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Dataset of Ecosystem Service Value of the Typical Islands in Beibu Gulf, China

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Abstract: Based on Remote sensing image of Gaofen-1, the island landscape pattern data was interpreted by ENVI 5.3. With this data, the island ecosystem service value was caculated, using the ecosystem service value measurement model. Then adopting Moran's Index method, we got the spatial distribution pattern and the value of significance level of the island ecosystem services value. The results showed that the value of ecosystem services per unit area was higher in Tuanhe Island than in Qixing Island. The ecosystem service value of Qixing Island had a high degree of dispersion. The service value of Tuanhe Island ecosystem presented a spatial clustering state, while the service value of Qixing Island ecosystem presents a dispersion trend.

Keywords: GF-1 satellite; landscape pattern; ecosystem service value; Moran's I; typical island in Beibu Gulf

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.2020.07.14.V1 & https://doi.org/10.3974/geodb.2020.07.15.V1.

1 Introduction

Beibu Gulf is a semi-closed Bay located in the northwest of the South China Sea with a total area of approximately 128,000 km^2. It reaches China's Leizhou Peninsula and Hainan Island in the East, Vietnam in the west, South China Sea in the south, and Guangxi Zhuang autonomous region in the north. The Guangxi Beibu Gulf area has 649 islands and has a great influence on the social and economic development in the Qinbeifang area, especially in Beibu Gulf area. The research on the value service and spatial heterogeneity of the island ecosystem in Beibu

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[3] Zhang, Q., Tian, Y. C., Huang, Y. L., *et al*. Ecosystem service value evaluation dataset on Tuanhe Island in Beibu Gulf, China [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2020. https://doi.org/10.3974/geodb.2020.07.15.V1.

Gulf is conducive to the protection of island resources, the rational utilization of island landscape, and the management and planning of island ecological environment.

Ecosystem services refer to all kinds of supporting products and services directly or indirectly provided by ecosystem for human beings, including natural capital and its corresponding ecological economic value[1]. A comprehensive and objective assessment of the value of ecosystem has been conducted, resulting in a series of valuable achievements. Ecosystem service value and its evaluation have become the focus in geography, ecology, and environmental science research[2–5]. Scholars have extensively studied the value of land ecosystem services in different research scales[6–9]. To reflect the spatial distribution of ecosystem service value scientifically, we focused on Tuanhe and Qixing Islands as the research objects to study the spatial distribution and heterogeneity of ecosystem service value of their regional sustainable development and provide a decision-making basis.

2 Metadata of the Dataset

The metadata of the dataset[10–11] is summarized in Table 1. It includes the dataset 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 "Ecosystem service value evaluation dataset on Qixing Island in Beibu Gulf, China" and "Ecosystem service value evaluation dataset on Tuanhe Island in Beibu Gulf, China"

Items	Description
Data full name/short name	Ecosystem service value evaluation dataset on Qixing Island in Beibu Gulf, China/Qixing_ESV Ecosystem service value evaluation dataset on Tuanhe Island in Beibu Gulf, China/Tuanhe_ESV
Authors	Zhang, Q. A-6449-2018, School of Resources and Environment,Beibuwan University, 676489898@qq.com Tian, Y. C., School of Resources and Environment, Beibuwan University, 935921897@qq.com Huang, Y. L., School of Resources and Environment, Beibuwan University, 1732305940@qq.com Tao, J., School of Resources and Environment, Beibuwan University, 187354980@qq.com Han, X., School of Resources and Environment, Beibuwan University, 2383272519@qq.com Zhang, Y. L., School of Resources and Environment, Beibuwan University, 641577425@qq.com Lin, J. L., School of Resources and Environment, Beibuwan University, 460197231@qq.com Yang, Y. W., School of Resources and Environment, Beibuwan University, 605331392@qq.com
Geographical region	Qixing Island (21.605°N–21.634°N, 109.031°E–109.068°E) Tuanhe Island (21.842°N–21.878°N, 108.460°E–108.494°E)
Year	2016 Spatial resolution 30 m Data formats .tif, .shp, .xlsx
Data files	Landscape type of two islands, ecosystem service value, grid value of LISA and *P*, statistics data of ecosystem service value of all kinds of landscape type, total 26 data files from two datasets covering Qixing Island and Tuanhe Island.
Foundations	Guangxi Natural Science Foundation of China (2018JJA150135); Guangxi Innovation-driven Development Special Project (AA18118038); Guangxi Base and Talent Project (2019AC20088); Beibu Gulf University (2019KYQD28)
Computing environment	ArcGIS10.2, ENVI5.3
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[12]
Data and paper retrieval system	DOI，DCI，CSCD，WDS/ISC，GEOSS，China GEOSS, Crossref

3 Methods

3.1 Algorithms

3.1.1 Ecosystem Service Value

According to Costanza's ecosystem service value evaluation method, Xie *et al*. formulated the ecosystem service value equivalent table of China[13]. This study refers to the method of formulating the ecosystem service value equivalent table by Hu Hebing'team[14] and adjusts the island ecosystem service value coefficient based on the actual situation in Qinzhou city, Guangxi. The specific data processing is as follows: from 2010 to 2018 in Qinzhou city, the average output of grain was 5,036.02 kg·hm^{-2}, and the average purchase price of grain in eight years was RMB 1.23 per kilogram. The economic value provided by the natural ecosystem without human input is the existing 1/7 of the economic value of food production services per unit area of farmland[15]. According to this method, the value of an ecosystem service value equivalent factor of a typical island in the Beibu Gulf can be determined to be 884.90 Yuan. Accordingly, the ecosystem service value equivalent table can be used to calculate the ecological service value coefficients of different landscape types.

The calculation formula of the ecosystem service value model is described as follows:

$$ESV = \sum (A_k \times VC_k) \tag{1}$$

where is the total value of ecosystem services in the study area, is the different landscape types in the study area, represents the ecosystem service value coefficient of the *k*th landscape type, and represents the area of *k*th landscape type.

3.1.2 Spatial Correlation Analysis

The local Moran index was used to characterize the spatial heterogeneity between variables. The calculation formula is as follows:

$$Moran's = \frac{(x_i - \overline{x})}{\sum_i (x_i - \overline{x})^2 / n} \sum_j w_{ij} (x_i - \overline{x}) \tag{2}$$

If the value of Moran's index is greater than 0, the spatial units are in high–high or low–low aggregation, and a value less than 0 indicates that the spatial units are in low–high or high–low aggregation.

3.2 Data Processing

The procedure of data processing is shown in Figure 1. Radiometric correction, geometric correction, and clipping were applied to remote sensing image data. Then, according to the technical regulations of the second national land survey and with the support of cart algorithm, the island landscape pattern including cultivated land, woodland, grassland, construction land, aquaculture water surface, water body, and ridge were interpreted. Following step is using calculation and specifications of the ecosystem service value equivalent methods, the spatial map of the ecosystem service value of Qixing Island and Tuanhe Island was calculated. Lastly, the spatial distribution map of the ecosystem service value of the islands was processed using the local Moran index tool of ArcGIS10.2, and the Local Indicators of Spatial Association map and significance level map of ecosystem service value were produced.

4 Results and Data Validation

4.1 Data Products

The dataset consisted of four subsets, including the landscape type of typical island data in the format of .tif, the ecosystem service value of typical island data in the format of .tif, the LISA and significance level (*P* value) data in the format of .shp, and the statistics data of landscape type and ecosystem service value in .xlsx. format with 13 data files in each of the two datasets.

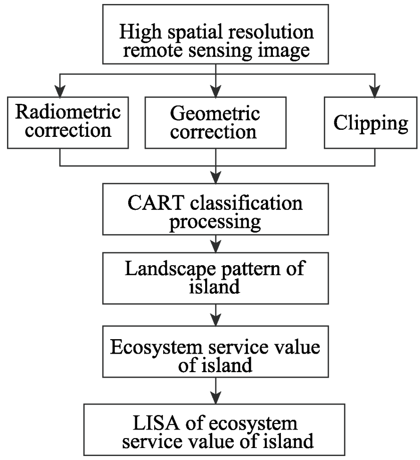

Figure 1 Flowchart of the dataset development

4.2 Data Results

The ecosystem service value of the unit grid ranges from 8.44 Yuan to 11,240.01 Yuan, with an average value of 4,783.39 Yuan in Tuanhe Island and from 1,565.49 Yuan to 8,034.26 Yuan, with an average value of 455.92 Yuan in Qixing island (Figure 2)[16]. The high-value areas of Tuanhe Island's ecosystem services are mainly concentrated in the eastern and southern areas of the island. The value of ecosystem services per unit area of this type of area almost exceeded 10,000 Yuan, and this phenomenon is mainly related to the landscape pattern of the aquaculture water surface in the area, while the low-value areas are mainly concentrated in the northern and south-central part of the island. These areas have low ecosystem service value per unit area, most of which are in the range of 10–15 Yuan. This type of area is mainly affected by construction land, resulting in low ecosystem service value. The high-value areas of the ecosystem service value of Qixing Island are mainly concentrated in the southwest and northeast of the island. The ecosystem service value per unit area of these areas is mostly between 7,000–8,000 Yuan, and a few areas exceeded 8,000 Yuan. The low-value areas are mainly concentrated in the central area and peripheral roads of the islands with a common value of approximately 1,600 Yuan. The ecosystem service value of the central area is mainly affected by the construction land of the residential area, while the peripheral area is mainly affected by the road. Therefore, the ecosystem service value is low, and the lowest value of the ecosystem service value of Qixing Island is considerably higher than the lowest value of Tuanhe Island.

LISA is a significant index that reflects the degree of positive or negative correlation between grid spatial attributes and other surrounding cells. Figures 3 and 4 show the LISA cluster map and the significance level spatial distribution map of the two islands[16], respectively. The figure shows that the ecosystem service value of Tuanhe Island mainly consists of low and low aggregation (the area of low and low aggregation is significantly larger than that of high and high aggregation), and the areas of low and low aggregation are mainly concentrated in the northern part of the island. The significant levels of the transition zone from the central to the south and that of the northern region and the central-southern transition zone were P=0.001 and P=0.01, respectively. The landscape pattern of these areas is dominated by construction land and farmland patches. The areas with high ecosystem service value are mainly distributed in the eastern and southern regions of the island. Among these areas, the ecosystem service value of the eastern region reached a significant level of 0.01, and the ecosystem service value of the southern region reached P=0.001. The level of significance is relatively high. The land use types in this area are mainly based on aquaculture water surface and water bodies, resulting in high aggregation. The LISA map of the ecosystem service value of Qixing Island is dominated by high–high aggregation distributed in the southwest and northeast of the island, and the *P* value of ecosystem service grid reached a significant level of 0.001 in the southwest and 0.01 in the northeast. The part of the region's high ecosystem service value gathering area is affected by the aquaculture water surface. The low-value areas are mainly distributed on the edge of islands. The ecosystem value in these areas is characterized by low-low aggregation mainly because the landscape type of the area is construction land. Most of the ecosystem service value levels in low-value areas did not have significant values.

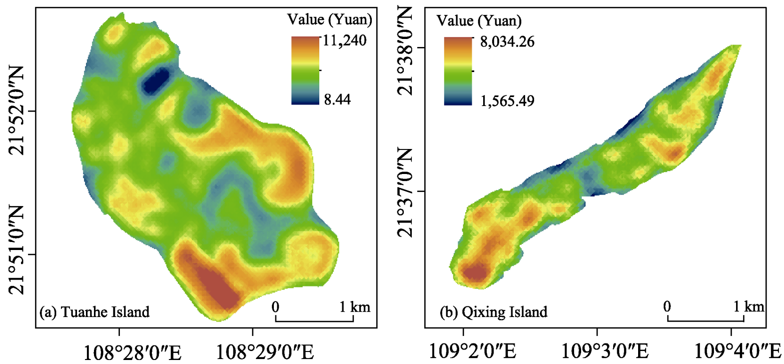

Figure 2 Ecosytem service value of Tuanhe Island and Qixing Island

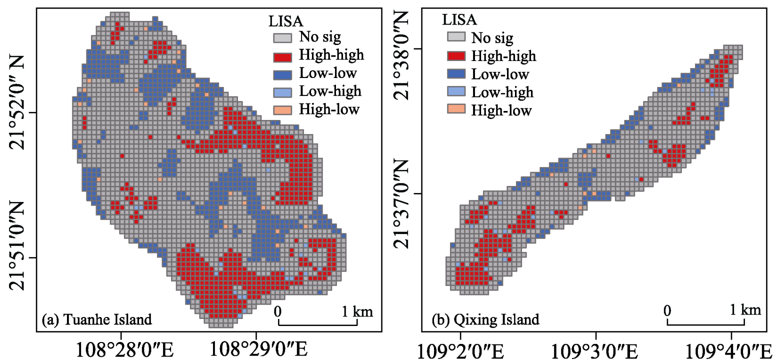

Figure 3 Aggregation of ecosystem service value of Tuanhe Island and Qixing Island

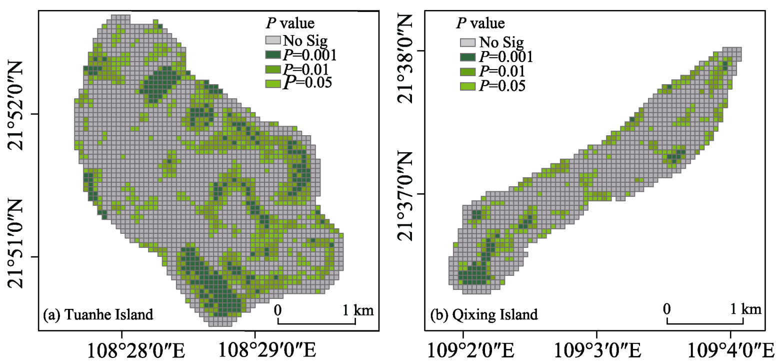

Figure 4 *P* value of local indicators of spatial association

4.3 Data Validation

The value of ecosystem services differed because of the adoption of different models, parameters, and ecosystem classifications. Based on the method of Xie[5] and the actual situation, we calculated that the ecological service value of each unit grid (60 m × 60 m) of Tuanhe Island is 8.44–11,240.01 Yuan, which is 23.44–31,222.25 Yuan·ha^{-1}·a^{-1}. Xun *et al*.[17] evaluated the ecosystem service value of the Qinzhou coastline and found that the ecosystem service value of the coastline near Tuanhe Island is mainly 0–50,000 Yuan·ha^{-1}·a^{-1}, which is close to the evaluation result of this paper.

5 Discussion and Conclusion

5.1 Discussion

The evaluation theory, index system, and implementation principle of island ecosystem service value need to be improved further, although progress made greatly during the last decades. In the evaluation of ecological service value, when different models, parameters, and regional ecosystem classification are used, the results of ecological value assessment often result in differences. Even for the same ecosystem, significant differences might be observed in evaluation conclusions. For example, in the evaluation of the value of global ecosystem services, the conclusions of Pimentel[18] and Constanza are orders of magnitude different. Based on the value estimation method proposed by Costanza and Xie, combined with the actual grain yield of Qinzhou city, the equivalent factor value of grain per unit area can be calculated as 884.90 Yuan, and the ecosystem service value of different islands can be calculated using the value equivalent table. Considering the special habitat of the island itself, natural factors such as climate differences, soil conditions, geology and landforms, and natural disasters affect the development of island vegetation, making the vegetation biomass of the island area significantly different from that of the mainland. The larger the biomass, the stronger the ecosystem service function is. Therefore, in the future, the net primary productivity of typical island areas can be estimated according to the vegetation and climate conditions in the future, and the equivalent table of forest ecosystem service value of islands can be modified according to the calculated net primary productivity, which will be a core content of this study in the future. In addition, spatial scale is an indispensable factor in the evaluation process of ecosystem services[19]. In the present study, according to the size of the study area and GF-1 data resolution, the final selected scales are 60 m × 60 m. It is recognized that mote detail research and data are needed focused on the spatial scale of ecosystem service value of typical islands with different geological landforms.

5.2 Conclucsion

This dataset provides data support for the evaluation of the ecosystem service value of the typical islands in the Beibu Gulf and the analysis of its spatial heterogeneity. The value of ecosystem services per unit area of Qixing Island is lower than that of Tuanhe Island, but the coefficient of variation of Qixing Island is significantly higher than that of Tuanhe Island. The overall dispersion of ecosystem service value of Qixing Island is relatively high. The space for the island's ecosystem service value and the characteristics of heterogeneity were mainly determined using the fitting model and fitting parameters of the variogram. The best fitting model of clusters and islands is a spherical model, and the model of Qixingdao is an exponential model. The landscape patterns of the two islands are controlled by different control factors. The Tuanhe islands is mainly controlled by structural factors, while Qixing Island is mainly controlled by random factors. The ecosystem service value of Tuanhe Islands is spatially clustered, while Qixing Island has a significant threshold of 900 m for the value of ecosystem services. Before the 900 m scale, the value of ecosystem services showed agglomeration, and beyond 900 m, the value of ecosystem services showed a random phenomenon.

Author Contributions

Zhang, Q. designed the study. Tian, Y. C. contributed to the data processing and analysis. Tao, J. designed algorithm. Zhang, Q. and Tian, Y. C. wrote the paper. Han, X. finished the data validation. Zhang, Y. L., Lin, J. L. and Yang, Y. W. made corrections to dataset and paper.

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