# Preface

In an often-quoted definition by the Brundtland Commission, sustainable development is understood as fulfilling the basic living needs of contemporary society "without compromising the ability of future generations to meet their own needs." Since the commission's report in 1987, there have been dozens of definitions for the term. Research findings, science, and scientific cognition greatly contribute to the balance in sustainable development strategies. Decision-making is currently based on a large number of inter-dependant factors that are rapidly changing. Decisions are made with uncertain and sometimes conflicting findings and data, reflecting the evolving human understanding of the environment around them. Indeed, one of the approaches, in the analysis and synthesis of decision processes, is the usage of methods involving uncertainty.

Understanding the advancement of the principles of sustainable development is a fundamental goal in managing human activities in such a way as to avoid the overexploitation of resources and the pollution of the environment beyond tolerable levels. Sustainable development means not only the preservation and care for environment, but also respecting a number of complex relations between economic, social and living systems.

The goal of this book is to present processing methods and their applications. These, are practical for decision making and task management at the regional level (strategies and plans for development, assessing regional sustainability, etc.) as well as for scientific studies in sustainable development assessment.

Research conducted worldwide has concentrated on creating indicator sets, a large number of which are currently available. Most of these evaluate the pillars of sustainable development separately, without the use of multi-dimensional assessment. Despite the vagueness of the term sustainable development, and the complexity of quantification, there great potential to identify and measure levels of sustainability. Parallel to the three dimensions of sustainable development, these may be classified as sensitive, valid, and representative, in various aggregations.

A general solution is difficult to find concerning the development of a framework of procedures and mechanisms for the integration process in decision making. This is; due to the immense differences among regions in regard to prevailing conditions and, needs as well as, national plans, policies, and programmes. Therefore, specific regional sustainable development frameworks might be more appropriate to meet local needs and expectations on important, diverse issues such as pollution, energy consumption, natural resource consumption, waste management, health, crime, employment, poverty, education, and social justice.

The modeling of sustainable development involves the following processes: decision-making and management; support, participation and consensus building; and research and analysis. This type of modeling activity might take the form of a decision-support system (linking empirical data and statis-

tical methods with expert knowledge), an optimization model (optimizing simultaneously economic, social, and environmental objectives), a simulation model, or a general equilibrium model supported by empirical data.

Today sustainable development models are, realized as decision-making systems, optimization models, simulation models, or general equilibrium models. These models allow governments and other organizations to examine the current status of sustainability, to suggest recommendations for decision-making, and to predict the impact of these decisions on the individual components of sustainable development. The complexity of such decision-making processes, including inaccuracy and uncertainty caused by vague or non-existent definitions of component's, requires new methods based on artificial and computational intelligence.

This book seeks to outline new trends in the modeling of several parameters of sustainable development, at the regional level. Among these are methods of artificial and computational intelligence, as well as tree and graph structures. Spheres of research in artificial intelligence (the symbolic representation of knowledge) are characterized by the theory of static systems, whereas spheres of computational intelligence (the sub-symbolic representation of knowledge) are characterized by dynamic systems theory. The basic principles of the mentioned methods are the usage of tolerance, inaccuracy, uncertainty and partial truth for robustness, as well as determining the realization price. The above-named systems are able to learn and process: uncertain, fuzzy, incomplete, and highly differently-structured data and information. Typical examples of these spheres are, fuzzy sets, intuitionistic fuzzy sets, and rough sets. Furthermore, an important feature of these methods is, apart from assessment, the generalizing and processing of non-linear dependencies, examples of which include forward, recurrent and cellular neuron networks. A noticeable advantage of these methods is the creation of the kinds of models, methods, procedures, and algorithms which take advantage of two or more approaches. The application of these methods has great significance in the economic, social, and environmental sphere, as well as finding equilibrium among the three sustainable development pillars.

Based on this information, posts have been selected from authors working in various geographical, political, economic and social spheres. The intent was to present the most heterogeneous view possible on the current status of sustainable development research from a regional viewpoint, using systems approach and other advanced methods.

We started with chapters which represent more complex, ultimately synthetic approaches. Chapters on the ecological footprint model, the large-scale modeling of approaches to environmental impact assessment, the modeling of integrative model stochastic system dynamics as well as regional risk assessment, are included in the first section. The next part of the book focuses on the modeling of environmental components. Uses of various methods are presented in case problems dealing with air quality in addition to, the usage of water sources and sewage water, including produced waste. In order to represent issues of efficiency evaluation, case studies involving various problems of environmental protection are included. The economic dimension of sustainable development is considered using regional and interregional economic models. Relations among the economic and environmental pillars of sustainable development are presented in the next chapters. Here, regional examples featuring relational models of the usage of resources, as well as economic issues versus risks for the environment, agriculture and forestry are highlighted. Social relations are examined in the next chapters, which present the modeling of relations between air pollution and public health along with, the usage of natural resources and related impacts on poverty levels and other inequities among citizens. A quality of life model can be selected as a synthesizing indicator.

This book may serve as a reference guide for post-graduate students in the field of management as well as, a critical guide for managers, government officials, and information professionals. Each chapter provides references to the cited literature along with suggestions for further reading. The described methods and case studies may be particularly useful for policy makers searching for alternative solutions for problems in regional sustainable development, taking into account socio-economic and environmental dimensions in a system integrated approach. The text is also suitable for use by educators as comprehensive tutorial literature or as complementary material for associated professionals and researchers.

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