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BOOK REVIEW: Stuart Smyth, Peter W.B. Phillips, William A. Kerr, and George G. Khachatourians. *Regulating the Liabilities of Agricultural Biotechnology.* Cambridge, MA: CABI Publishing, 2004, xiii + 210pp., $85 hardcover. ISBN 0-85199-815-1.

Regulating the Liabilities of Agricultural Biotechnology offers an in-depth view of the current and emerging trends related to the regulation of and liabilities from producing and marketing genetically modified foods. Collectively, this book's four University of Saskatchewan authors have been involved in researching agricultural biotechnology since its inception. Their book divides the issues related to the complex nature of biotechnology liabilities into four key parts: (*a*) an analysis of the current situation, which includes an introductory discussion of liability and agriculture; (*b*) a "diagnosis"; (*c*) a current "prescription"; and (*d*) a "prognosis."

The authors introduce the concept of liability and transformative technologies in their first chapter, with an ensuing discussion of chaos. "Chaos" is an appropriate term here because there is great potential for these technologies to change our lives in ways not yet known, and continuation of the rapid emergence and adoption of these technologies is likely. Although it is true these changes may create misgivings for consumers, entrepreneurs, however, may find them full of opportunities.

While technological advancements in agriculture over the past 80 years have come through machinery, chemicals, and genetics, the authors argue it is genetics that may have fundamentally changed the industry. As the centerpiece of this book, liability from the production and marketing of transgenic crops is currently an evolving concept. Undoubtedly, agricultural producers and marketers will continue to face new issues related to that liability in both the near-term and long-term future.

A brief history of these transformative technologies is offered by the authors. Only 30 years ago, recombinant DNA was identified, allowing for developments leading to the first commercial planting of a GM crop—tobacco—in China in 1992. Shortly thereafter, the first commercial acreage of a GM crop for food was established in 1994 with Calgene's Flavrsavr™ tomato. Although this product was a commercial failure, other crops like cotton, canola, potatoes, and maize followed in 1995. The number of GM crop types continues to grow as an increasing number of transgenic fruits, vegetables, spices, and flowers are being granted regulatory approval.

The United States, Canada, and the European Union have reacted differently to this new technology. In North America, some estimates indicate that nearly 70% of all processed foods have genetically modified food incorporated into them (a number which shocked me initially). In the United States in 2003, over 80% of the soybeans grown were transgenic. The release of these transgenic crops has created a split in agriculture. One can see elements of this split when examining the North American organic market where the fear is that if transgenic seeds are detected in organic shipments, then export

markets will be jeopardized. According to the authors, it is these types of splits that give rise to the potential liabilities of transformative technologies.

The analysis of agricultural biotechnology liability is framed in an institutional setting. The authors build on the work of Picciotto (1995), who examined some of the institutional fundamentals required for successful international development projects. That methodology is used to first define the institutional actors in biotechnology and then to demonstrate how they interact. These actors are identified as (*a*) the regulatory agencies, (*b*) the private firms, and (*c*) the civil society.

The authors' "diagnosis" comes with a closer examination of liability and agriculture. With civil liability as the focus, the authors address issues such as negligence, strict liability, nuisance, trespass, and pollution. I believe the existing case law identified in the book reveals how far we have yet to go in terms of being able to successfully deal with the rapidly developing challenges related to the production and marketing of biotech crops. Before reading this book, I had hoped that some of the major issues noted above had already been resolved, but this seems not to be the case. For example, the authors' illustration involving proving trespass or nuisance (Hunter v. Canary Wharf Ltd., 1997) appears to be a standard that will not be in favor of producers claiming damage to their crops from GM pollen. Case law relating to strict liability (Rylands v. Fletcher, 1868) is analyzed several times in an attempt to determine how the courts might view liability coming from the production of GMO crops, and the results seem mixed.

As with most transformative technologies, technological advancements typically outpace the ability of government to regulate them. An inherent complication associated with these new biotechnologies is that the level of risk cannot be known with certainty due to the fact that complete scientific information may not be available. This creates difficulty for those attempting to manage the liabilities that might be generated as a result of the production and marketing of GM products. The authors apply Kuhn's paradigm—i.e., the process by which a science is born and undergoes change and development—to agricultural biotechnology. Kuhn's paradigm of knowns and unknowns is used to demonstrate the effects of policy and liability implications on the institutional actors. The authors use rBST, BSE, and cross-pollination as examples in illustrating how this paradigm works. It is presumed that once these knowns and unknowns are delineated, they can be acknowledged and debated by policy makers, regulators, and even courts. However, since emotion and rhetoric are often more influential than objective data, it will still be difficult to identify risk and adjudicate liabilities.

In Part III of the book, the authors begin with a discussion of the regulatory issues involved in dealing with a new transformative technology in the agricultural industry. The obvious goal of this type of regulatory system should be to reject unsafe technologies and allow safe ones to enter the market. They go on to offer a brief review of the scale and scope of the new transgenic technologies that have been introduced into developed and developing country markets, and examine various theoretical approaches to understanding risk analysis.

The "current prescriptions" discussion is continued by describing how international institutions operate and how they react to change. According to the authors, the World Trade Organization (WTO) and the BioSafety Protocol (BSP) appear to be the two competing international organizations that will be the primary regulators of biotechnology.

These institutions are voluntary and generally react slowly to change. Consequently, it is predicted that it will be some time before an international liability regime for biotech products emerges, leading to less than smooth international relations over the regulation of these products in the foreseeable future.

The potential for biological mechanisms to control GM liabilities is discussed as well. Much of the economics literature on the gains from GM technology has acknowledged the potential for "externalities" that could reduce the net value of these technologies. GM crop liabilities stemming from gene flows can come from seeds left behind during harvest or from pollen flow. The authors argue that these genetic use-restriction technologies ("terminator genes") provide some advantages by first acting as built-in safety mechanisms to prevent the escape of potentially harmful traits from new GM crops. Second, they could prevent pirate growers from exploiting GM seeds and compounding risks, and third, they might reduce the liabilities assigned to the seed growers by preventing contamination with nontransgenic crops.

The authors conclude their discussion of current prescriptions with supply-chain responses to liability and product differentiation strategies. Given the tenuous public perception of GM products, consumers clearly need to be able to trust the systems that bring these products to them. This gives rise to the need for identity-preserving production and marketing (IPPM) systems. The authors state that the ultimate question facing the industry is whether it makes any economic or commercial sense to develop (IPPM) systems to serve the GM-free or other differentiated food markets. This is "where the rubber meets the road," and there seems to be limited information on the costs of such systems.

The system requirements for input traits as well as output trait technologies are also discussed, to give an idea of the scope of changes we are confronting. New supply chains have created closer relationships among participants along the chain for these new GM products. The authors provide a review of the evolving systems that allow for identity preservation, traceability, and segregation of the new differentiated products created by the biotechnology. These systems are seen as bridging the gap between the old system of food production that delivers homogeneous commodities and the new differentiated products desired by consumers. For years, the focus in production agriculture has been on producing homogeneous products that reduce production and marketing costs. Now the question has become: For what product characteristics are people willing to pay premiums, and how can we deliver these product traits? The authors conclude that efficient use of product differentiation systems can contribute greatly toward the reduction of potential liabilities, thus making these systems cheaper than the alternative of failure. They also note that on-farm assurance seems to be one potential area of weakness—having contributed to the StarLink™ maize failure and thought to have challenged the Monsanto and Aventis systems for HT canola.

The book's final section, the "Prognosis," discusses issues related to the liabilities of plant-made pharmaceuticals and the challenge of handling the liabilities created by the utilization of transformative technologies. The chapter on plant-made pharmaceuticals demonstrates there may be substantial non-food value in these biotechnologies. The Rylands v. Fletcher case is revisited in this section of the book. As asserted by the authors, a strong argument could be made that these crops are not naturally occurring,

and the pollen flow from these transgenic crops may be foreseeably inherently dangerous. The rationale they give is that production of these crops might lead to the presence of pharmaceutical genes in crops destined for human consumption which might be inherently dangerous. Such a scenario presumably would lead to different outcomes in the courts.

Where do we go from here? The approach taken with traditional incremental technologies has been to do nothing; however, this strategy is unlikely to be optimal. The authors suggest an alternative approach is to implement a multi-stakeholder strategy, engaging the various groups in a constructive way, not mobilizing them, and with the public sector having the most important role. The government needs to make fundamental contributions to the system—specifically, it should provide the rules that underpin the system. According to the authors, the greatest threat to the public good comes when the private interests are allowed to have opaque political or administrative systems and then exploit their position to benefit themselves or their counterparts. Thus, creating transparent and accountable structures that deliver credible, predictable, appropriate decisions about technologies and products would protect the public health and environmental safety. Finally, the authors argue that to limit the liabilities associated with new transformative technologies, both the public and private actors need to become more open to engaging with the appropriately structured collective actors.

Overall, I found this book to be informative about the fast-paced developments within the biotech industry as it relates to agriculture. The information provided in the book's latter chapters regarding the supply-chain responses to liabilities and product differentiation strategies would be especially insightful for those interested in the areas of agricultural marketing and international trade. With its detailed discussions on the many problems now facing the food industry related to the production and marketing of genetically modified crops, this book would also serve as useful reading for graduate courses in agricultural economics.

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