BOOK REVIEW

Universalising Food Security

Madhura Swaminathan*

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Glenn Denning, *Universal Food Security: How to End Hunger While Protecting the Planet*, Columbia University Press, New York, 2023, pp. 425.

Glenn Denning's book stands out for its focus on *universal* food security, that is, for the recognition of food security as a universal human right. A second distinctive feature of the book is its emphasis on science-based transformation of food systems (the author started his career as a soil scientist). The third feature of the book is that it recognises that the achievement of universal food security will be a complex process, requiring the participation of and cooperation between diverse sections of society. The book is a call to young people to engage in the challenging task of transforming food systems and establishing universal food security.

The first section of the book has two chapters, the first on mid-20th century Malthusian prophets of doom, and a second on the answers given by the Green Revolution to these doomsayers. Denning emphasises the point that the Green Revolution benefitted not only producers, but also consumers, rural and urban, who gained as cereal availability rose and real prices for rice and wheat fell.

In telling the story of the Green Revolution in Asia, Glenn Denning draws on insights from his tenure at the International Rice Research Institute (IRRI). Take for example his experience in Cambodia, where the brutality of years of bombing by the United States was followed by years of brutality imposed by the Khmer Rouge. Agriculture began to recover in Cambodia after the Vietnamese deposed the Khmer Rouge. The IRRI played a critical role in improving rice production and bringing back the diversity of rice crops that had been lost during the war years. A salient aspect of IRRI's support was building local scientific talent and infrastructure (in line with the emphasis of M. S. Swaminathan, then Director General, on the need for strong national research systems). Fast forward to this century, where a Cambodian rice variety, Phka

* Professor, Indian Statistical Institute, Bengaluru, madhuraswaminathan@gmail.com

Rumduol, has been selected four times as the "world's best rice" by the Rice Trader World Rice Conference!

As an economist, I learned the most from the second section of the book, especially from the excellent summary of current scientific knowledge on issues concerning three core requisites of food production – soil, water, and seeds.

Let me describe the author's approach using the example of soil. The chapter educates a layperson on soil taxonomy, soil fertility, and principles for improving soil fertility including that of "synchrony," the principle that "aligns soil fertility management to the growth pattern … and nutrient uptake of plants." Nutrient-use efficiency, using this principle, can be improved by linking the availability of nutrients in the soil to the specific stages of growth of the selected crop.

The discussion on nitrogen, "the mineral nutrient that most often constrains food production in both tropical and temperate regions," is an example of the balanced scientific approach running through this book. There is little doubt that the use of synthetic nitrogen fertilizer was critical to the observed growth of food production globally. It is as important to recognise the negative environmental effects of excessive nitrogen use, such as groundwater contamination, eutrophication of fresh water, and global warming. Today, there is clearly need to modify nitrogen use practices to halt and even reverse the observed environmental effects.

Here, Denning recommends using the idea of agronomic efficiency (ratio of increase in yield to fertilizer use) developed by Pedro Sanchez rather than nitrogen use efficiency (ratio of crop yield to fertilizer use). Agronomic efficiency can be raised by following the principles outlined in the chapter. These include ensuring nutrient balance (based on Liebig's law of the minimum), ensuring synchrony (in terms of timing and calibration of application) and nutrient cycling (such as through crop rotation, use of manure, etc.) In other words, changes in agronomic practices (involving new technology) can both reduce the quantity of nitrogen fertilizer applied and the cost to the farmer while ensuring a higher yield.

Biological nitrogen fixation, particularly by legume crops, is often recommended as an alternative to the application of chemical fertilizers. Denning gives examples from his experience of growing legume crops as intercrops (forage legumes between rows of cassava in Bali, for example) or as rotation crops, practices that can improve soil fertility. However, legumes cannot be used "as the solution for all places and all times." For example, when soils are deficient in other nutrients such as phosphorous, nitrogen fixation is limited. Growing legume crops has its own opportunity costs. For example, land from other uses was diverted to planting nitrogen fixing trees and shrubs in Africa. And, not all legumes fix atmospheric nitrogen. The use of chemical fertilizers or other alternatives ultimately depends on the context (the existing nutrients in the soil, for example).

The following chapter on water resources discusses water use especially in irrigated farming and the requirement for sustainable irrigation in the future. In finding solutions such as better water management practices or increased water productivity, Denning underlines the role of new technology but also recognises that there will be trade-offs that need to be discussed transparently in making choices.

The chapter titled "Seeds of Life" takes us through the story of genebanks, biodiversity, and genetic improvement leading up to the Green Revolution in rice in Asia and the hybrid rice revolution in China. I found a very useful discussion on conventional breeding methods as compared to breeding based on transgenesis and cisgenesis (or gene-editing). The example of golden rice or rice genetically modified to increase the Vitamin A content is a constructive addition to the standard discussion on GMOs. As Denning points out, Greenpeace actually withdrew its campaign against Golden Rice in response to a letter by 150 Nobel laureates who questioned campaigns "based on emotion and dogma contradicted by data (p. 116)." In July 2021, Golden Rice was approved for commercial production.

The third section of the book lays out a strategy for ensuring universal food security. Denning identifies five areas of investment (the "Big Five") in this regard: sustainable intensification, market infrastructure, post-harvest stewardship, healthy diets, and social protection.

The premise of the chapter on sustainable intensification is that enhancing and ensuring regular food supply is a prerequisite for universal food security, and that increasing production through extensive methods (or expansion of area cultivated) is not feasible. Indeed, expansion of arable land is likely to result in loss of forests and biodiversity even further. Denning is very clear on the trade-offs involved. Intensification can have environmental effects such as biodiversity loss, but "we cannot feed ten billion people without an environmental footprint" (p. 195). Sustainable intensification involves understanding and minimising these tradeoffs. In practice, sustainable intensification will differ in different contexts: it may involve more scientific water use; it may involve new seeds to bring in higher yields under situations of abiotic and biotic stress; it may involve irrigation of previously unproductive land, and it may require changes in post-harvest methods to increase the actually utilised output per unit of land. The chapter on post-harvest stewardship is thus an important companion chapter, discussing ways of ensuring quality of food, and reducing waste and losses in the supply chain.

There is much more to this book that I will leave the reader to discover. The book provides clarity on many contemporary debates in agriculture based on the latest scientific evidence. It is easy to read, as technical matters are interspersed with examples and anecdotes from the author's life and career. I recommend this book to scholars and to activists and policy makers in the field.