

Water Resource Economics: Towards a Sustainable Use of Water for Irrigation in India. M. G. Chandrakanth, Springer, New Delhi: 2015. xli +212 pages. ISBN 978-81-322-2478-5, ISBN 978-81-322-2479-2 (eBook), DOI: 10.1007/978-81-322-2479-2.

The book under review is a timely and most comprehensive assessment of water and its use in agriculture. The author of the book, Chandrakanth, has done a remarkable job of weaving the hydrological, economic and institutional aspects of water use into a meaningful and complete product. He urges economists to elevate the status of water from a myopic 'factor of production' to a more holistic 'resource' (p. 4). This rebranding of water allows us to recognize the interplay of multitude of hydro-economic factors, which ultimately influence the origin, delivery and sustainable consumption of irrigation water. Unlike other factors of agricultural production, extant water use on a farm has sustainability implications for other users of water in the current time (through well interference and reciprocal externality) as well as implications for one's own use in the future (through scarcity and user costs). Throughout the book, the suggestion to internalize the irrigation-imposed reciprocal externality and users' cost has enhanced the role of water use in agriculture far beyond its traditional role. The author reminds readers that the existence of these additional costs raises more questions about the ability of private markets and water governance institutions to accurately reflect the true value of agricultural water use, and in turn, to achieve efficient and equitable water use for irrigation.

Furthermore, water use problems in a developing country like India are rooted in the fundamental notion that water is simply 'an essential resource which is required by humans, livestock, wild animals and all the flora and fauna' (p. 11). There is no room for considering 'wise use' of water; it is inconceivable to price water based on its future scarcity or value from non-human uses. The simple rule of the game is for each individual to exploit water at one's own access till the immediate and essential need is met. Chandrakanth calls for a fundamental change in this basic understanding through improved literacy and governance structure.

What I find interesting about the book is that it has new information and insight for both economists and hydrologists. Drawing from the analogy of the 'Six Blind Men and an Elephant', Chandrakanth reminds readers that the water use problem is viewed differently from different stakeholders (p. 16). Therefore, the water use decisions and solutions to its scarcity are limited by each user group's inability to understand the complexity of the entire hydro-economic system. There is a good deal of discussion on the hydrological processes underlying groundwater extraction, cone of depression, well interference and well failure. Resource economists should find this extremely valuable in sharpening their understanding of the hydrological reasons which externality emerges in the first place from, and why water is a resource, not just a factor of production (chapter 2). Similarly, hydrologists, water engineers and resource managers will find valuable insight on why the exploitative nature of water harvesters is a collective outcome of the inefficient existing markets and institutional process. Chapter 3 describes the nature of externality in irrigation agriculture, a classic market failure problem. Moving toward a more sustainable agricultural irrigation would require policy changes that ensure improved water use efficiency both temporally and spatially. For students interested in agricultural irrigation, this is a one stop reading where they find a comprehensive set of concepts, theory, practical examples and case studies, and policy solutions to agricultural water use problems.

Sand mining (chapter 4) is a stark reminder of yet another urban-rural conflict. Rampant development in metropoli-

tan areas such as Bengaluru, India, has created a quantum jump in the demand for sand. Chandrakanth estimates the price elasticity of demand for sand at -0.88 . This price inelasticity is not a good news for agriculture. As the urban demand for sand continues to surge, the rate of sand mining in the nearby riparian areas increases, causing reduction in groundwater recharge, changes in cropping pattern and attendant economic losses in agriculture.

Chapter 5, although a bit scattered, stresses the importance of securing groundwater recharge from rainfall. Geologically speaking, with 65% of the country being situated on hard rock (with states like Karnataka, 99%), the groundwater recharge rate tends to be naturally low. With some insightful example, the author illustrates the severity of the exploitative nature of the current extraction practices. Farmers' education and appropriate water use policies become even more essential in hard rock regions than other places. Readers unfamiliar with fundamental concepts and tools in water resource economics will find chapters 6 and 7 useful to gain better understanding of the practical applications of these tools as well.

Chapter 8 explores the economic consequences of well interference for the value of irrigation water. As the number of wells and the rate of well failure increase, the cost of water increases and its value decreases. Chapter 9 presents the contrasting characters of conventional and drip irrigation systems for various crops in terms technical efficiency and marginal values of irrigation. The comparison is based on empirical estimates, and therefore, provides policy-relevant insights. It is further noted that the rising water scarcity has pushed farmers to become more water efficient by adapting drip irrigation. While initial establishment costs are higher for drip irrigation system than for the traditional system, the former is more efficient than the latter and has become a necessity in the midst of growing water scarcity.

Chapter 10 gives the estimates for the economic contributions of various watershed development programmes in Karnataka, particularly *sujala* programme. Chapter 11 is an extensive discussion of water markets and how various factors, including cropping pattern, irrigation system, institutions and market transactions govern the efficiency of water trade

among farmers. The chapter is replete with empirical estimates of value of irrigation water under various agro-climatic and cropping conditions, yielding useful policy insights.

Chapter 12 is for advanced readers with background in dynamical mathematical modeling. With this approach Chandrakanth demonstrates that failure to consider the user costs of current water extraction will lead to sub-optimal exploitation of the resource. He further argues that this myopic approach not only leads to economic inefficiency, but also to intergenerational inequity. Like in the previous chapters, he develops empirical application of the theoretical model for underground aquifers that are recharged by tanks and canals. Comparing the time paths of water table, harvests and net revenues between extraction decisions with and without user costs should sharpen the readers' understanding of the inefficiency arising from myopic water use decisions.

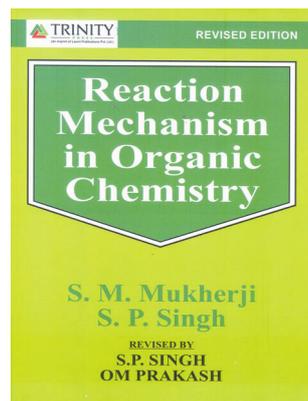
Chapter 13 gives a good account of various regulatory- and incentive-based policy options for increasing water use efficiency and minimizing reciprocal externality. The author identifies existing institutional and policy failures that continue to pose threat to sustainable water use and food security in irrigated agricultural belts of India. Among other policy failures, the author is particularly concerned about the poorly informed electricity subsidy policy, which serves as a perverse incentive and promotes over-exploitation. A more sustainable policy would entail equitable and selective subsidy rather than universal entitlement given to farmers irrespective of their income and wealth categories. The water use decisions must be made on *right* value of water that takes into account more objective water budgeting and external costs. The success of such policy implementation requires proper education of farmers on various aspects of water that transcend the boundary of their farms and the immediate future.

The readers should not mistake the book for one that is applicable to a small geographic region of the world. The hydrological concepts, empirical analyses and policy discussions found in this book could very well be applied to agricultural water use decisions and policies in other parts of India and even other

parts of the world with suitable adjustments.

MAHADEV G. BHAT

*Department of Earth and Environment,
Florida International University,
Modesto Maidique Campus,
Miami, FL 33199, USA
e-mail: bhatm@fiu.edu*



Reaction Mechanism in Organic Chemistry, Revised Edition. S. M. Mukherji and S. P. Singh (revised by S. P. Singh and Om Prakash). TRINITY Press, An Imprint of Laxmi Publications Pvt Ltd, 113, Golden House, Daryaganj, New Delhi 110 002. 2015. xiv + 705 pages. Price: Rs 595.

Anyone who has been involved with teaching science to undergraduate students in India, especially those in the rural areas, would be familiar with the students' greater liking and familiarity with text books that are written by Indian authors. The book *Reaction Mechanism in Organic Chemistry* has, for over four decades (since 1976), been one of the most popular books for aspiring undergraduate organic chemistry students of India. The revised edition (2015) of the book is an essential and apt update of the principles in this field. At its core, understanding organic chemistry is about understanding the mechanisms of organic reactions – thoroughness of which is both necessary and sufficient for creative exploration. This book attempts to serve this purpose through systematic (i) definition of principles, (ii) crisp discussions, and (iii) problem sets; on 14 chapters – including chemical bonding, stereochemistry, reaction intermediates,

different reaction mechanisms, reactions of carbonyls and aromatic rings, molecular rearrangements, photochemistry and pericyclic reactions. The chapter on stereochemistry is new in this edition and attempts to correlate well, the spatial relationship among reacting atoms with the rates of those reactions. Succinct updates on the stability and reactivity of carbocations – including neighbouring group participation, nonclassical cations – have been made. The new presentation on Curtin–Hammett principles and the Hammett and Taft equations is clear with concise mathematical explanations – to the benefit of even an average organic chemistry undergraduate. The new discussions on photochemical oxidative coupling, isomerization and substitutions of aromatic compounds, are simple and informative. Apart from these additional discussions – including on hydrogenation reactions, cheletropic reactions – explanations are brief with self-explanatory reactions. The book is admirably indexed and contains clear images, covering most of the topics relevant to undergraduate level organic chemistry. Apt reaction schemes, energy profile diagrams and figures with precisely informative labels, supplement the discussions in all chapters. Additional reading materials are aptly suggested in each chapter. Barring the spelling errors in a few places and the significant brevity in discussion of certain principles, the new edition maintains the *Dictionary* nature of the first edition and serves as an appropriate update. The simple English and brief presentations of the principles in reaction mechanisms in organic chemistry, will continue to suit those preparing for competitive national examinations such as GATE, CSIR–UGC–NET, as it has done over the last 4 decades. Overall, this book accomplishes the challenging task of describing most fundamental aspects regarding reaction mechanisms in organic chemistry in a single book and is an excellent guide for an undergraduate student in this field.

E. N. PRABHAKARAN

*Department of Organic Chemistry,
Indian Institute of Science,
Bengaluru 560 012, India
e-mail: erodeprabhakaran@gmail.com*