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Time Series of Land Use/Cover Dataset of Changwu County in Five-Year Increments (1990–2015)

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Abstract: Time series of land use/cover dataset of Changwu county in Five-Year Increments (1990-2015) was developed based on the Landsat TM/OLI images from 1990 to 2015 in five-year increments. According to the regional characteristics of Changwu county, this dataset has constructed a classification system of land use/cover, including 8 primary classification categories (cultivated land, forest land, garden land, grassland, water bodies, residential land, industrial and mining land, and unused land) and 24 secondary classification categories. The data was validated by ground-sampled points and points selected from high-resolution Google Earth images, the overall classification accuracy of the dataset is 86.64%, and the Kappa coefficient is 0.853,6. This dataset includes the land use/cover data of Changwu county from 1990, 2000, 2005, 2010 and 2015. The data is archived in .shp format with a data size of 7.36 MB.

Keywords: land use/cover; time series; Changwu county; five-year; increment

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.2020.05.16.V1.

1 Introduction

The Changwu county is located in Loess Plateau in northern China. It has been strongly eroded by flowing water, and the landforms are undulating. Mountains, hills, plains and wide valleys coexist in the area. Its main landform types include hilly and gully areas, hilly areas, broad valley hilly areas, grassland areas, plateau gully areas, ruined gully areas, etc. Due to the special terrain, climate conditions and long-term human activities, its ecological environment is fragile, and soil erosion is serious. The local land resources are seriously de-

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graded, and the ecological security and sustainable social and economic development of the lower Yellow River basin are always threatened. Over the past 30 years, the country has carried out large-scale ecological restoration projects, coupled with the changes in mineral development and human use of land under the influence of regional socioeconomic development, resulting in major changes in the land use/cover status of the region[1]. Land use/cover changes have an impact on the structure and function of the ecosystem[2], which in turn affect the natural basis for human survival and development[3]. Changwu county is located in the hilly and gully area of the Loess Plateau. It is an experimental demonstration county of the program of the "Returning Farmland to Forest", and its economic development is representative of the central and southern regions of the Loess Plateau. The area of Changwu county is small, but the land is complex, including ditch slope and flatland[4]. In most recent decades, on the one hand, with the implementation of the national "Returning Farmland to Forest" program and the development of the regional economy, the area of sloping farmland has been drastically reduced and gradually converted to forest land and orchards, reducing the land use intensity; on the other hand, the implementation of the Western Development Policy and Regional Urbanization and Dilapidated/Dangerous Housing Renovation projects have significantly increased the construction land area in Changwu county and increased the land use intensity[5]. These changes in external conditions have caused major changes in the land use patterns of Changwu county, which inevitably lead to corresponding changes in its ecosystem structure. Therefore, the production and analysis of the land use/cover dataset of Changwu county in recent decades is necessary to clarify the trend in land use/cover changes in the region and then to analyze the dominant factors for the cause of land use/cover changes as well as the changes in ecological service caused by the land use/cover changes. An analysis from the above perspectives is of great significance for making sustainable development policies for Changwu county.

For providing data support for the analysis of land use/cover changes, evaluating ecological services, and creating sustainable development policies for Changwu county, this study designed a land use/cover classification system from the analysis of regional characteristics. Then, a time series land use/cover dataset of Changwu county was developed using the visual interpretation method based on Landsat Thematic Mapper/Operational Land Imager (TM/OLI) imagery. Compared with the existing land use/cover dataset, this research focuses on small-scale work, designing a land use/cover classification system suitable for Changwu county and using field-sampled data and high-resolution images to make a more detailed evaluation of the dataset. All of these components ensure the high accuracy of the produced dataset.

2 Metadata of the Dataset

The metadata of the "Land use/cover dataset of Changwu, Shaanxi, China (1990–2015)"[6] are summarized in Table 1. This table includes information such as the full name, short name, authors, year, temporal resolution, spatial resolution, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the "Land use/cover dataset of Changwu, Shaanxi, China (1990–2015)"

Items	Description
Dataset full name	Land use/cover dataset of Changwu, Shaanxi, China (1990–2015)
Dataset short name	LULC_Changwu_1990-2015
Authors	Chen, P. F. D-7136-2019, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, pengfeichen@igsnrr.ac.cn Zhang, Z. Q. AAV-6982-2020, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, zhangzhiqiangsnd@163.com
Geographical region	Changwu county
Year	1990, 2000, 2005, 2010, 2015
Temporal resolution	Five years
Spatial resolution	1∶100,000
Data format	.shp
Data size	7.36 MB (Compressed data size is 3.20 MB)
Data files	The dataset contains 5 .shp files. Data name represents the data of the corresponding year
Foundation(s)	Chinese Academy of Sciences (XDA23100101)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing &Repository includes metadata, datasets (in the *Digital Journal of Global Change Data Repository*), and publications (in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[7]
Communication and searchable system	DOI, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS, Crossref

3 Methods

3.1 Study Area

3.1.1 Remote Sensing Data

The dataset was created using Landsat TM/OLI data[5]. According to the land use/cover interpretation needs, ten images corresponding to summer and winter of 1990, 2000, 2005, 2010 and 2015 were collected. The images used are shown in Table 2.

Table 2 The Landsat TM/OLI imageries used for producing the dataset

Year	Date	Track number (column/row)	Image type
1990	1988/9/15	128/36	TM
	1991/8/23	128/36	TM
2000	2000/5/11	128/36	TM
	2000/7/30	128/36	TM
2005	2005/7/12	128/36	TM
	2005/10/16	128/36	TM
2010	2010/1/15	128/36	TM
	2010/7/10	128/36	TM
2015	2014/12/28	128/36	OLI
	2015/7/24	128/36	OLI

3.1.2 Validation Sample

According to the remote sensing interpretation results, the ground validation samples are

randomly arranged according to the area and fragmentation of each land type. In 2015, a field survey was conducted in Changwu county to obtain the land use/cover type at the selected sample points, which are shown in Figure 1. In addition, due to traffic restrictions, some locations are difficult to reach (such as Dongjiashan). The land use/cover types in these locations are mainly obtained through Google Earth's high-resolution images[1]. In total, 247 validation samples were finally obtained. Among them, 52 samples were field-sampled data, and 195 were obtained using Google Earth images.

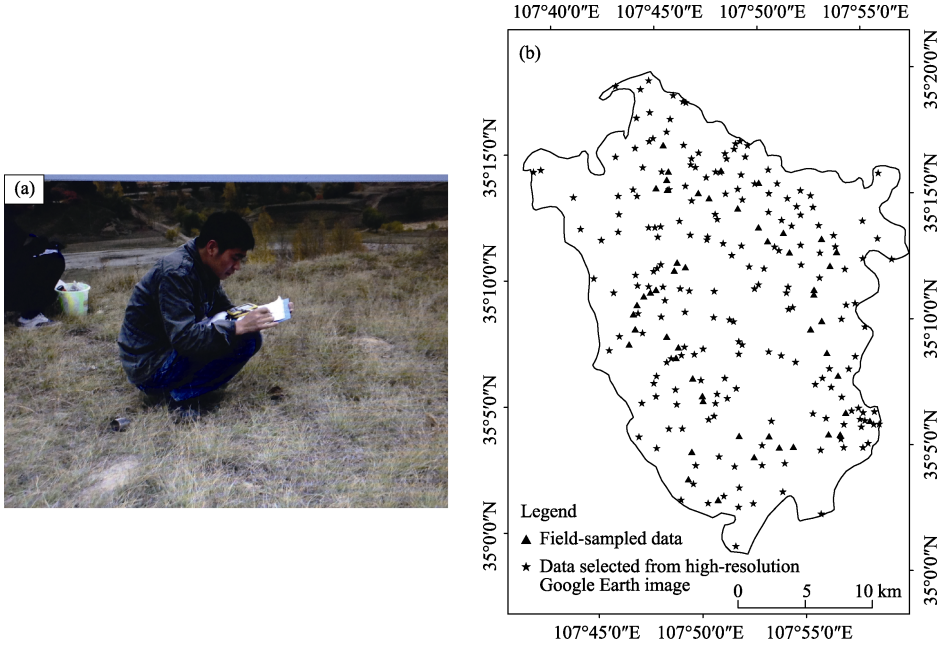

Figure 1 Photo from the field sampling step (a) and map of the data validation samples (b)

3.1.3 Digital Elevation Model (DEM) Data

To assist in the visual interpretation of the remote sensing images, the study also collected 30 m digital elevation data[5].

3.2 Data Processing

First, the classification system was designed according to the regional characteristics of Changwu county (Table 3). During this process, the national land resource classification system[8] was taken as a reference, and some changes were made to reflect the impact of human activity and the characteristics of Changwu county: (1) making garden land into the first level of land classification; (2) removing permanent glaciers, snow and mudflats from the secondary classification of water bodies; (3) making industrial and mining land into the first level of land classification, including industrial land and mining land; (4) removing the Gobi Desert from the secondary classification of unused land. Second, using Landsat TM/OLI imagery, digital elevation model (DEM) and slope data, interpretation signs were made for each class. The slope data were calculated from the DEM. Third, based on the interpretation signs, classification data were created from the visual interpretation of the imagery. Finally, the classification results were validated and evaluated using field-sampled data and data selected from Google Earth image. The flow chart is shown in Figure 2.

Table 3 Land use/cover classification system

First-level classification system	Secondary-level classification system
Cultivated land	Paddy land, dry land
Forest land	Woodland, shrub land, sparse woodland, other woodland
Garden land	Garden land
Grassland	High-coverage grassland, medium-coverage grassland, low-coverage grassland
Water bodies	Rivers, lakes, reservoirs/ponds, beaches
Residential land	Urban land, rural residential land, other construction land
Industrial and mining land	Industrial land, Mining land
Unused land	Sandy land, saline-alkali land, marsh land, bare land, bare rock and gravel

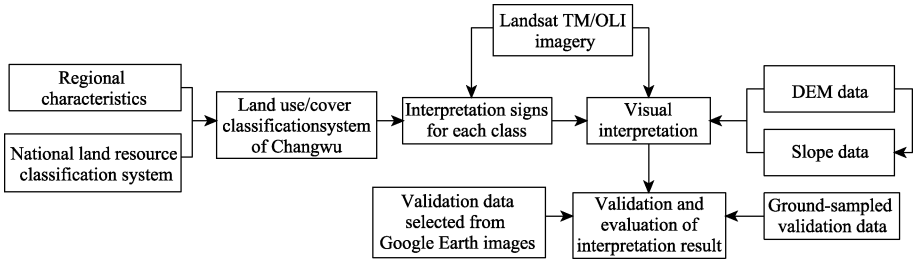

Figure 2 Flow chart of the dataset development

4 Data Results and Validation

4.1 Data Composition

The dataset includes 40 data files, i.e., land use/cover data of Changwu county in 1990, 2000, 2005, 2010 and 2015 (Figure 3, 4), all of these files are in .shp (group) data format.

4.2 Data Results

The results of land use/cover in Changwu county for 1990, 2000, 2005, 2010, and 2015 are shown in Figures 3–4. For clarity, only first-level classification system is listed at the map. Among all land types in Changwu county in 1990, the area of cultivated land was the highest, with a value of 287.67 km^2; forest land and grassland followed, with values of 131.55 km^2 and 104.03 km^2, respectively. For the other land types, the areas of residential land, garden land, water bodies and unused land were 19.61, 10.75, 8.31 and 0.08 km^2, respectively. In the following 25 years, the area of cultivated land and grassland in Changwu county continued to decrease. The area of cultivated land decreased from 287.67 km^2 to 133.28 km^2, and the area of grassland decreased from 104.03 km^2 to 60.92 km^2. At the same time, the forest land, garden land, residential land, and industrial and mining land areas continued to increase. Among them, forest land increased from 131.55 km^2 to 213.55 km^2, garden land increased from 10.75 km^2 to 91.26 km^2, residential land increased from 19.61 km^2 to 46.88 km^2, and industrial and mining land increased to 4.56 km^2. These changes are mainly caused by the combined effects of the program of the "Returning Farmland to Forest" and regional economic development. These initiatives made forest land the largest land type in Changwu county, followed by cultivated land and garden land. For the other land types, grassland and residential land have moderate amounts of land area and water bodies, industrial and mining land, and unused land have the smallest amounts of land area.

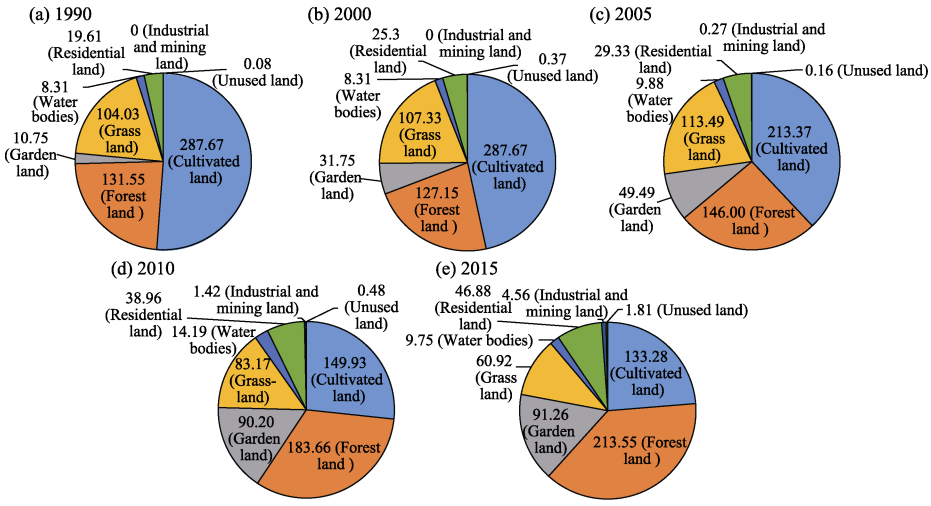

Figure 3 Area of each land use/cover type in Changwu county (Unit: km^2)

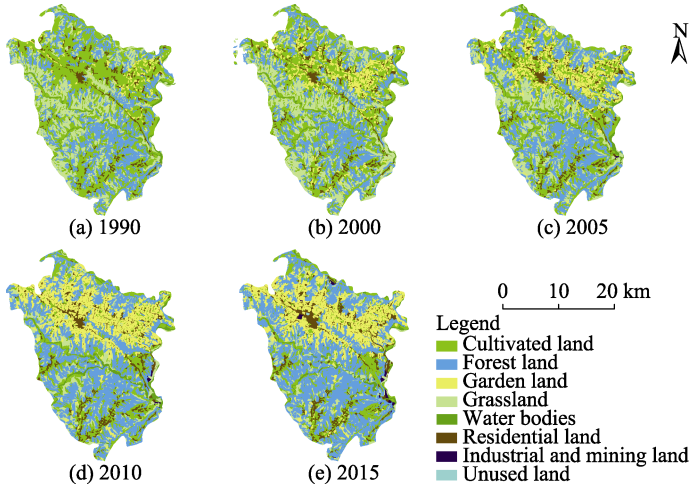

Figure 4 Map of the first-level land use/cover classification system of Changwu county

4.3 Data Validation

Due to the long time span of the dataset, it is hard to validate the classification results for earch of the time periods. Considering that the dataset was made using the visual interpretation method with the establishment of interpretation signs for each class, only the data in 2015 were validated to represent the data accuracy for all the periods. Based on the validation dataset, the accuracy of the classification results in 2015 is validated. From the error matrix, the overall classification accuracy is 86.64%, and the Kappa coefficient is 0.853,6. It is generally recognized that a Kappa coefficient greater than 0.61 indicates that the classification method achieved good results. Thus, the dataset produced in this study has a high accuracy. In addition, among all the land use/cover types, the identification accuracies of rivers, urban land, industrial land, rural residential areas, other construction land, reservoirs/ponds, mining land, bare land, and forest land are high, with values between 88% and 100%, because these classes can be easily visually interpreted from the imagery. The identification accuracies of shrub land, garden land, high-coverage grassland, medium-coverage

grassland and dry land are lower than those of the above mentioned land use/cover types, with values between 70% and 87%. The reason is mainly because sometimes it is difficult to distinguish between shrub land and garden land, between high-coverage grassland and medium-coverage grassland, and between grassland derived from abandoned cultivated land and cultivated land.

5 Discussion and Conclusion

Changwu county is representative in the central and southern regions of the Loess Plateau, it is of great significance to study the trend and impact of its land use/cover changes. The time series of land use/cover classification sytem in 1990, 2000, 2005, 2010 and 2015, are based on the interpretation of Landsat TM/OLI images. Compared with the previous similar dataset, the classification system developed in this study is more suitable to the local area. With the development of the regional economy, the orchard land in the mountain area of Changwu county had increased significantly, and gradually become the main land use/cover type in the local area. Thus, this study considered it the primary class, which is useful for the subsequent use of the dataset for regional ecological service assessment and sustainable economic development policy research. On the other hand, this dataset is specifically aimed at Changwu county. The data used in this study are more refined, and the quality evaluation is stricter than that of the national data. The dataset can be used to analyze the trend in land use/cover changes in Changwu county, the driving factors for land use/cover changes in this area, as well as the decision making for regional sustainable development policies.

Author Contributions

Chen, P. F. designed the research framework and writing of the data paper; Zhang, Z. Q. collected the data and made the dataset.

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