Applied Geography 34 (2012) 1–9

Contents lists available at SciVerse ScienceDirect

Applied Geography

journal homepage: www.elsevier.com/locate/apgeog

Coupling Community Mapping and supervised classification to discriminate Shade coffee from Natural vegetation

Guillermo C. Martínez-Verduzco [a], J. Mauricio Galeana-Pizaña [a], Gustavo M. Cruz-Bello [b,*]

[a] Centro de Investigación en Geografía y Geomática "Ing. Jorge L. Tamayo" A.C. Contoy 137, Col. Lomas de Padierna, Mexico DF CP 14240, Mexico
[b] Instituto de Ecología, Universidad Nacional Autónoma de México, Circuito Exterior, CU, México DF CP 04510, Mexico

Keywords:
Land use mapping
Shade coffee
Community Mapping
Orthophotos
Supervised classification
Chiapas

A B S T R A C T

Discriminating between Shade coffee plantations and Natural vegetation using Remote Sensing is particularly difficult in zones where both coverages have almost the same mix of species, as is the case in several areas of the Chiapas highlands. This investigation couples supervised classification with Community Mapping to separate these vegetation classes. Local knowledge of the study area was elicited from local inhabitants through workshops. The participants were asked to delimit both coverages inside the areas they knew the best (confidence map) with the help of printed orthophotos to build a land use map. The accuracy of this coupled method was similar to supervised classification alone and with less time and resources invested. This method can be applied in the rural zones of developing countries, as it is easy to understand and is cheaper than similar alternatives.

Introduction

One of the first tasks in compiling an inventory of agricultural crops is to generate an accurate map of the distribution of a given crop. This information is of great importance for the Mexican coffee sector, in which the area under coffee cultivation has decreased as a result of economic crises in market prices and a lack of governmental support (Ávalos-Sartorio & Beccerra, 1999; Nestel, 1995; Pérez-Grovas, Cervantes, & Burstein, 2001). One approach that has been used to delimit coffee plantations is ground-based census; however, this approach is time consuming and expensive, which precludes continuous updating (Frolking et al., 2002; Tsiligirides, 1998). An alternative is the use of Remote Sensing for non-shaded coffee or where shade is provided by a single tree species (LeLong & Thong-Chane, 2003). Nevertheless, this endeavor is difficult in sites where forest and Shade coffee are mixed (Blackman, Albers, Avalos-Sartorio, & Crooks, 2005; Helmer, Brown, & Cohen, 2000; Langford & Bell, 1997) because coffee growers usually establish their plantations in previously forested areas. Therefore, the spectral responses of the two covers on the satellite images are not easily distinguished (Cordero-Sancho & Sader, 2007). The work is further hampered by the difficulty of collecting training and ground-truth sites in steeply sloped mountains (Carfagna & Gallego, 2005).

An alternative for overcoming this Remote Sensing problem where forest and Shade coffee are mixed is to use local expert knowledge. When this knowledge is used to produce cartography, it is called Community Mapping. This type of mapping can incorporate geospatial information such as sketch maps, participatory 3-dimensional models, aerial photographs, satellite imagery and tools such as global positioning systems and Geographic Information Systems to compile virtual or physical 2- or 3-dimensional maps (Corbett & Keller, 2006; Lydon, 2000; Perkins, 2007; Rambaldi, Chambers, Mccall, & Fox, 2006).

This integrated approach can provide information to solve issues in natural resource management, the delineation of conservation areas, environmental restoration, natural hazard mapping, community development and poverty alleviation (Dunn, 2007; Perkins, 2007; Rambaldi & Callosa-Tarr, 2002; Tane & Wang, 2007).

For Community Mapping, printed orthophotos or a technology that simulates them have proved to be easy to use by communities because, to some degree, they alleviate people's distrust of computer technology and their lack of cartographic literacy; these tools are also less expensive than other related inputs, such as high-resolution satellite images (Mapedza, Wright, & Fawcett, 2003; Muller & Wode, 2002; Tane & Wang, 2007; Wang, Yua, Cinderbyc, & Forrester, 2008).

In this study, we developed a method to build a land use and vegetation map using Remote Sensing combined with local expert

* Corresponding author. Tel.: +52 55 5622 9002.
E-mail addresses: guillermocmartinezv@yahoo.com (G.C. Martínez-Verduzco), geomauricio23@gmail.com (J.M. Galeana-Pizaña), gcruzbel@hotmail.com (G.M. Cruz-Bello).

0143-6228/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.apgeog.2011.10.001

knowledge. The advantage of this method is its capability to discriminate Natural vegetation from Shade coffee, which is spectrally similar to Natural vegetation (Cordero-Sancho & Sader, 2007; Cruz-Bello, Eakin, Morales, & Barrera, 2011), with less time and resources invested.

The study area

The study area is in the municipality of Cacahoatan in Chiapas, Mexico (Fig. 1). This areas is 129 km^2, and the land use is mainly shade and non-shade coffee, tropical rainforest, *Quercus* and *Pinus* forests, field crops and livestock land (Balduzzi & Toaseli, 1978–1979, pp. 3–43; CONABIO, 1999; INEGI–INE, 1996; Rzedowski, 1990). The area is primarily mountainous from the north to the central portion, while the southern part is predominantly plain (INEGI, 2002; Fig. 1). The elevation ranges between 370 and 3120 m above sea level. The annual rainfall varies between 2500 and 4000 mm (Vidal-Zepeda, 1990). In 2005, Cacahoatan had 40,975 inhabitants, of whom 2504 were indigenous (INEGI, 2008). Of the total population, 40% live in two urban localities and the rest in 93 rural towns. The whole municipality has been classified as having a high rate of marginalization (INAFED, 2003).

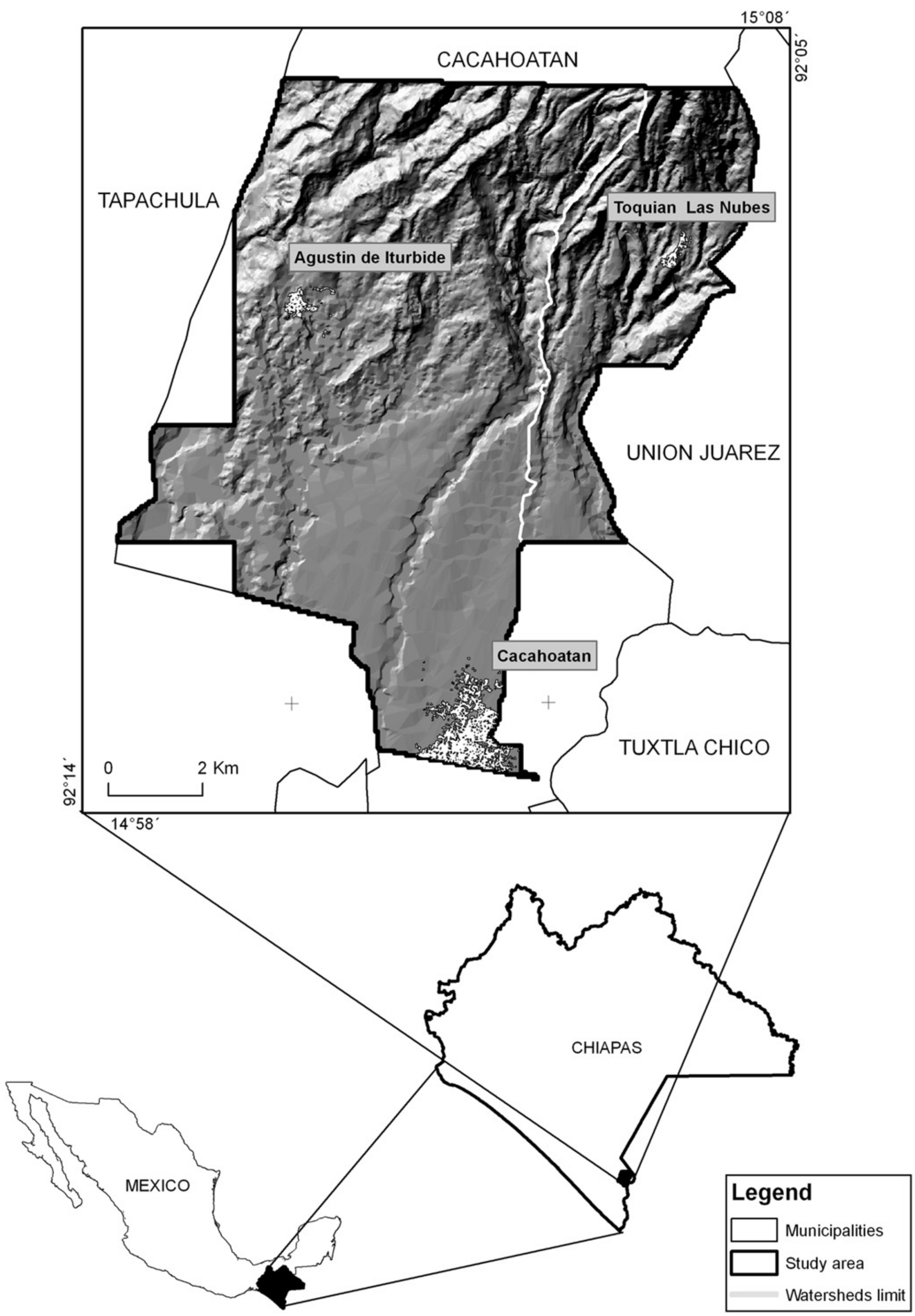

Fig. 1. Study area in the municipality of Cacahoatán, Chiapas, Mexico.