

BOOK REVIEW

The Gene Hunters: Biotechnology and the Scramble for Seeds by Calestous Juma, Princeton, N.J., Princeton University Press and London, Zed Books, 1989, xiv + 288 pp.

I

This book examines the role played by biotechnology in the socioeconomic evolution of Africa. Since U.S. scientists successfully cloned the gene in 1973, a great number of books and articles have been published on the advances in this field, but genetics-related studies connected with the economic evolution of the Third World and with Africa in particular, such as this one, are extremely rare. The book is not merely a regional study. Juma first traces the history of botany from the early days of Egyptian civilization down to the rise of U.S. agriculture. He then looks at agriculture on a global scale and scrutinizes the significance of the Green Revolution after World War II, the activities of the world's leading seed companies, the formation of the international network of gene banks, and the impact of the patent systems in industrialized countries on the Third World countries. Following these introductory chapters, it becomes evident in the remainder of the book that the chief aim of the author is to recast Africa's image by emphasizing two of the primary sources of agricultural growth: genetic resources and related technologies, and the necessary institutional innovation to support these technologies.

In the same way that earlier plant hunters introduced exotic genetic resources into the various parts of the world, the advances in biotechnology made by the gene hunters of today are likely to have a strong impact on the world economy. It is the agricultural sector which will experience some of the earliest effects. Considering the fact that in the 1970s the decline in the level of nutrition was observed only in Africa, it is quite natural that African countries would respond quickly to the new impetus brought about by the recent achievements in the modification of plant life. These are changes which have imposed new challenges on the African economies. Juma ascribes recent ecological and economic crises in Africa to the existing development policies and the prevailing economic theories upon which they are based. He proposes "a shift from dependence on economic advisers and planners who still accept moribund economic theories that fail to take into consideration long-run social and economic dynamics" (p. 4). He emphasizes that the introduction of new genetic materials and the related technology into the economic systems have caused discontinuity in production methods and reorganization of the existing social relations. Thus, the approach that he adopts is quite different from that of the modern economist.

Compared with mechanical technologies, which are highly visible and tangible, the potential of genetic resources hidden in plant material is less conceivable and its impact is obscure. Since people have long taken for granted the widespread contribution of genetic resources, they have hardly noticed such problems as the loss of biological diversity. Also long ignored by Western historians has been the effects of the introduction of new genetic resources and related technological know-how into the economy.

However, the author stresses very strongly the significance of the historical contributions of these resources and technologies. He points out that they helped Britain build its empire and were used to build the agricultural economy in the United States that now stands unrivaled. By contrast, the purging of geneticists in the Soviet Union reduced the potential contribution they could have made to the agriculture of that country. But Juma is not a genetic-determinist. Rather he attaches great importance to the social changes related to genetic resources.

II

The global distribution of genetic material is extremely uneven. The world's poorest nations as a group contribute more than 90 per cent of the world's genetic resources. Nevertheless, world agricultural production is dominated by a small number of the industrialized countries, despite their being "gene poor." Because of this, the author poses a question: How did the United States, a continent of berries, become an agricultural superpower in the world? He maintains that "the answer lies in the capacity to introduce into the country new plants and the related agricultural know-how and allow for relative autonomy and diversity in experimentation" (pp. 51-52).

He points out that U.S. agriculture was already firmly based on a narrow range of genetic resources with emphasis on hybrids and monoculture-like practices by the 1940s. This U.S. agricultural model was later exported to a large number of Third World countries. The Green Revolution in Latin America and Asia, characterized by the expanded use and flow of genetic resources, is a good example.

The Green Revolution, Juma argues, is analogous to the mass production paradigm in industry, and "the new seed varieties are . . . more likely to be suited to large-scale production and will therefore displace smallholders or lead to the loss of their land to large farmers as happened during the Green Revolution" (pp. 84-85). However, as far as I know, agricultural economists think that the available evidence from rural Asian and African communities does not indicate that the introduction of modern varieties has been viewed as a source of inequity in income distribution and of polarization in rural communities.¹ In this sense, Juma's view is quite different from that of agricultural economists. It seems that Juma puts less emphasis on the distinction of the roles between mechanical and biological-chemical innovation in the U.S. model.

In addition to the Green Revolution, the author brings up three other issues of world agriculture with reference to genetic resources: the restructuring of the seed industry, the formation of an international network of gene banks, and genetic vulnerability. He points out that the production of hybrids was one of the most significant developments in plant breeding which helped reorganize and strengthen seed companies. The use of hybrid varieties led to the rejuvenation of the U.S. seed industry. The trend prompted patent-like protection of new varieties which activated a wave of corporate mergers and takeover. Particularly after 1974, the prospects for advances in biotechnology stimulated further takeovers and increased concentration of the industry. Juma states that the changing composition of the seed industry along with the emerging biotechnology will introduce major changes in world agriculture. The potential for the industrial production of new seeds is expanding, and the Third World countries are likely to be major destinations for these new seeds (pp. 80-84).

¹ Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development* (Baltimore, Md.: Johns Hopkins University Press, 1985).

The establishment of a global network of gene banks is one of the current issues in world agriculture. The genetic resources stored in gene banks are usually the wild and weedy ancestral species and primitive cultivars and these are the source of variability from which the modern plants have been developed (p. 199). Therefore, gene banks have greatly contributed to global agriculture in providing genetic material with disease-resistant, pest-resistant, and environment-tolerant characteristics (p. 91). For example, the International Rice Research Institute (IRRI) developed IR-36 rice, one of the varieties that dominate global food production, partly on the basis of material that was previously held in gene banks. One of the points that attracts attention is the legal status of material that has been collected from Third World countries and stored in foreign gene banks, because, as Juma states, "the genetic resources... still remain a source of legal conflict for some time to come" (p. 97).

The author is greatly concerned with genetic vulnerability. He points out that genetic vulnerability has been a major challenge for plant breeders. In the case of food, the range of useful resources has been very narrow. Historically over three thousand plant species have been used for food. In contrast, today, most of the world's food comes from only twenty species. The reduction in the species used for food partly resulted from external conquest and colonial domination which was marked by the suppression of local food crops on the one hand and the introduction of exotic crops on the other (p. 14). The ecology of existing crops was inevitably changed by the introduction of new crops.

The introduction of the Green Revolution likewise led to the reduction of traditional varieties. Some varieties that were taken out of use were subsequently lost. The loss of traditional genetic resources due to the introduction of high-responsive varieties later became another of the controversial international problems. More recently, plant breeding programs have also reduced the number of crops used for food. Moreover, the genetic vulnerability of major crops has generated the problem of the prevailing crop epidemics which previously had been known as insignificant pests and diseases. By the late 1960s, the vulnerability of U.S. agriculture was reflected in the narrowness of its genetic base: all the millet in the United States was from three varieties, and 71 per cent of the corn was dependent on six varieties (p. 101). The author adds, however, that by the early 1980s, U.S. farmers had been able to improve the genetic diversity of their crops to some extent. My comment in this regard is why the author fails to mention at all the genetic vulnerability of crops in African countries.

III

Juma highlights the implications of advances in biotechnology for Third World as well as industrialized countries in Chapter 4. He states that the use of recombinant DNA and cell fusion techniques made it possible to modify life forms for a wide range of industrial applications. A series of technological breakthroughs generated the market potential and signaled to large enterprises that biotechnology could offer a new source of industrial renewal. The advances in the biotechnology industry in the United States were then accompanied by new forms of institutional organization that helped support the process of innovation (p. 112).

The author points out that biotechnology work is not restricted to industrialized countries and that a large number of Third World countries have formulated or are preparing biotechnology policies. The establishment of international organizations has facilitated the formation of biotechnology policies in Third World countries, because

some of the functions of these international organizations are to promote research and to provide technical support and policy guidance to these countries (p. 118). A large number of joint ventures are growing between firms and institutes in industrialized countries and the Third World. Also the formation of joint ventures and collaborative programs between Third World countries is expected to become one of the most significant developments in the evolution of biotechnology in these countries (p. 123). But Juma recognizes that African countries have shown little indication that they are seeking research opportunities and cooperation with other Third World countries. Rather they are still relying on project initiatives from the industrialized countries.

At the same time the author discusses the potential impact of biotechnology on the African economies, and predicts that the effects of these innovations are likely to be profound. He suggests the possibility of production being transferred away from Africa to Third World countries which have already taken the lead in the use of biotechnology. The production of cocoa, for example, is likely to move from Africa to Malaysia and Brazil. He shows how the production of sweeteners, flavors, and insecticides is being relocated from Third World farms to the laboratories of industrialized countries. Such changes can only lead to the loss of substantial foreign exchange earnings for African countries.

Juma next turns his attention to Kenyan agriculture and genetic resources. Kenya is one of the few African countries which has accumulated extensive capacity in agricultural research and has the ability to embark on biotechnology programs. He examined the historical evolution of Kenya's laws relating to genetic resources and discovered that since colonial times there have been strict regulations governing the transportation, storage, commercialization, and pricing of so-called "African produce" such as local legumes, sorghums, millet, and potatoes. In contrast to these crops, there are plants which were declared "special crops" and allocated extensive financial and scientific resources. Apparently most of them were exotic to the country and had been incorporated into commercial agriculture. For local species used in subsistence agriculture, no comparable provisions were ever made. Juma concludes that such crop discrimination along with other colonial restrictions over indigenous crops led to the marginalization of local genetic resources from the mainstream of food production.

IV

Although the author acknowledges that the current trends in the industrialized countries are narrowing the development options of African countries, nevertheless he asserts that Africa's future also lies in the application of "some" of the biotechnology innovations (p. 5). This "some" is important because in my judgment Juma pays attention to only a limited range of advances in biotechnology. Will this be an effective solution when African countries are faced by new challenges and looking into alternative development options? The author clearly recognizes that "in countries such as Kenya, the existing capacity in the biological and biochemical sciences is sufficient to enable the formulation of a core biotechnology programme" (p. 223). But at the same time he points out that virtually no inventories of the current biotechnology-related work have ever been prepared in most African countries. What Juma emphasizes is, therefore, the option of effective science and technology policy which will lead to enhancement of the capacity of African countries to generate technologies.

The scientific and technological knowledge of African crops has not been developed as extensively as for crops from other regions of the world because the accessibility to

equatorial Africa has been hampered by tropical diseases, incompatible climate, and ecological conditions (p 21). Some of the indigenous genetic resources have been lost with the introduction of exotic crops for the world market. Africa, however, still has a wide range of genetic resources adapted to its various ecological environments. People there still utilize most of the indigenous genetic resources in subsistence agriculture. Juma states that expanding future economic activity on the continent will require the increased introduction of indigenous resources into the economic system in addition to the use of exotic ones. But as Kenya's case indicates, local genetic resources for food have been neglected. The author suggests in the conclusion of his book that biotechnology offers extensive possibilities for dealing with Africa's chronic food and medical problems (p. 238). But, in my view, he puts less emphasis on the applicability of biotechnology for food crops which are currently crucial to the people of Africa.

Juma also takes up the issue of genetic resources and biotechnology as intellectual property and looks at its impact on African countries (Chapter 5). He argues that the new patterns of patent protection are likely to limit the flow of scientific information at a time when African countries need to build up their scientific and technological capabilities. Then he offers a remarkable suggestion from observations of Kenya's situation; in effect that country should formulate "explicit policies that would guide the country towards new levels of advancement in biotechnology and the related fields" (p. 203).

Added to this are the risks posed by biotechnology products and processes which have become a major topic of concern recently. Biotechnology empowers mankind with the ability to create and to destroy life using genetic information. In industrialized countries environmental and public interest groups are becoming more concerned with the long-term effects of biotechnology products (p. 128). Juma points out that, since risk perception changes with the degree of uncertainty and amount of information available to the public, the problem of risk assessment is complicated and difficult to manage. He admits that most African countries today lack the capacity to monitor the impact of modified life forms and cannot do so until they have built up a certain level of technological and scientific capability (p. 238).

V

One of the significant features of this book lies in the author's philosophical or epistemological basis and approach (Chapters 1 and 7). According to Juma, the major academic attitudes in Africa are being challenged and a new wave of questioning is starting. He says that there is now an urgent need to reexamine the epistemological underpinnings of the prevailing economic theories and the resultant policies in relation to the continent's need (p. 209). He emphasizes that Africa can neither rely on Keynesian economics nor on the neoclassical school. Most conventional economic approaches are based on static models that are inherently incapable of dealing with socioeconomic systems which evolve under conditions of uncertainty (p. 6). It is true that the transformation of Africa will, as he describes, take a long time, perhaps several generations, but I would not share his view that economics is one of the most moribund of disciplines, nor the notion that modern economics is inconsistent with Africa's long-term interests. Time in terms of history differs from time in terms of modern economics.

Throughout his book the author prefers dynamic approaches involving uncertainty and disequilibrium rather than static ideas of stability and equilibrium. He tends to

underrate the significance of uniformity and promote diversity. He seems to disregard reductionism in philosophy and the Cartesian-Newtonian world view (Chapter 7). It seems to me his epistemological basis and approach are analogous to the ideas of institutionalism that thrived in the United States at the turn of this century. According to the institutionalists, the intellectual orientation of Alfred Marshall and other orthodox economists led them to view the economic system as a static mechanism. By contrast the institutionalists regarded the economic system as dynamic. Like the institutionalists, Juma attaches great importance to the term "evolution" rather than "development."

One final comment and suggestion. It would have been good if the author could have examined some of centrally planned economies, in addition to Kenya, because the competitiveness of diverse political and social systems is a crucial issue in Africa.

All in all and despite my criticisms, this is a pioneering work on biotechnology with its view from within Africa, a continent confronting a critical period in its history.

(Seiji Sakiura)