PCA Method in Landscape Visual Quality Assessment, Case study: Ziarat Watershed of Golestan Province

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Introduction: Conservation and management of landscapes and beautiful sceneries is one of the necessities of establishing and maintaining the protected areas. Analysis of landscape visual quality has an important place in landscape planning and designing. In this way, reviewing effective criteria and discovering the simple patterns which affect the landscapes is the most important step of modeling and problem solving. Principal Component Analysis (PCA) is a way of identifying patterns in data, and expressing the data to highlight their similarities and differences. Since it is hard to find patterns in high dimension data, where the luxury of graphical representation is not available, PCA is a powerful tool for their analysis. The other main advantage of PCA is reducing the number of dimensions, without much loss of information. This study shows the application of this method in environmental sciences especially in landscape visual quality assessment. This study has tried to identify the most important subjective and objective criteria which are effective on scenic value in order to evaluate visual quality of landscape more accurate and fast using the lower volume of data. In this study by reviewing the different references and according to expert opinions and geographic location of the study area, 8 objective and 15 subjective criteria have been selected. The objective criteria are including: tree types, vegetation density, diversity of vegetation density, ecoton of tree type, water falls viewshed, peaks viewshed, river viewshed along walking tracks and visibility of high diversity points. The subjective criteria are including color diversity, texture variety, cleanliness of environment, dynamism, sequence, complexity, singularity, density, closed view landscapes, open view landscapes, landscapes with moderate visibility, front view landscape of visitors, overhead view landscape of visitors, and bottom view landscape of visitors. These were distinguished as effective criteria in PCA analysis to reduce the number of criteria and select more important variables.

Material and methods: In this research, walking tracks of Ziarat Basin of Golestan Province in Iran were investigated to assess the visual quality of landscape. After the determination of subjective and objective criteria which are effective on aesthetic value of landscapes, a questionnaire in two parts including a table of subjective criteria and a table of objective criteria was distributed between the 150 visitors. The visitors were asked to rate the amount of effect of each criterion on the preference of landscape in four categories including: very high, high, medium and low. Finally, the results of questionnaire were analyzed using PCA method in SPSS at five steps as following:

ü Collecting data and preparing a list of effective criteria on aesthetic value of landscape.

ü Check the pre assumption of factor analysis by KMO and Bartlett indices, setting the data and reviewing subscriptions table.

ü Calculate the covariance matrix.

ü Compute eigenvalues and reviewing the scree plot.

ü Extraction of principal components.

In PCA method KMO and Bartlett's indices and the tables of total variance and rotated component matrixes are more important tables for better analysis of variables.

Results and discussion After running the PCA method in SPSS, KMO and Bartlett's table should be checked at first. If KMO index was more than 1, then the volume of data would be acceptable. And "if the probability of Bartlett index was lower than 0.05 (chi-square is significant), correlation matrix would be appropriate for factor analysis. Thus, multi linear pre assumption is respected and use of this statistical method doesn't hinder. Tables 1 and 2 show these indices.

The other important table is rotated component matrix, this table by categorizing the component made it possible for us to extract the criteria which has the highest value in each column as the representative of group, because these criteria would cover the other criteria which are in its group to a large extent. In this table, the criteria which allocate the maximum number of values in each column are considered as the main criteria. Table 3 and 4 shows the main subjective and objective criteria.

Conclusions: Since conservation and management of landscapes and beautiful sceneries are necessary

for establishing and maintaining the protected areas, so analysis of visual quality assessment has an important place in landscape planning. There are three different approaches in visual quality assessment including subjective approach, objective approach and comprehensive approach. In this research, we have tried to extract more important subjective and objective criteria which are effective on landscape visual quality assessment using PCA method. The results of this research show that from the fifteen subjective components, 5 components including color diversity, texture, complexity, front view landscape of visitors, and cleanness of the environment were chosen as more important subjective criteria. From the eight objective components, 3 components including the diversity of vegetation density, waterfalls viewshed, and visibility of high diversity points were chosen as the more important objective criteria. These components are actually the representative of other components. This research shows that PCA method could also have a widespread application in environmental sciences. We can use this method in different places according to the specific environmental situation of the region and extract more important effective criteria. Using the results of this study made it possible to form questionnaires with fewer questions, so the managers of tourist areas can achive the perception of visual quality of the area of interest by spending less time and cost.

Keywords: landscape visual quality assessment, objective and subjective criteria, Principal component analysis (PCA), Ziarat Watershed