Ashok K. Dutt · Allen G. Noble
Frank J. Costa · Sudhir K. Thakur
Rajiv R. Thakur · Hari S. Sharma *Editors*

Spatial Diversity and Dynamics in Resources and Urban Development

Volume 1: Regional Resources

Springer

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Preface

Natural resources is back on the stage, largely because the human–environment condition has emerged as one of the central issues of the new millennium, particularly as it has become apparent that human activity is transforming nature across several scales in both systemic and cumulative ways. Spatial Diversity and Dynamics in Resources is centrally concerned with the contentious and problematic issues of resources in urban, rural, and peripheral regions of the world. This book is a result of a project initiated by Ashok K. Dutt with his colleagues Allen G. Noble and Frank Costa (Department of Geography and Planning, The University of Akron, Akron, Ohio) to provide a festschrift in honor of Professor Baleshwar Thakur, former Vice-Chancellor of L. N. Mithila University, Darbhanga, Bihar, and Professor of Geography at the Delhi School of Economics, University of Delhi. Baleshwar Thakur has been a collaborator and contributor on several projects initiated at Akron. During the past more than four decades, Thakur has established his national and international credentials as one of the leading exponents of resource management and urban development. He has been recognized for his research contributions by the Association of American Geographer's Regional Development and Planning Specialty Group's Distinguished Scholar Award, besides other recognitions such as the Commonwealth and Fulbright Scholarships, and a Shastri Indo-Canadian Fellowship, among many others. We take this opportunity to thank all the contributors to the volume and the family members of editors in bearing the burden of being away from family responsibilities while working on this project.

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Part I
Introduction

Chapter 1
Introduction: Regional Resources

Sudhir K. Thakur, Ashok K. Dutt, Allen G. Noble, Frank J. Costa, Rajiv R. Thakur, and Hari S. Sharma

Abstract Natural resources are attributes found in nature such as coal, wilderness, water, soil, and air that can be used as factors of production. A resource is a means to an end. Although resources are plentiful, their distribution is spatially uneven in developing and developed countries. Concomitantly, there is a contrast in the population and resource relationship in relation to regional levels of development. The explosion of population size and its resultant pressure on consumption and depletion of resources is a big question for development analysts and decision makers. Adverse relationships have led to loss of cultivated lands, deforestation, soil erosion, water shortage, groundwater depletion, ecological imbalance, pollution hazards, deterioration of water quality, and environmental degradation. This disparity impacts the gross national product as many governments do not take into account the loss of resources in the measurement of development, thereby inflating the sum of goods and services produced in the economy. Further, resource analysts have advocated an increase in wealth per capita over time to maintain intergenerational social well-being.

Keywords Natural resources • Uneven development • Population and resource relationships • Sustainable development

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Natural resource studies have become a subject of exceedingly high importance in the enrichment of civilized human existence and, ultimately, our biological survival. Mother Earth is rich in diverse natural resources, although their distribution is spatially uneven. There are contrasts in the geographic pattern of distribution of natural resources in both the developed and developing world. The subsistence-level economy of developing countries diverges sharply with highly developed countries in natural resource consumption, resulting in unequal relationship among natural resource and development relationships. The population pressure on natural resources in the two worlds is also significantly different. Natural resource developers and managers are intrinsically concerned with the quantitative explosion in the population size and the concomitant pressure on natural resources. In many parts of the world, this pressure has exceeded the carrying capacity of the resources. Pressure on resources caused by increasing populations and their quest for a high standard of living is growing at a rate that is difficult for the world to sustain. Such trends along with many other factors have resulted in loss of cultivated lands, deforestation, soil erosion, water shortage, groundwater depletion, ecological imbalance, pollution hazards, deterioration of water quality, and environmental degradation.

Many countries are blessed with relatively diverse natural resources, including fertile soil in Argentina, China, India, Nile Valley, Great Plains of the USA; abundant forests in the Amazon basin, Northern Canada, Eurasia; abundant water in North America and humid tropics; rich mineralized rock beds in the USA and former USSR, China, and Australia; energy minerals in the USA, former USSR, Middle East, Venezuela, France, China, and India; and scenic resources in the USA, Canada, Switzerland, and tropical islands. These resources are unevenly distributed, and there are variations in the development of natural resources spatially. The land-to-man ratio is favorable in Australia, Canada, Argentina, USA, Chile, Denmark, and Mexico. Conversely, the land–man ratio is unfavorable in India, Japan, The Netherlands, Egypt, UK, Israel, and China. The developing countries, especially, the humid tropics, are the most densely populated regions of the earth, where by the year 2030 about one third of the world population is expected to reside. The poor productivity in food resources results form the unusual ecological diversity of large parts of the tropics; it is also caused by geologic and climate factors that make tropical soils (Oxisols and Ultisols) deficient in minerals nutrients as compared to middle latitudes.

Soil erosion is occurring in developed and developing countries alike. In the United States and South Africa, soil erosion is a national disaster of the first magnitude. In much of Asia, Latin America, and Africa, change from forest to crop fields is accompanied by increase in runoff. The continued deforestation in the Himalayas and the Aravallis has created serious soil erosion problems in northern India. Soil erosion is making future production more difficult in China. The growth in global population and the expansion of agriculture and industry have put pressure on the world's water resources. Oceania, South America, and North America are relatively water abundant because their per capita water consumption is less than per capita water availability, whereas Asia has the least amount of water available per capita. Forests are important natural resources as they moderate local climates,

reduce soil erosion, regulate stream flow, support industries, and provide opportunities for recreation. Latin American and Asian countries have shown an increase in arable areas and decrease in forest coverage. Most European countries are characterized by an increase in the extent of forests and a reduction in arable area.

Mineral and energy resources are central to all economic activities and are perceived as one of the key variables that determine the sustainability of the development process. A region's economic development relies on a variety of energy resources including fossil fuels, hydropower, nuclear energy, biomass fuels, and exotic power resources. Minerals are means for producing energy (atomic minerals, tar shale, oil shale), controlling energy (ferrous and nonferrous minerals), and conserving energy (nonmetals).

In general, natural resources have had a positive effect on the development process, but in some economies it has had negative or less favorable effects on development, especially in Sub-Saharan Africa (Carmignani and Choudhary 2012). Many of the underdeveloped regions in Latin America, Sub-Saharan Africa, Asia, and South Asia are abundant in natural and mineral resources but have not experienced growth compared to resource-poor countries. It is a dilemma that the eastern states of India, rich in coal, iron, aluminum, and groundwater resources, have not shown prosperity relative to the developed western states. What explains this paradox? Perhaps elucidation lies in an alternative explanation called the *resource curse thesis* (Auty 2001, 2007). This concept integrates neoliberal, political, institutional, and environmental approaches that provide an explanation for the fate of mineral-dependent economies. A threat to excessive dependence upon mineral products can result from depletion of such resources, mineral sector marginalization with synthetic substitutes, low responsiveness of primary sector products, and the volatile nature of revenue from this sector.

Further, economic growth and social progress of national economies have been measured by an economic indicator called the Gross National Product (GNP). This is the total sum of marketed goods and services in an economy over a year. This measure of economic progress is misleading because in the process of development natural resources are utilized and consumed as well. Natural resources such as agricultural land, forests, watersheds, groundwater, atmosphere, and ecosystems are utilized; and although some resources can regenerate, their overconsumption leads to depletion and depreciation. Thus, the depreciated asset should be deducted from the GNP to accurately reflect the level of development. Incorrect estimates of GNP can give erroneous signals to policy makers for investment planning and allocation of resources (Miller 1990; Das Gupta 2010). This debate led to the coining of a new measure called the Index of Sustainable Economic Welfare (ISEW). The ISEW is a measure of economic progress that utilizes GNP and accounts for both current environmental issues and long-term sustainable use of natural ecosystem and resources. The much-cited Brundtland Commission on Environment and Development (1987) proposed the idea of sustainable development. This concept implied a process of development in which the need of the current generation does not compromise the ability of production and consumption for future generations. Government planners and decision makers are always vexed with the trade-off between current consumption and intergenerational equity.

Also, the notion of sustainable development has been elaborated as an increase in intergenerational social well-being only if a comprehensive measure of wealth per capita increases over time. National wealth comprises not only manufactured capital, but also knowledge, human capital, and natural capital (Das Gupta 2010). It is necessary for societies to consume natural resources in a manner that allows people and government to invest in natural capital for its regeneration and sustainable use. For example, decision makers have advocated an integrated water resource management (IWRM) approach to manage the complex problem of interstate water conflicts and water management. The IWRM is a process that entails multiple actors to integrate diverse rules and resources in a strategic context for effective water management (Saravanan et al. 2009).

Given this overview, this book is a felicitation honoring Professor Baleshwar Thakur as an academician *par excellence*. The book is a collation of papers on issues resonating with his teaching and research interests over the past 45 years. The papers have been contributed by his friends, colleagues, esteemed teachers, and former students, many of whom have known and worked with him for several decades. The book contains 28 chapters broadly classified around the theme of spatial diversity and dynamics in regional resources, divided into eight parts: Introduction, Methodology, Global Perspectives, Economic Perspectives, Ecological Perspectives, Water Management, Energy and Forest Resources, and Land Cover and Rural Planning.

The introductory part consists of two chapters. The first chapter is an overview to the theme of the book and the second chapter is a review of the academic background and contributions of Professor Baleshwar Thakur to geographic research in general and in particular urban and resource development in developing countries with particular focus on India. The second part on methodology contains two chapters. The first chapter, by **Chandrama Dey Sarker, X. Jia, Liguo Wang, D. Fraser, and L. Lymburner**, discusses flood inundation mapping; in particular, exploring the issue of separating inundated areas from wet areas where trees and houses are partly submerged under water. Experiments were conducted using three different flood events in Australia, leading to satisfactory results. The next chapter, by **Srikumar Chattopadhyay**, posits the importance of a microlevel approach in natural resource management planning with examples at the local level in Kerala.

The third part consists of two chapters concerning global perspectives on natural resources. The first chapter in this part is coauthored by **Supriya Francis and Vandana Wadhwa**. Their analysis concludes that policy makers have a lackluster approach to the effect of climate change on the agriculture sector upon which millions of Indian farmers depend for their livelihoods. The second chapter, by **Bruce Mitchell**, discusses innovative concepts related to environmental, resource, and water management.

The fourth part, covering the economic perspectives of land and natural resources, includes four chapters. The first chapter, by **Sanjoy Chakravorty**, encompasses the evolution of land markets in India before independence. The chapter is written from an economic history perspective to manifest an improved understanding of the role of the state since independence and its ramifications in the current period.

The second chapter, coauthored by **R.C. Hess and G. Pomeroy**, concerns the geographic distribution of land trusts in the United States. Multiple variables such as spatial distribution of land trusts, the number of acres owned, acreage under conservation easement, and the total number of acres protected by all means by the various land trusts are considered for mapping and location quotient analysis. The third chapter in this part, co-authored by **Adil Mohammad Khan and Ishrat Islam**, addresses poverty reduction and social development in Bangladesh. The factors that explain the incidence of regional poverty are lack of electrification, urbanization, number of cooperatives, and industrialization. They suggest a stronger institutional mechanism to address the issue of spatial disparity and policy making. The last chapter in this part, by **Rameshwar Thakur and Swati Thakur**, addresses the topic of mineral resource potential and prospect in Chotanagpur region in eastern India. His analysis suggests that the region has suffered from resource depletion and environmental pollution although the region is endowed with abundant mineral deposits that can contribute to regional development.

The fifth part comprises three chapters under the rubric ecological perspectives of regional resources. The first chapter in this part, by **P.P. Karan**, is an in-depth study of the land, life, and environmental changes in the Himalayas. The second chapter in this part, coauthored by **Paul Robbins and A.K. Chhagani**, contributes to the debate on adaptive management of India's wildlife sanctuaries and suggests the opportunity for the practice of science, democracy, and conservation. The third chapter, jointly authored by **M.B. Singh and V.K. Singh**, describes the food consumption patterns among various ethnic and caste groups in Uttar Pradesh, India.

The sixth part contains nine chapters on water management encompassing issues such as water scarcity, groundwater, floodplain management, water development, and interstate water disputes in India. The first chapter, by **Rajesh Abhay**, utilizes the methods of Thornthwaite and Sullivan to measure water scarcity, alluding to their methodological merits and demerits. **Trevor Birkenholtz** investigates the relationships between groundwater decline and land use changes in Rajasthan. In particular, he highlights the role of markets and social institutions in agriculture decision making. The subsequent chapter by **Inder Jeet** utilizes a political ecological approach to investigate the factors that explain groundwater exploitation in Northwestern India. **G.K. Panda** addresses the impact of floods upon human vulnerability using a quantitative approach. He measures average risk of death and maps vulnerable districts in Orissa, India. The chapter by **Preeti Sachar** assesses water demand for growing various crops in different seasons in the Hindon basin located in Western Uttar Pradesh, India. The next chapter, by **John Sinclair, Alan Diduck, and Matthew McCandless**, alludes to the potentials and pitfalls of small hydropower development in the local areas of the states of Himachal Pradesh and Uttarakhand. The following chapter by **Narendra Rana** utilizes a conceptual approach to address the issue of floodplain management in the Rapti River basin. In a similar spirit, **Archana Gupta** in the subsequent chapter addresses the quality and quantity issue of groundwater, reduction in water table, and water harvesting techniques as a potential solution to recharge aquifers. The last chapter in this part, by

Nina Singh, examines interstate water conflicts in India and offers suggestions for a National Water Commission for mitigating conflict resolution among the States.

The seventh part comprises three chapters around the broad theme of energy and forest resources. The first chapter, by **Jitender Saroha**, examines the nonconventional energy resources in India and further evaluates the achievements, constraints, and measures to reduce gaps between potential and achievements. The next chapter, by **Punyatoya Patra**, examines the concept, characteristics, and perception of joint forest management in India. The last chapter in this part is written by **Ramashray Prasad** and covers community forest and its management in Bhutan.

The last part of the book contains three chapters on land use, land cover, and rural planning. The first chapter, authored by **Risa Patarasuk**, examines the land cover pattern and its distribution along road types in Thailand using the Geographic Information System and remote sensing technology. The change in land cover and loss of forests is a major contributor to local and global environmental change. The second chapter, by **Darin Khongsatjaviwat and Jayant Routray**, examines rural development planning issues in Thailand. The final chapter by **Ravi Singh** concerns with the study of patterns of land use and agricultural change at the district level. There is a need for state intervention as the rural areas are not fully monetized and integrated into the market system, and several constraints affect agricultural development.

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Chapter 2
Baleshwar Thakur: Professional Career and Contributions

Sudhir K. Thakur, Ashok K. Dutt, Allen G. Noble, Frank J. Costa, Rajiv R. Thakur, and Hari S. Sharma

Professor Baleshwar Thakur, 2013

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Abstract This chapter is a discussion of the growth, evolution, and contribution of Baleshwar Thakur (B.T.) to Indian geographic research. He is a doyen among Indian geographers and has been an acclaimed teacher, scholar, and administrator throughout his illustrious career of four and a half decades. He made immense contributions to the discipline and strived for its popularization both within and outside India. His research career can be divided into two phases: 1964–1980 and the post-1980s. During the first phase he was interested in understanding the long-term processes of urbanization in its regional context in developing countries, focusing on India, using quantitative methods. After accepting the position of Reader in Geography at the University of Delhi, his interests shifted to the study of natural resource management and the history of Indian geography, although he pursued his interest in urban geography as well. His contributions during the past five decades can be subdivided into four broad areas: urban geography, quantitative geography, natural resource management, and history of Indian geography. He continues to be actively engaged in research and publications, and his contributions serve as a model for young Indian geographers aspiring to become scholars.

2.1 Background

Baleshwar Thakur (B.T.), nicknamed '*Bale*' by his parents, is a doyen among Indian geographers. He has worn several hats with distinction and has been an acclaimed teacher, scholar, and administrator throughout his illustrious career of four and half decades. He is among the selected few Indian geographers who transcend the parochial boundaries of academic pursuit. He can be characterized as an erudite knowledge seeker and as a disseminator of knowledge to those who are passionate about learning and understanding the world through the lens of a perceptive geographer. He transmitted immense affection to his students and served on the graduate committees and doctoral dissertations of several dozens of students at Patna and Delhi University. He has an insatiable passion to push the frontiers of academic knowledge beyond its boundaries. Although he retired from the University of Delhi in 2008, yet he spends hours reading journals, engaging in research, visiting the Ratan Tata library at the Delhi School of Economics (DSE), University of Delhi, and meeting with students to advise them on their research projects. His commitment and dedication to research shows that one can retire from a university position but not give up academic life. Throughout his long career, he has been very much a field geographer and has traveled in every nook and corner of the Indian subcontinent.

B.T. was born on July 16, 1943, at Sarabey Village of Madhubai District in North Bihar, in a working-class family. He is the second among three siblings. His father and uncle were influential in his early education that led him to obtain a first place in his matriculation (tenth grade) examination. He received his early school education at Khajauli and his intermediate education at R.K. College, Madhubani, affiliated with Bihar University. In 1960 he was placed in the top ten merit list for his

excellent performance in undergraduate studies. During his undergraduate studies, the late Professor Arun K. Dutt (Principal of R.K. College, Madhuhbani, and uncle of the senior editor of this volume, Professor Ashok Dutt) recognized his academic performance and provided a scholarship for his higher education.

2.2 Education and Academic Career

Dr. Thakur obtained first class in both his B.A. Honors (1962) and M.A. (1964) in geography from Patna University, where he was awarded the Merit Scholarship and National Scholarship in Humanities. Soon after completing his master's degree he obtained his first employment as a Lecturer at Ranchi University, in 1964–1965. Simultaneously, he started preparing for the coveted Indian Administrative Service (IAS) examination. One fine morning a chance event changed his trajectory forever. A young and astute professor of psychology (Dr. Jaiballav P. Sinha), who had returned from The Ohio State University in 1965 after obtaining a doctoral degree, convinced the young B.T. of the excellent and world-class academic programs in geography in American universities, and the resulting contribution one could make to knowledge after receiving training from such an acclaimed program. These thoughts mesmerized the young and ambitious B.T., and the very next day he disposed of all the books related to the IAS examination and started applying for a graduate fellowship and admission to academic programs in North America and Great Britain. Professor Ashok Dutt was instrumental in advising and writing recommendation letters for admission to graduate programs in North America. Finally, he was awarded a Commonwealth scholarship to attend a Canadian university and studied for a second master's in geography at the University of Waterloo, Canada, during 1970–1972. He took courses with distinguished urban geographers and resource management specialists. It was there that he became acquainted with Professors Richard E. Preston, Lorne H. Russwurm, and Bruce Mitchell. He worked with the late Professor Lorne H. Russwurn, who became his graduate advisor. At Waterloo University he completed path-breaking work on the topic of hierarchically structured urban places over space and time in southwestern Ontario's complex hierarchical regional systems. This research on urban system dynamics was published in the *Canadian Geographer* journal in 1981 with his advisor as coauthor. Later, he obtained his Ph.D. degree from Patna University, in 1978, on "Entropy Analysis of Changing Urban Patterns in Eastern India" under Professor P. Dayal, former Vice-Chancellor of Magadh University, Bihar. During the 1970s and 1980s his research focused on the long-term processes of urbanization in its regional contexts in developing economies, especially in India.

Subsequently, he was a Visiting Fulbright scholar at the University of Akron, United States (USA), in the summer of 1992 and a Visiting Professor in 2000, where he had the privilege of working under the tutelage of Professor Ashok K. Dutt on "Urban Structure and Processes in India." Professor Ashok Dutt would often introduce B.T. to his colleagues, students, and friends as his 'first-generation student,' as

he was indeed his teacher at Patna University during 1960–1962 at the undergraduate level. Further, he has guest lectured at the Geography Department, University of North Dakota, in Grand Forks, USA, during spring of 2005. His epistemological foundations have been influenced by illustrious luminaries in geography, both in India and in North America, such as L.N. Ram, P. Dayal, A.K. Dutt, A.G. Noble, F. Costa, R. Ramachandran, R.P. Misra, Savitri G. Burman (late), A.B. Mukherji (late), V.K. Verma, Gerard Rushton, and Bruce Mitchell. In the past two decades he has cherished his association with the "Akron school of geography and planning" (Thakur 2012b) through which he worked on several book projects and scholarly works with his colleagues at the University of Akron, Ohio (USA).

B.T. was hired as a lecturer in geography at the University of Ranchi (1964–1965) and Patna University (1965–1980), respectively. He relocated and accepted the coveted position of a Reader in Geography at the prestigious and very illustrious Delhi School of Economics (DSE), University of Delhi (1980–1990); then was Professor of Geography, University of Delhi (1990–2005); and was reemployed as Professor of Geography, University of Delhi (2005–2008). He was a Commonwealth Research scholar at the University of Waterloo (1970–1972) and Fulbright Visiting Scholar at the Department of Geography and Planning, University of Akron (1992). He was invited as Visiting Professor at the University of Akron (2000) and Guest Speaker at the Department of Geography, University of North Dakota (spring 2005). He was the Shastri Indo-Canadian Fellow, Department of Geography, York University, Toronto, Canada, during 2004. He was the recipient of several awards and honors, such as University Grants Commission Awards (1969, 1976, 1986), Distinguished Scholarship Award, Regional Development Planning Specialty Group of the Association of American Geographers (AAG) at Washington, D.C. (2005), and Bhoovigyan Samman by Bhoovigyan Foundation, Delhi (2005).

He was ambitious, determined, and truly committed toward achieving the highest accolades in higher education, and worked hard to reach the highest echelon in higher education. He earned a professorship in one of the most reputed institutions of higher education in Asia: the Delhi School of Economics. Although he spent a major part of his academic career living and working in urban areas, his heart was rooted in understanding the rural sector of India. He never missed an opportunity for visiting the rural areas of his home state and thinking about issues pertaining to resource development and the emancipation of the marginal populations of Indian society.

B.T. has been a devout 'Guru' in the proverbial sense of the term and has been a mentor to several generations of students at Ranchi, Patna, and Delhi University. As a mentor, he was conscientious and thoughtful and put much effort into preparing his lectures. His courses had very current readings on the topics of discussion and included readings from cognate fields as well. He had a remarkable ability to appreciate and expose students to alternative debates on the topic, particularly in his conceptual developments in geography courses. He has been an excellent teacher who meticulously prepared his lectures before entering the classroom. He motivated students to do research and spent countless days, months, and years to train them in their research endeavors. His energy, enthusiasm, generosity, and strong commit-

ment to graduate students have produced many budding professionals during the past four decades.

His published works are rich in both ideas and empirical data. Many of his publications were coauthored with younger colleagues and graduate students whom he advised over the years. His students and younger colleagues have been strongly influenced by his inspiration and guidance, and they received an exemplary influence in the pursuit of knowledge. Several of them followed the academic path of going abroad to North American and European doctoral programs to continue seeking higher education and then held academic positions in the USA, Canada, Europe, and Australia. Several others accepted teaching positions at home in regional and national universities. Many of the students competed for coveted positions with the government and in private sectors.

B.T. has accomplished 44 years of teaching and research experience at Ranchi, Patna, Waterloo, Delhi, Akron, and North Dakota. He successfully supervised 21 Doctoral dissertations, 35 Master of Philosophy dissertations, and 62 Master's theses. He was associated with teaching and research at the Department of Geography, Delhi School of Economics, for the longest duration of his career, approximately 28 years (1980–2008), and was the Chairman of the Department during 1996–1999. Later, he also served as the Vice-Chancellor of L.N. Mithila University in Bihar during 2001–2003.

He has been passionate about acquiring knowledge, and his home in Delhi is a testament with the most current research books in geography and social sciences. He spent most of his career engaging in intriguing discussions with his students regarding their research and with colleagues on the frontiers of geographic research. He has a strong interest and an understanding of the philosophy and methodology of geographic debate, enabled by the cerebral power that allowed him to remember details of what he observed, read, and synthesize. He has a phenomenal ability to think systematically, juggling through multiple complex variables and analyzing the cause-and-effect relationship of a spatial phenomenon. During conversations he would often cite references with intricate details. His success can be attributed to the sacrifice, dedication, and congenial atmosphere provided and nurtured by his wife Chanda Thakur. Most of the visitors at his home are students of geography and colleagues who are engaged in the business of promoting the knowledge sector across various disciplines. During visits by students and colleagues, his wife Chanda would provide excellent cuisine, snacks and delicacies in the *Maithili* tradition, which made the academic conversations irresistible, tempting, and oftentimes jovial.

Those who believe in genetics might attribute his influence on his children in pursuing an academic career in geography and related disciplines. His elder son Sudhir earned a doctorate in geography from The Ohio State University and is currently an Associate Professor in the College of Business Administration, California State University, Sacramento; his younger son Rajiv earned a doctorate in geography from Indiana State University and is an Assistant Professor at the University of Missouri State University in Geosciences. Similarly, his elder daughter-in-law, Rajrani Kalra (also his former student at the University of Delhi), earned a doctorate