

Preface

Although agriculture represents an increasingly marginal role in the world economy in terms of percentage of Gross Domestic Product, the radical economic and social transformations characterizing not only the Western but also the developing countries have recently caused a new and promising interest in this field.

It is becoming increasingly difficult to provide reliable information to assist in making public policy decisions for monitoring the production of agricultural goods and its effect on the environment and food safety.

Agricultural data collection programs can normally be classified as either census or sample surveys. A census is a survey which collects data from all members of a population. A sample survey differs by surveying a small number or proportion of the population. However, a census has strong limitations: in particular, the cost and the logistics associated with the need for human and financial resources. As a consequence, it has never been very practical to organize a census on an annual basis.

Conversely, sample surveys are more efficient and are able to provide results in a more timely fashion.

This book is completely concerned with the analysis of sample surveys in agriculture. This research field particularly deals with area estimation methods for different crops, crop yield, and crop production for various harvests across different regions. In particular, our focus is on sampling of spatial units. This typology of survey has increasing strategic importance for providing appropriate information in the agricultural sector as a support for both policy makers and market stakeholders.

The particular nature of geo-referenced units has influenced the definition of the models for the analysis of spatial data, but surprisingly, we do not find a similar research effort for the issue of spatial data collection.

The phase of data collection is crucial and influences in a remarkable way the following step of data analysis. To the best of our knowledge, in the current literature there exists no comprehensive source of information regarding the

collection methods exploiting the *spatial characteristics* of the data. Our aim is to contribute to fill this gap with a book that describes all the phases of spatial data collection.

Another aim of this book consists in stimulating research in this field and, for this reason, we are aware that it cannot be considered as a comprehensive and definitive reference about the methods that can be used in spatial agricultural surveys. However, it presents, in our opinion, the state of the art about several crucial issues on spatial sampling.

Furthermore, the agricultural orientation of the book might represent one of the main novelties of the work. In fact, the framework of sampling spatial units is also used for environmental and forest data, with methods that are often different from those used for agricultural data.

The methods described in the text will be accompanied by real and simulated examples that will be implemented in *R* code. We added the *R* codes of many of the techniques described in the text hoping to make these methods available to anyone who wants to use them either for research purposes or for designing and processing existing surveys. *R* is an open-source and free software environment for statistical computing and graphics that runs on a wide variety of operating systems including Windows, Mac OSX, and LINUX. Since the last couple of decades, it has been developed by hundreds of contributors and new capabilities are added each month. We believe that the flexibility and robustness of this software justify its use, even for large populations.

We hope that this book could serve as a starting point for research in this field to stimulate the derivation of new and efficient methods for the analysis and design of spatial samples and, finally, as a field manual for practicing agricultural surveyors, analysts, and researchers.

Outline of the Book

The book is organized in 12 chapters. The scheme and the main interrelations between chapters are summarized in the following Fig. 1.

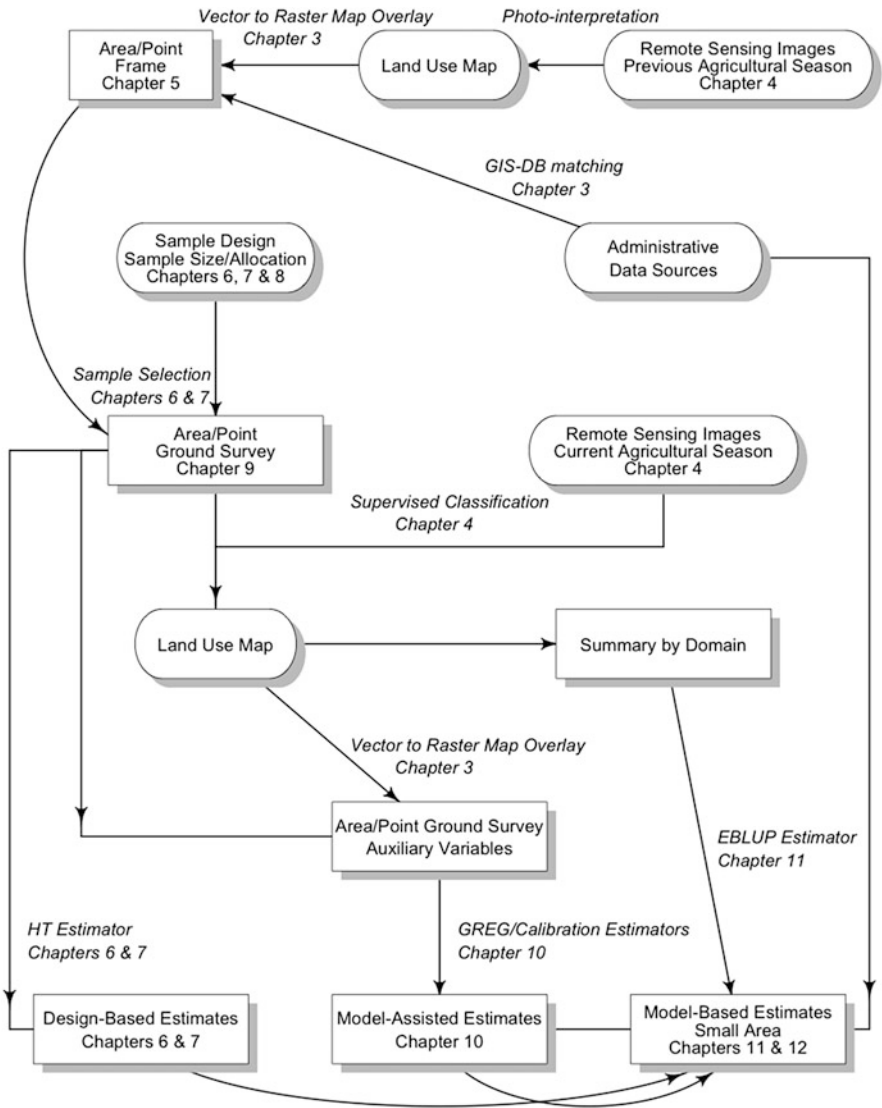


Fig. 1 Outline of the book

The topic of spatial sampling for agriculture is complex and composite, since it involves several disciplines or professional specializations for its treatment. For this reason, we devote the first four chapters of the book (Chaps. 1–4) to the description of some aspects that constitute a necessary scientific background for spatial sampling of agricultural resources.

In particular, Chap. 1 represents our starting point on which is based all the narrative of the book. In fact, Chap. 1 contains the description of the main

approaches to sampling, namely design-based and model-based approaches, and of the main statistical models for spatial data that will be largely used in the rest of the book. Chapter 2 presents a brief history of the previous experiences in the field of survey of natural and agricultural resources. In Chaps. 3 and 4, we outline some topics that represent helpful instruments for spatial sampling: GIS (Chap. 3) and the analysis of remotely sensed data (Chap. 4).

From Chaps. 5–10, we provide an overview of all the phases of spatial collection for agricultural data. First, we discuss the problem of the choice of spatial statistical unit (Chap. 5) that will be used in sampling designs. Chapter 6 describes the main basic selection procedures that represent the foundations of every sample design. Chapter 7 contains the discussion about the methods for spatial sampling. This chapter represents, in our intention, the core of the book. Then, in Chap. 8, we present the problem of sample allocation and selection.

In Chap. 9, we describe the main tools for the collection of the data (i.e., definition of the questionnaire or instruction manual and technique for data quality assurance). Finally, with Chap. 10, we conclude this part with the description of the estimation methods with a particular focus on the use of some auxiliary information in order to improve estimation.

The last part of the book aims at describing some recent advanced topics in spatial sampling of agricultural data (Chaps. 11–12). The first issue considered in Chap. 11 is the small area estimation that concerns several statistical techniques involving the estimation of parameters for small subpopulations, generally used in order to give aggregated estimates of minimum variance obtained through modeling. Finally, in Chap. 12, our purpose is to present two different approaches that represent possible novelty to our field of analysis. In particular, we outline the predictive strategy (i.e., model-based approach) that represents a different viewpoint of classical sampling theory and the problem of the analysis of spatial sampling data, moving from the consideration that sampling data cannot be treated in the same way as population data, as generally is in the literature.

Acknowledgments

It is a pleasure to express our appreciation to those who have influenced this work or have provided assistance in preparing this book.

Many chapters of this book were written during our stay at Regional Economics Applications Laboratory (REAL) at the University of Illinois at Urbana-Champaign (USA) and at the Centre for Sample Survey Methodology at the University of Wollongong (Australia).

We are very indebted to all REAL people who with a word or a suggestion have continuously supported this long and laborious project. In particular, we would like to thank Geoff Hewings. For us, he is not only the Director of REAL but a

prominent scientist and person who has continually and enthusiastically encouraged our work. If we were able to complete this book, much of the merit must be ascribed to him.

Very special thanks are also due to Ray Chambers, Director of the Centre for Sample Survey Methodology at the University of Wollongong. We had several scientific discussions with him that have largely inspired many parts of this book.

Thanks to Anton Grafström who carefully read Chapter 7 and made many helpful suggestions on spatial sampling methods.

Thanks also to the Springer Editor Barbara Fess for her continuous encouragement and facilitation of this project.

Finally, we would like to thank our family for their inspiration and support during the years this book was being written.

The responsibility for any errors that may be present in the final version remains with us.

Rome
December 24, 2014

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Sampling Spatial Units for Agricultural Surveys

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2015, XVIII, 325 p. 44 illus., Hardcover

ISBN: 978-3-662-46007-8