Chapter 5
Objective Sampling Estimation of Crop Area Based on Remote Sensing Images

Alfredo José Barreto Luiz
Embrapa, Brazil

Antonio Roberto Formaggio
INPE, Brazil

José Carlos Neves Epiphanio
INPE, Brazil

ABSTRACT

Having the ability to estimate crop areas is a necessity ever more pressing for all the stakeholders of productive chains. For many scientists involved in agricultural research it is also important to know the location of crops and the area they occupy. With this information, considered together with data on soil, climate, availability of infrastructure for storage and transportation, among others, it is possible, for example, to build scenarios and fit models to attend multiple demands. In this chapter the authors propose a simple method combining the techniques of statistical sampling with the characteristics of images obtained by remote sensing, to construct estimates of acreage in a micro-region scale. The objective to be achieved is to produce an estimate of crop area in a defined territory, with estimated statistical error associated.

INTRODUCTION

Area estimation is one of the most obvious applications of remote sensing because, among other reasons, it has a direct economic impact and very early found a user community with clearly defined accuracy specifications, at least for applications to agriculture statistics (Gallego, 2004). In his chapter, Gallego (2004) cited an abundant literature that made use of different ways to use satellite images for land cover area estimation. However, the linkage with statistical sampling techniques and field work to check or substitute image interpretation are not presented in a simple way yet.

DOI: 10.4018/978-1-61692-871-1.ch005
Context and History

Proper utilization of statistics within any scope depends primarily on how well the nature of employed data is known, and on how clearly the goals are established. Remote sensing offers a rather particular set of data, which almost predetermined the characteristics that must be taken into consideration when choosing the statistical methods to be used in analysis. Application of those data in agriculture, particularly when the aim is to quantify crop areas, will define quite specific goals that should influence the selection of statistical analysis techniques. An alliance between statistics and remote sensing, based on theory and used in proper ways to estimate crop areas, shall result in a step ahead in the efficient use of data from orbital sensors for agriculture purposes. In this direction, this document presents:

1) a method to prepare and use satellite images in agricultural surveys by sampling;
2) the way to calculate estimates over objective data of crop area and their respective variances;
3) a case study consisting in the estimates of soybean area in a municipality, using remote sensing as auxiliary data; and
4) how to use stratification to improve the quality of estimates.

THEORETICAL FUNDAMENTALS

Objectives

The purpose of this chapter is to present a simple and reliable method based on the use of remote sensing images and statistical sampling, which allows the quantification of areas occupied by a particular crop in micro-scale regional or municipal level. This method was developed by Luiz (2003).

To achieve this general goal the following specific objectives are established:

a. Provide a guide for the preparation of images from orbital remote sensing in order to allow their use in agricultural sample surveys;
b. Establish a procedure to extract a random sample of image’s pixels from a set of pixels spatially delimited;
c. Present formulas for the calculation of estimated planted area by micro-region or municipality, as well as its variance from data obtained by sampling.

Agriculture Estimations and Relationships with Remote Sensing

Despite the decline in the proportional importance of agriculture in global economy, there is a growing need to monitor the agricultural complex (Ryerson et al., 1997). This interest is justified when we consider absolute figures are significant and reach US$ 171 billion annually in the U.S. alone (The World Factbook, 2009).

According to Pino (1999), more countries need to have information and agricultural forecasts that are effective and allow fast perception of change. For Ray et al. (1999), estimates of production in the micro-regional level are essential for management decisions related to the farming-sector economy of any country.

Since the cost of applying traditional techniques over large areas is a limiting factor, the use