Data Repository</i> ), and publications (in the <i>Journal of Global Change Data &amp; Discovery</i> ). <b>Data</b> sharing policy includes: (1) <b>Data</b> are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use <b>Data</b> subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute <b>Data</b> subject to written permission from the GCdataPR Editorial Office and the issuance of a <b>Data</b> redistribution license; and (4) If <b>Data</b> are used to compile new datasets, the ‘ten per cent principal’ should be followed such that <b>Data</b> records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset <sup>[12]</sup>
Communication and DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS searchable system	

capita consumption on the TP from 1985 to 2016, we differentiated the per capita consumption levels between urban and rural residents on the TP, and multiplied it by the county-level urban and rural population to obtain the county-level urban and rural grain consumption. The ratio and difference between grain production and grain consumption are the grain self-sufficiency rate and the grain supply-demand gap, respectively. Based on this, the spatial and temporal differences of grain self-sufficiency rates and supply-demand gaps at the regional, provincial and county scales from 1985 to 2016 were scientifically evaluated to reflect the grain self-sufficiency on the TP and its adjacent area.

**3.2 Data Development Process**

We used the county-level statistical data from 1985 to 2016 to develop this dataset, and the following steps were carried out (Figure 1):

- (1) Statistical data at the county scale in the study area were collected and sorted, and data cleaning, abnormal value processing, etc. were carried out;
- (2) The grain consumption of each county was calculated by multiplying the provincial per capita consumption by the county-level population of urban and rural residents;

(3) According to the ratio and difference between county-level grain production and consumption, the grain self-sufficiency rate and the supply-demand gap were calculated, respectively;

(4) Aggregating the county-level data to provincial and regional scales, data of grain self-sufficiency were obtained at these two scales;

(5) Finally, the spatial and temporal patterns of the balance of grain supply and demand on the TP and its adjacent areas were analyzed.

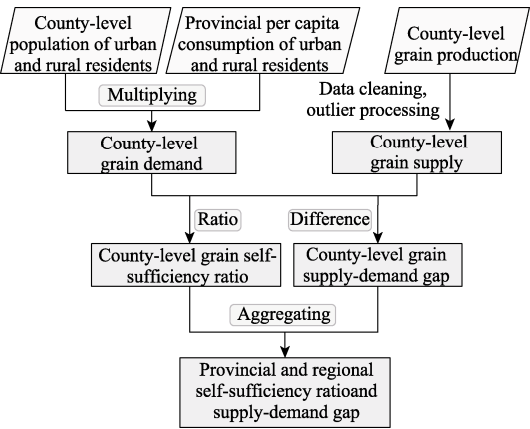


Figure 1 Flowchart of the dataset development

4 Data Results and Validation

4.1 Data Composition

The dataset of grain self-sufficiency capacity on the Tibetan Plateau and its adjacent area (1985–2016) includes the boundaries of the county-level administrative units of the TP and the data of grain self-sufficiency at different scales. The data include three perspectives of the whole regional scale, the provincial scale during different periods, and the county-level scale from 2010 to 2016, to reflect the grain self-sufficiency of the TP and its adjacent area from 1985 to 2016. Table 1 (in the dataset) shows the overall self-sufficiency information on the TP and its adjacent area from 1985 to 2016. The specific indicators include grain production, grain consumption, grain self-sufficiency rate, supply-demand gap, and per capita grain consumption of urban and rural residents. Table 2 (in the dataset) shows the grain self-sufficiency status of provinces on the TP and its adjacent area during the four periods of 1985–1989, 1990–1999, 2000–2009, and 2010–2016. The specific indicators include grain production, grain consumption, grain self-sufficiency rate, and supply-demand gap. Table 3 (in the dataset) shows the average county-level grain self-sufficiency on the TP and its adjacent area from 2010 to 2016. The specific indicators include grain production, grain consumption, grain self-sufficiency rate, and supply-demand gap. The attribute information of grain supply and demand indicators is shown in Table 2.

Table 2 Attribute information of the dataset on the Tibetan Plateau and its adjacent area

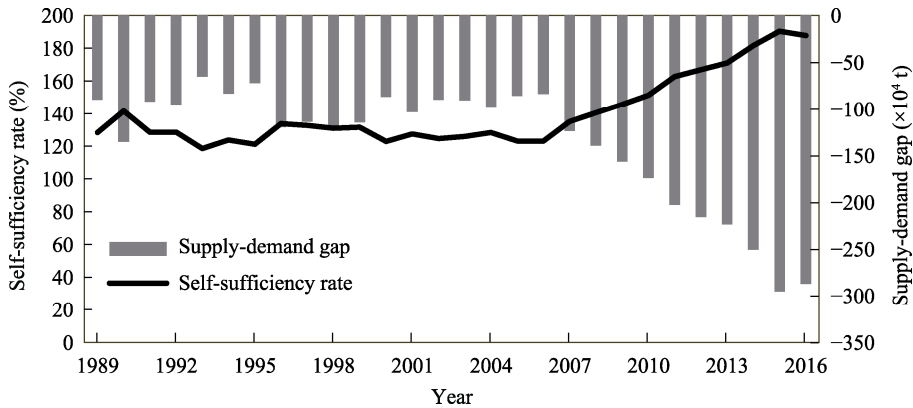
Index	Abbreviation	Attribute	Unit
1	P	Grain production	10 <sup>4</sup> t
2	C	Grain consumption	10 <sup>4</sup> t
3	SS	Self-sufficiency rate	%
4	SDG	Supply-demand gap	10 <sup>4</sup> t

4.2 Data Results

4.2.1 Regional Grain Self-sufficiency of the TP and its Adjacent Area

The grain self-sufficiency rates of the TP and its adjacent area has maintained an increasing trend since 2005. The self-sufficiency rate of the TP shows that the grain supply can mainly meets the demand (Figure 2). The overall grain self-sufficiency rate of the TP and its adjacent area has remained above 120% all year round. With the improvement of the self-sufficiency rate, the grain supply-demand gap has been continuously reduced. After 2014, the grain supply exceeded the demand by more than 2.5 million tons. The increasing trend of grain self-sufficiency rate depends on the increase in grain production and the

decline in grain consumption. The overall grain consumption of the TP and its adjacent area is over 3 million tons, and the grain production increased from 4.05 million tons in 1989 to 6.14 million tons in 2016.

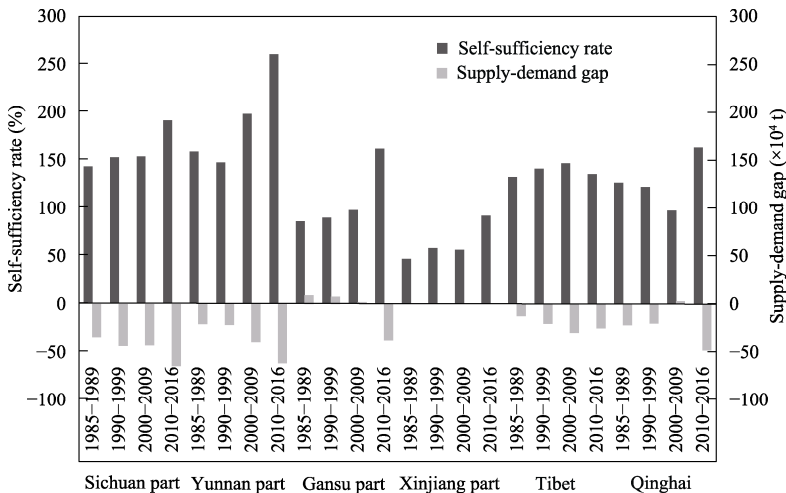


**Figure 2** Changes in grain self-sufficiency rate and supply-demand gap on the TP and its adjacent area

#### 4.2.2 Provincial Grain Self-sufficiency of the TP and its Adjacent Area

Statistical analysis of grain self-sufficiency according to provincial-level administrative units showed that, except for the Xinjiang part, all other provinces were able to achieve grain self-sufficiency from 2010 to 2016 (Figure 3). Among the provinces, Sichuan and Yunnan had the best self-sufficiency rates and had an increasing trend. From 2010 to 2016, their self-sufficiency rate was greater than 190%, and the supply exceeded demand by more than 600,000 tons. Except for Qinghai from 2000 to 2009, Qinghai and Tibet had relatively poor self-sufficiency rates, but they were both able to achieve self-sufficiency at the provincial level, with grain supply exceeding demand by 250,000 t and 480,000 t, respectively, during 2010–2016.

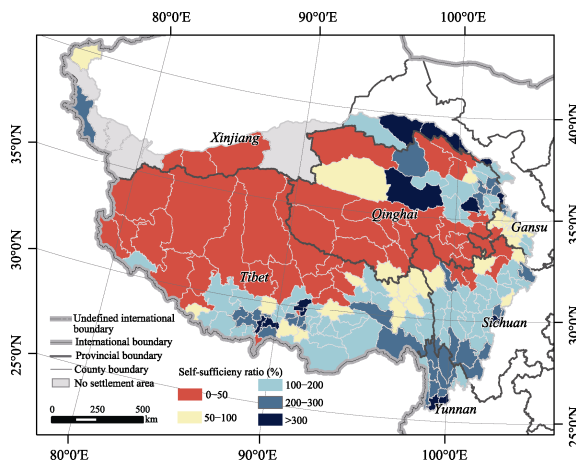
Gansu part could not achieve grain self-sufficiency before 2010, but it successfully achieved grain self-sufficiency between 2010 and 2016, with the grain supply exceeding demand by 380,000 tons. Xinjiang part could not be self-sufficient in all periods, but because of its small area on the TP, their grain shortage was only less than 10,000 tons.



**Figure 3** Provincial changes in grain self-sufficiency rate and supply-demand gap on the TP and its adjacent area

### 4.2.3 County-level Grain Self-sufficiency of the TP and its Adjacent Area

According to the spatial distribution of the grain self-sufficiency rate at the county scale on the TP from 2010 to 2016, it can be seen that the grain self-sufficiency in southern Tibet, eastern Qinghai, Sichuan, and Yunnan was relatively favorable, and the grain self-sufficiency rate in the central region was relatively low (Figure 4). Areas with better grain self-sufficiency on the TP and its adjacent area were mainly distributed in agricultural areas, such as in the Yarlung Zangbo River, Nyangqu River, and Lhasa River Region (YNL) in southern Tibet and the Huangshui Valley agricultural area in eastern Qinghai. The Qiangtang Plateau in northern Tibet and the Hoh Xil region in western Qinghai were mostly uninhabited areas and animal husbandry areas, with low population density and basically no planting areas, so basic grain supply cannot be guaranteed. At the county level, a total of 42% of the counties on the TP and its adjacent area cannot achieve a balanced status between grain supply and demand (the grain self-sufficiency rate was less than 100%). Among the provinces, counties in Yunnan part had the best grain self-sufficiency, with all counties achieve self-sufficiency. The supply and demand status of Sichuan part was relatively good, and only 23% of the counties cannot achieve grain self-sufficiency. Tibet, Gansu, and Qinghai accounted for 42%, 50%, and 55% of the counties that could not achieve a balance status between grain supply and demand, respectively. Among the 11 county-level administrative units in Xinjiang, only Tashkurgan Tajik Autonomous County can achieve self-sufficiency.



**Figure 4** The grain self-sufficiency rates at the county scale on the TP and its adjacent area from 2010 to 2016

## 5 Discussion and Conclusion

To clarify the temporal and spatial differences in the balance of grain supply and demand on the TP and its adjacent area at different scales, we calculated the grain self-sufficiency rate and the supply-demand gap at the regional, provincial, and county scales based on statistical data, then the spatial and temporal patterns of grain self-sufficiency on the TP were described. The grain self-sufficiency on the TP showed an increasing trend from 1985 to 2016, but the spatial distribution at the county scale was quite different. This dataset can provide scientific support for the regulation of the spatial distribution of grain supply and demand status and the sustainable development of agriculture on the TP. Due to the limitations of the original statistical data, the grain consumption calculated in this dataset was based on the provincial per capita grain consumption of urban and rural residents, and the difference in per capita consumption at the county scale has not been reflected. Besides, the grain consumption calculated in this dataset was mainly for staple grain and has not considered the consumption of feed grains for meat production and other aspects of grain demand such as industrial grain and seed.

### Author Contributions

Shi, W. J. and Shi, X. L. developed the overall design and model algorithm for the dataset; Shi, W. J, Shi, X. L. and Ding, R. completed the data verification, wrote and revised the data

paper; Cui, J. Y. collected and processed the statistical yearbook data.

### Conflicts of Interest

The authors declare no conflicts of interest.

### References

- [1] Cheng, S. K., Li, Y. Y., Liu, X. J., *et al.* Thoughts on food security in China in the new period [J]. *Journal of Natural Resources*, 2018, 33(6): 911–926.
- [2] Tang, H. J. China's grain self-sufficiency strategy in the new situation [J]. *Issues in Agricultural Economy*, 2014, 35(2): 4–10, 110.
- [3] Ding, R., Shi, W. J. Quantitative evaluation of the effects of climate change on cereal yields of Tibet during 1993–2017 [J]. *Acta Geographica Sinica*, 2021, 76(9): 2174–2186.
- [4] Yang, C. Y., Shen W. S., Li, D. H. Response of grain yield in Tibet to climate and cultivated land change during 1985–2010 [J]. *Transactions of the Chinese Society of Agricultural Engineering*, 2015, 31(17): 261–269.
- [5] Ding, R., Shi, W. J. Contributions of climate change to cereal yields in Tibet, 1993–2017 [J]. *Journal of Geographical Sciences*, 2022, 32(1): 101–116.
- [6] Duan J., Xu, Y., Sun, X. Y. Spatial patterns and their changes of grain production, grain consumption and grain security in the Tibetan Plateau [J]. *Journal of Natural Resources*, 2019, 34(4): 673–688.
- [7] Gao, L. W., Xu, Z. R., Chen, S. K., *et al.* Food security situation and major grain supply and demand in Tibetan region [J]. *Journal of Natural Resources*, 2017, 32(6): 951–960.
- [8] Xu, Z. R., Zhang, Y. L., Cheng, S. K., *et al.* Scientific basis and the strategy of sustainable development in Tibetan Plateau [J]. *Science & Technology Review*, 2017, 35(6): 108–114.
- [9] Hu, T., Ju, Z. S., Zhou, W. Regional pattern of grain supply and demand in China [J]. *Acta Geographica Sinica*, 2016, 71(8): 1372–1383.
- [10] Yang, M. Z., Pei, Y. S., Li, X. D. Study on grain self-sufficiency rate in China: an analysis of grain, cereal grain and edible grain [J]. *Journal of Natural Resources*, 2019, 34(4): 881–889.
- [11] Shi, W. J., Ding, R., Cui, J. Y. Dataset of grain self-sufficiency capacity on the Tibetan Plateau and its adjacent area (1985–2016) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2021. <https://doi.org/10.3974/geodb.2021.11.09.V1>. <https://cstr.escience.org.cn/CSTR:20146.11.2021.11.09.V1>.
- [12] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. <https://doi.org/10.3974/dp.policy.2014.05> (Updated 2017).
- [13] Bureau of Statistics of Qinghai Province. Qinghai Statistical Yearbook (1986–2017) [M]. Beijing: China Statistics Press, 1986–2018.
- [14] Bureau of Statistics of Tibet Autonomous Region. Tibet Statistical Yearbook (1993–2017) [M]. Beijing: China Statistics Press, 1994–2018.
- [15] Bureau of Statistics of Sichuan Province. Sichuan Statistical Yearbook (1987–2017) [M]. Beijing: China Statistics Press, 1988–2018.
- [16] Editorial Board of Gansu Development Yearbook. Gansu Development Yearbook (1986–2017) [M]. Beijing: China Statistics Press, 1985–2018.
- [17] Bureau of Statistics of Yunnan Province. Yunnan Statistical Yearbook (1986–2017) [M]. Beijing: China Statistics Press, 1985–2018.
- [18] Bureau of Statistics of Xinjiang Uygur Autonomous Region, Xinjiang Statistical Yearbook (1989–2017) [M]. Beijing: China Statistics Press, 1990–2018.
- [19] Department of Rural Socioeconomic Investigation, National Bureau of Statistics. China Statistical Yearbook (County-level) (2000–2017) [M]. Beijing: China Statistics Press, 2001–2018.
- [20] Department of Population and Employment Statistics, National Bureau of Statistics. China Population & Employment Statistics Yearbook (1988–2017) [M]. Beijing: China Statistics Press, 1989–2018.
- [21] Department of Population and Employment Statistics, National Bureau of Statistics. Tabulation on the Population Census of the People's Republic of China by County [M]. Beijing: China Statistics Press, 2011.