

# GIS in Action: Conservation Priority Evaluation at District and Village Levels in Laos

Mui-How Phua  
Universiti Malaysia  
Sabah,  
Kota Kinabalu,  
Malaysia  
pmh@ums.edu.my

Su Wah Hue  
Universiti Malaysia  
Sabah,  
Kota Kinabalu,  
Malaysia  
capricornhue@gmail.com

Alexius Korom  
University Technology  
Mara  
Kota Kinabalu,  
Malaysia  
jasiuko@hotmail.com

Vongphet Sihapanya  
National University of  
Laos,  
Vientiane, Laos  
vongphetforest@gmail.com

## Abstract

GIS-based multicriteria analysis is a simple yet powerful spatial planning method. It was applied to evaluate the conservation priority at district and village levels in Laos. We developed three planning criteria i) Forest type, ii) Potential tillage erosion and iii) Distance to accumulated changes. The Conservation Index (CI) produced by combining these criteria provided an overall idea about conservation priority in the Feung district, Laos. Sustainability in forest resource conservation against rapid agricultural development and timber extraction is a big issue in at district and village levels. Most of the Feung district was covered with CI value below 15 occupied. Areas with CI value higher than 30 were limited; stretched from the Northeast and Southwest of the district. At the village level, only small areas bordering the district protection forest were still covered with high CI values. This indicates the lack of land use regulatory under the existing village land use plan.

*Keywords:* GIS multicriteria analysis, conservation index, land use, Laos.

## 1 Background

In Southeast Asia, the numbers of local people who depend on shifting cultivation are estimated to range from 14 to 34 million (excluding China and Cambodia where no estimates were found) (Mertz et al., 2009). Local people tend to convert from shifting cultivation to other economic activity that provides better economic return (Phua et al., 2014). Without government intervention, most shifting cultivators continue slash-and-burn cultivation and depend on timber and non-timber forest products for their livelihood. This is probably due to the fact that most of the indigenous communities in the developing world are left as the most disadvantageous groups by the government and policy makers (Muhammed and Koike, 2009).

Increasing population threatens sustainable livelihood in rural villages of Laos that largely depend on slash-and-burn cultivation as well as forest product uses. Even with a land use plan in place, unmanaged slash-and-burn cultivation contradicts the needs of forests for non-timber forest product and firewood collection. This research aimed at evaluating conservation priority at district and village levels in Laos using GIS-based multicriteria analysis techniques.

## 2 Methods

Planning criteria developed were i) Forest type, ii) Potential tillage erosion and iii) Distance to accumulated changes. For criterion i, four land cover classes (non-forest, highly degraded, degraded and intact forests) were derived with the object based classification approach. These classes were assigned a score between zero and one at equal interval. The potential tillage erosion map was developed using Shuttle Radar Topography Mission Digital Elevation Model based on the study of Dupin et al. (2009). Distance to accumulated

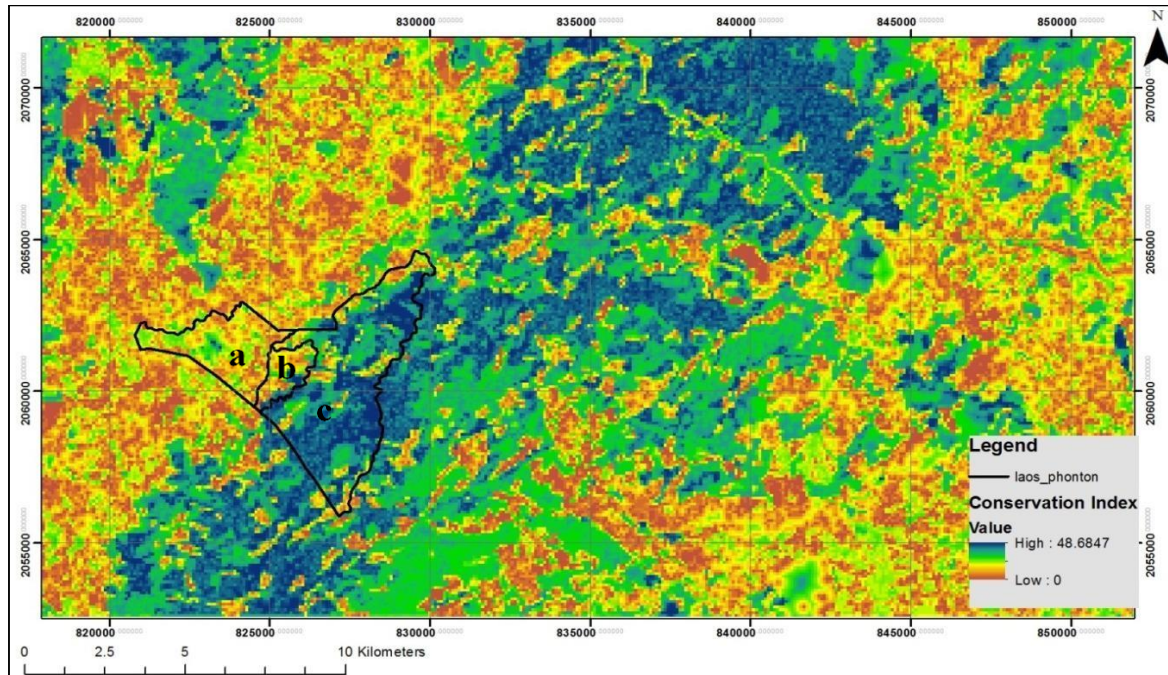
changes was calculated from accumulated changes class represents threats of deforestation, which is the accumulated deforestation areas 1990-2015 at 5-year interval derived from Normalized Burned Ratio image differencing (Phua et al., 2007). These criteria were standardized to score between zero and one using the minimum and maximum scores as scaling points (e.g. Malczewski, 1996; Phua and Minowa, 2005). A Conservation Index (CI) was calculated by taking an average of the three standardized criteria and scaled to percent.

## 3 Results and Discussion

The CI provided an overall idea about areas to be emphasized in conservation planning in the Feung district. The CI of the study area ranged between 0 to almost 50 (Figure 1). The areas with CI value above 30 (blue to dark blue in Figure 1) were considered very important to protect because it consists of intact forest, steep area and relatively undisturbed. The areas with CI values 15 to 30 (yellow to green in Figure 1) were considered important to be conserved by restricting the uses to prevent further degradation. The areas with CI value below 15 (orange to red in Figure 1) were mostly bare land, agriculture area and plantation area. Most of the Feung district was covered with CI value below 15 occupied. Areas with CI value higher than 30 were limited; stretched from the Northeast and Southwest of the district.

The case study area, Photon Village, has a land use zoning map that divide the village area into 3 zones namely, agriculture land/ forest, village protection forest and district protection forest, labelled as a, b and c in Figure 1, respectively. For the agriculture land/ forest zone, low CI values covered most of the zone. Only small areas bordering the district protection forest were still covered with high CI values. In fact, at least one-third of the district protection forest had a CI value lower than 30.

Figure 1: The Conservation Index of Photon village in Feung District, Laos.



The GIS-based multicriteria analysis is a simple yet powerful spatial planning method. The multicriteria evaluation highlighted a sustainability issue in forest resource conservation against rapid agricultural development and timber extraction in the Feung district, Laos.

Land use can involve multi-decision makers in the planning. All criteria and stakeholders were also considered equal in this study. If it is important to capture different levels of influence among stakeholder groups, the procedure can be expanded to become a GIS-based multiple decision making analysis (Phua and Minowa, 2005). Village heads, government officers and other stakeholder organizations can contribute to weighting the criteria in order to determine the conservation priority area in the existing village land use plan.

At village level, the access to the village protection forest needs stricter control. The intact forest especially those in steep slopes must not be disturbed. Land use regulatory needs to be implemented and enforced to prevent further degradation of the village protection forest. In long run, ecosystem management is recommended to ensure that ecosystem services and biological resources are preserved while appropriate human uses and options for livelihood are sustained (Brussard et al., 1998).

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