Landform Classification for Community Siting: A case Study in Quxian County, China

ZHAO Ke

DENG Zhao-hua

1 Faculty of Architecture and Urban Planning, Chongqing University, Chongqing 400045, China
2 Key Laboratory of New Technology for Construction of Cities in Mountain Area, Chongqing 400045, China
3 School of Architecture, South China University of Technology; State Key Laboratory of Subtropical Building Science, South China University of Technology, Guangzhou 510641, China


Abstract: This study is to explore a suitable method to classify landform, in order to support the decision making for community siting in mountainous areas. It first proposes the landform classification for community siting (LCCS) method with detailed discussions on its rationality and the chosen parameters. This method is then tested and verified in Quxian county. The LCCS method entails two-grade parameters, which uses relative relief as the first grading parameter, slope as the second, followed by a synthesis process to form a suitable landform classification system. By applying the LCCS method in Quxian county, the result shows that its use of watershed to identify geomorphometric units, and its use of the altitude datum concept, can effectively classify landform according to the local cultural traditions, and the economic and environmental conditions. The verification result shows that comparing to the conventional methods, the LCCS method respects to people’s daily experience due to its bottom-up approach. It not only help to minimize the disturbance to the nature when choosing locations for community development, but also helps to prepare more precise land management policies, which maximizes agricultural production and minimizes terrain transformation.

Keywords: Landform classification; Community siting; Relative relief; Slope; Mountainous areas; China

Introduction

Mountainous areas account for two thirds of China’s total territory, accommodate nearly half of the country’s population, and contain most of its mineral, hydropower, and forest resources (Huang 2002). As a result of China’s rapid urbanization, such areas are facing conflicts among the demand for land to absorb immigrants, the protection of farmland, and the maintenance of the natural environment. Community development activities must therefore fully respect the local culture and the natural environment, and treat both with care (Divyneaud 1987; McHarg 1969; Huang 1998; LaGro 2011).

In mountainous areas, landform is the external manifestation of the natural and built environment. It not only represents the local identity, but also plays a critical role in controlling the ecosystem (Bailey 2009; Renschler et al. 2007). For example, strong relationships between plant communities and landforms have been found by many ecosystem...
studies (Castillo 1991; Baroni et al. 2007; Garcia-Aguirre et al. 2007; Hoersch et al. 2002; Wondzell et al. 1996); close relationships between the soils and landform have been recognized (Deumlich et al. 2010; Moura et al. 2012; Reddy et al. 2013); and the relationship between climate and landforms has been found in climatic geomorphology research (Gutiérrez M and Gutiérrez F 2013). Therefore, to protect and enhance the natural environment, mountain communities should adapt themselves to the local landform.

Landform classification is a crucial basis on which to develop a harmonized relationship between mountain communities and the natural environment. It can effectively portray the form of the land surface, and the nature and the properties of the surface materials, and can reflect the geomorphic evolution processes (Maitra 1999; Summerfield 1991).

Landform classification has two traditions, both of which emerged from regional geomorphology. The first takes a top-down perspective and is mainly based on altitude gradient. For example, China used to classify landforms as plain (elevation < 500 m), hill (500–1000 m), or mountain (> 1000 m) (NRCCAS 1959); in the UK and the USA, mountains are landforms higher than300 m; in continental Europe, an elevation of 900 m is the standard used to define mountain (The Gale Group Inc. 2002). This classification method, however, does not respond to the needs of people's daily life.

The second landform classification tradition takes a bottom-up approach and is based on relative relief rather than elevation. In the 1870s, one of its pioneers, von Sonklar, used relative relief to classify landforms, using a 200 m level difference from valley floor to summit to distinguish mountain from hill (Rasemann et al. 2004). This method was later broadly applied in continental Europe to use relative relief of 30 m, 75 m, 300 m, and 600 m to classify landforms as low plain, high plain, hill, low mountain, or high mountain, respectively (Demek 1976), and in landform classification research elsewhere (Cai 1986). The broad application of the relative relief method was due to its ability to better respond to human activities. But this method still has defects when it is used for decision making on community-level development, as it can hardly portray the landforms' morphologic characteristics.

People’s daily experiences have accustomed them to using relative relief to recognize the height of mountains (plain or mountainous), and to using slope to discriminate the gradient of the terrain (flat or steep), rather than using elevation to understand the abstract concept of “high” or “low” mountain. Based on the above analysis and a case study of Quxian county, which is a representative mountain region in southwest China, this paper explores a new landform classification method: landform classification for community siting (LCCS). This method takes a bottom-up perspective with regards to local people’s daily experiences. In contrast to the conventional altitude classification method, the model presented in this paper uses both relative relief and slope to classify landforms with the help of subjective and objective classification methods proposed by Gai (1986) and Gao (2004). The rationality of LCCS’s methodology framework, the choice of the key parameters, and the applicability of the method to the rest of the world are discussed extensively. Finally, Shipai village, Quxian county, is used as an example to test and verify the method. It shows that the LCCS method can help to build a better relationship among community construction, soil and water conservation, agricultural production, forestry preservation, and the efficient transformation of terrain in mountain areas.

1 Study Area and Materials

The study area corresponds to the administrative boundary of Quxian county (30°38’N–31°16’N; 106°38’E–107°15’E), Sichuan province (Figure 1). Quxian county is on the eastern edge of the Sichuan Basin at the southern foot of the Daba mountain range in central China, north of the Yangtze River. It is a typical mountainous area and there are significant concerns about the balance between environmental protection and community development.

The study area covers 2013 km². The mean slope is 8.12° and the altitude ranges from 222 m to 1190 m. Qujiang River, which has numerous tributaries, flows through the county from north to