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# 中国地质大学 博士学位论文

基于 GIS 的山地景观生态综合评价研究  
——以越南老街省沙巴县为例

学 号：LBYG20100001

博 士 生：KIEU QUOC LAP（桥国立）

学科专业：地图制图学与地理信息工程

指导教师：吴信才 教授、 刘修国 教授

所在学院：信息工程学院

二〇一四年五月

学校代码: 10491

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A Dissertation Submitted to  
China University of Geosciences for Doctoral Degree

**Study on Mountainous Landscape Ecology  
Assessment Based on GIS  
A Case Study in Sapa district, Laocai province, Vietnam**

Ph.D. Candidate: KIEU QUOC LAP

Major: Cartography and Geographic Information Engineering

Study Orientation: Geographic Information System

Supervisor: Prof. Wu Xincan and Prof. Liu Xiuguo

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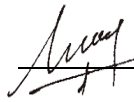
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日 期：2014 年 5 月 28 日

# 作者简介

桥国立 (Kieu Quoc Lap)，男，越南国籍，1982 年 08 月生，越南老街省宝胜县人。2005 年毕业于越南河内师范大学，获地理学学士学位；2008 年毕业于越南河内师范大学自然地理学专业，获工学硕士学位，同年来太原科学大学当教师，从事的主要研究方向为景观生态学、地图学与地理信息系统。

2010 年 09 月来中国学习了一年汉语，然后在中国地质大学（武汉）开始攻读地图制图学与地理信息工程专业博士研究生。在博士研究生学习期间，共完成 12 门课程的学习，累计学分 29.5 分。同时也在这段时间作者有六篇科学论文已被录用，具体如下：

1. Kieu Quoc Lap, Wu Xincai, Nguyen Tien Thanh. Entropy problem simulation in Landscape Ecology assessment based on GIS: A case study of landscape conservation value assessment in Sapa district, Laocai province, Vietnam. Applied Mechanics and Materials, Vols 295-298 (2013): 2373~2377. (2012 年可持续能源与环境工程国际学术会议, EI 检索)
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4. Kieu Quoc Lap, Nguyen Tien Thanh. Applying GIS technique to create Land mapping unit for Agricultural land assesment of Sapa - Taphin area in Laocai province Vietnam. Journal of Geographical Sciences, 2013, 12(04): 68~72. (在越南发表)
5. Kieu Quoc Lap, 吴信才, 刘修国, Nguyen Thi Thu Thuy. 基于 GIS 技术的森林景观保存值评价研究中的熵模型模拟. 地理与地理信息科学, 2014, (30): 34~36 (核心检索)
6. Nguyen Tien Thanh, Liu Xiuguo, Wang Hongping, Kieu Quoc Lap, Dang Thai Son. Ore Volume Measurement Based on 3D Laser Scanning Technique: a Case Study. Advanced Materials Research, Vols 610-613 (2013): 3708~3714. (EI 检索)

# 基于 GIS 的山地景观生态综合评价研究

## ——以越南老街省沙巴县为例

博士生：桥国立 (KIEU QUOC LAP)

指导教师：吴信才 教授、刘修国 教授

### 摘要

地理信息系统 (GIS) 作为一种有效的技术方法, 已广泛应用于多种科学领域, 其中包括景观生态学研究。该论文以越南的沙巴县为研究地点。研究地点是越南的海拔最高的山地县, 也是一个非常特殊的自然地理区域, 具有潜在的自然资源丰富, 该地区地形复杂、气候多异、植被类型纷繁、土母质多变, 形成了对农林业是十分有利的土壤资源。然而沙巴也是越南最贫困的地区之一, 主要表现在经济活动有限, 自给自足的生产方式, 自然资源开发利用的效率不高, 土地利用系数低。

本文以 GIS 为主要研究方法, 针对山地景观生态进行分析与评价。本文总结了景观生态学的研究现状, 初步应用山地景观生态的理论基础及研究方法。在生态学理论、可持续发展理论、系统理论和越南的热带季风生态理论的基础上, 结合 GIS 空间分析方法以及包括遥感图像处理法、统计数据收集和文献查阅法、野外调查法、农村快速评估法、定量分析法在内的多种技术手段进行数据的收集处理和分析。基于上述研究, 本文已采用了一些 GIS 模型在山地景观生态综合评价中的应用, 如在作物生态适宜性评价中 ALES-GIS 模型、在山地土地适宜性评价中 GIS 和 AHP-GDM 耦合模型。

本研究取得以下主要结论和成果:

1. 建立了沙巴县山地景观生态综合评价研究的服务 GIS 数据库。利用所收集的数据 (卫星遥感影像、地形和土地利用现状的纸质图、行政区划空间数据、有关的统计年鉴数据及文档数据等) 建立了 GIS 数据库, 包括空间数据库和非空间数据库。该数据库是沙巴县山地景观生态分析评价与规划的基础, 具有重要的作用。在山地景观生态评价分析过程中, 本研究主要采用地理信息系统的空间分析软件, 如 Arcview 3.3、ArcGIS 10.1、Mapinfo 10.0 以及遥感影像处理软件 Envi 4.6、Erdas Imagine 9.0。

2. 根据上述 GIS 数据库, 针对沙巴县山地景观生态格局进行分析, 并建立了一系列山地景观图。首先, 通过沙巴县山地景观生态格局的单因子, 深入分析山地景观的垂直格局构成地形、地貌、土壤、气候和植被的五种主导自然要素。对每个要素进行了分析、分级并在地图上可视地显示。在此基础上利用 GIS 空间叠加功能, 将各景观单因子图叠加生成

综合景观生态图和山地景观分区图。分析结果表明沙巴县山地景观生态是非常复杂多样的，全县共可分为 3 个景观生态组、87 个不同的景观类和 280 个不同的景观斑块。

3. 针对山地农林业景观生态，本文对景观适宜性进行评价。在评价过程中，主要集中在三个内容：第一，森林景观生态保存值评价，应用熵模型，基于 GIS 技术对森林景观指数进行模拟，并确定森林景观保护的边界。第二，对一些主要农作物的景观生态适宜性评价。采用 ALES-GIS 评价模型，选择果树、经济作物和药用作物三个农作物组对沙巴县景观生态条件进行生态适宜性评价，评价结果以适宜性评价图的形式体现。第三，基于 GIS 和 AHP-GDM 模型的区域稳定土地适宜性评价，在专家提出的参考意见下对林地、果园用地、工业原料用地、药材用地 4 种土地景观进行适宜性的分类。

4. 提出了沙巴县山地农林业景观生态规划方案。在沙巴县山地景观生态分析评价的结果与农林业发展现状的基础上，以可持续发展观点为主，确定了四个景观生态功能区，包括生态保护区、生态缓冲区、生产与生态恢复区及生态农业区；同时提出了农作物的发展规划优先的空间、森林发展优先的空间和生态保存优先的空间。

通过研究的成果和内容可知本文有以下创新点：

1. 在越南老街省沙巴县，运用 GIS 技术进行景观生态综合评价研究，初步提出山地景观生态评价研究理论框架、概念及内涵。

2. 提出了山地景观生态分类与评价指标体系：沙巴县山地景观生态分类指标体系包括景观组、景观类型、景观斑块和景观小区。针对沙巴县农林业景观生态特点，以可持续为理论基础，建立一些作物生态适宜性评价指标。

3. 建立了基于 GIS 技术的农林业景观生态功能分区编制技术体系，提出了沙巴县山地农林业景观生态规划方案。

**关键词：**GIS 技术； 山地景观； 景观生态格局； 生态适宜性评价； 沙巴县



# **Study on Mountainous Landscape Ecology**

## **Assessment Based on GIS**

### **A Case Study in Sapa district, Laocai province, Vietnam**

Ph.D Candidate: KIEU QUOC LAP  
Supervisor: Prof. Wu Xincai and Prof. Liu Xiuguo

#### **ABSTRACT**

Geographic Information System (GIS) has become a very effective application that is being applied in many different fields including landscape ecology research. The research area of this thesis is Sapa district which is the highest mountainous region in Vietnam. This region possesses particular geographic features that containing mainly high mountains. In other hand, the complex divided mountains lead to variously other natural conditions like climate, soil, vegetation systems, etc. These natural conditions could give strong advantages to develop its economy especially in developing agriculture, forestry and tourism. But this district could not use up effectively its resources. Thereby, Sapa district is still the poorest district in Vietnam. In order to meet objectives of sustainable development, we need more thorough researches to estimate its natural conditions, and put forward proposals to plan this territory suitably.

In this thesis, GIS is used as a mainstream approach to analyze and assess the ecological structure of mountainous region landscape. This thesis sums up the research on landscape ecology, by initially building a theoretical basis and research methods for mountainous landscape ecology. Furthermore, this application uses other theories in fields of ecology, sustainable development, systems and the tropical monsoon nature of Vietnam. Research methods that supported this thesis include: fieldwork, remote sensing image processing, collecting statistical data, rural rapid assessment and quantitative analysis. In particular, the thesis has established and successfully applied a number of integrated GIS models, such as ALES-GIS model for adapting assessment of plant ecology, AHP-GIS model for adapting assessment mountainous land, DEM model for analyzing terrain elevation, etc.

This study has made important results and achievements as followings:

1. The GIS database system was built to adequately serve research and integrated assessment of mountainous region landscape ecological such as in Sapa district. From the data collected such as satellite remote sensing images, paper topographic maps, land use map, administrative map, statistical yearbooks data, related texts and documents, etc... GIS data platform was built, including spatial data and attribute data. This is an important database for spatial structure

analysis, assessment and planning of mountainous landscape use in Sapa district.

2. Based on the GIS database, this thesis analyzed structure of mountainous landscape ecology and established system of landscape map for Sapa district. Firstly, landscape ecological structure analysis was conducted according to form factor, which analyzed five natural elements forming vertical structure of the landscape. These five natural elements were topography, geomorphology, soils, climate and vegetation. Each of these factors were analyzed, decentralized and were shown on the visualization of map. Under the help of overlay functions in GIS space, the composition maps were overlaid to form landscape ecological map and landscape ecological zoning map. The analytical results show a differentiation complex of mountainous landscape in Sa Pa, whole territory was divided into 3 groups of landscape, 20 areas of landscape, 87 types of landscape and 280 patches of landscape.

3. Focusing on agricultural and forest landscape of mountainous region, the study conducted level of adaptive landscape ecology assessment. The assessment process mainly focused on three contents: The first was conservation value assessment of the forest landscape and Entropy mathematic model was applied, indicators of forest landscape was simulated to determine conservation boundary of the forest landscape based on GIS technology; The second assessment conducted level of adaptive landscape ecology for some agricultural crops, application ALES-GIS integration model in assessing ecological adaptation for 3 groups of agricultural crops. The assessment results have identified the specific level of adaptation and shown to be clear boundaries on adaptive assessment maps; The third, sustainable land assessment, application GIS and AHP-GDM model consult the experts, assessment results were categorized for the 4 types of sustainable land landscape including forest land, land for fruit crops, land for industrial crops and land for medicinal plants.

4. This thesis recommends using rational planning of agricultural and forestry landscapes in Sapa district. The basis for the proposed planning scheme is based on the results of analysis, landscape assessment, and the current state of agriculture and forestry development in Sapa district. Take the perspective of sustainable development as a key, thesis has identified four zones of landscape function, which include: ecological protection zone, ecological buffer zone, ecological restoration zone and agro-ecological zone. Simultaneously proposed space planning development of agricultural crops, space priority forest development and space ecology conservation.

**Keywords: GIS, mountainous landscape, landscape structure, adaptive ecological assessment, Sapa district**