The Promise of Biotechnology

Mark Cantley

Knowledge is an inexhaustible resource. Understanding of living organisms has increased massively in recent years, and biotechnology applies this knowledge to agriculture, health care and environmental protection. The new knowledge changes possibilities and responsibilities for safety, performance, competitiveness and costs, with implications for policy that transcend sectoral boundaries. Biotechnology is central to sustainability. The knowledge and techniques it provides will be essential to feed safely a population that is rising to over 10 billion, without significantly expanding cultivated areas or increasing pollution.

In the 1980s, interest in biotechnology focused on safety and guidelines for laboratory work with genetically modified organisms, then extended to industrial production and field release. Now, as the products of modern biotechnology are commercialised, new policy issues bearing more directly on sustainability emerge, with implications for a far wider range of policy-makers in agriculture, development, environment, health, industry, trade and research – and for sustainability.

Environmental Protection

Biotechnology can prevent or reduce local environmental damage. It can convert wastes into useful products or, by 'end-of-pipe' biological processes, purify them for harmless discharge. Biomaterials can be developed with a reduced environmental impact. New biological production processes can generate more manageable wastes.

'Bioremediation' uses micro-organisms to break down pollutants. Applications in the clean-up of waste water have been followed by biofiltering of air and 'off-gas'. The focus is now shifting towards treating contaminated soil and solid waste, raising complex scientific and technical questions and creating an industry worth an estimated $75 billion by the year 2000. The innumerable polluted sites are testimony to the non-sustainability of past and current practices, and demand urgent remedial action. The improving relative cost-efficiency of biological clean-up methods, as compared to the more traditional physical and chemical, favours bioremediation.

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The recycling of water in a crowded world poses scientific and technical problems the solution of which is central to the maintenance of public health and to agricultural productivity. An OECD workshop in Mexico in 1996 highlighted these issues, and work is under way to find ways in which modern, molecular techniques can provide earlier, surer and more cost-effective surveillance of water quality.

The priority for environmental biotechnology will be to reduce and prevent damage, employing 'bioprevention'. The OECD has launched a major project on the use of biotechnology for cleaner industrial products and processes, aiming to define technologies for use in specific sectors and to contribute to the redesign of vast sectors of manufacturing industry.

Food and Agriculture

Food products resulting from modern biotechnology are now appearing on the market, raising regulatory issues of environmental biosafety, food safety and varietal seed certification.

The OECD has developed scientific concepts and principles to ensure the environmental safety of biotechnology R&D related to plants and micro-organisms, from the laboratory stage to field testing. This work provides a common, internationally accepted scientific basis for assessing risk, and promotes harmonised approaches to regulation.

Consensus documents offer technical information for use in regulatory assessment of the biology or traits of a particular product. Non-member countries and UN agencies are involved in this work for the exchange of expertise and information. The BioTrack OnLine database[1] provides access to these documents and to information on legislative developments, field trials, products commercialised and links to related websites.

1. Website: http://www.oecd.org/ehs/service.htm.

Foods developed through modern biotechnology offer increased harvests, stronger resistance to diseases and reduced use of pesticides. They also raise safety questions. The OECD has drawn up scientific principles for assessing food safety, in particular the concept of 'substantial equivalence', based on comparison with traditional counterparts with a history of safe use. Current work is focusing on toxicological and nutritional evaluation of novel foods, in co-ordination with work at the Food and Agriculture Organization and the World Health Organization.

Distinctness, uniformity and stability form the basis for identifying seed varieties, the backbone of seed development and commercialisation. They also lie at the heart of the diversity of cultivated crops and the survival of wild strains, central to sustainability, especially when hybridisation and genetic modifications are involved.

'Bioremediation' uses micro-organisms to break down pollutants.

C. O'Rear/Westlight/Cosmos

The OECD schemes for seed certification were developed to regulate international trade in seed. They involve 45 member and non-member countries from all continents. The object is to harmonise assessment and certification of identity and purity of cultivated crop plant varieties, including those genetically modified by modern biotechnology.

Most OECD countries are involved in the 'co-operative research programme on biological resource management for sustainable agricultural systems', currently organised around four scientific themes:

- the safe exploitation of micro-organisms in plant/soil systems
- quality of animal production
- utilisation and ecology of new organisms
- surface and ground water quality and agricultural practices.

The programme supports fundamental research in biotechnology, emphasising more efficient use of inputs and water quality. Fellowships and workshops reinforce international scientific co-operation and facilitate the exchange of information.

Developing countries can benefit from biotechnology's potential for more sustainable methods, and the OECD Development Centre has sought to identify the necessary policies.[2] Studies in different continents have examined constraints in the process from basic research to marketing and diffusion of biotechnology products, and have analysed the outcomes of agricultural biotechnology projects and programmes funded by donor agencies.

In certain situations it may make scientific and economic sense to import some items of technology or finished biotechnology products, though products developed in industrialised countries may not be the most appropriate for low-input agriculture in developing countries.

Biotechnology will play a central role in sustainable development, not least in helping feed an increased world population by developing disease-resistant strains of plant.

Developing countries have to build national capacity – human resources, financing and institutions – and improve their ability to manage biosafety and intellectual property rights. Policies and programmes must be closely integrated into the framework of agriculture and research, with a clear sense of where biotechnology could best contribute. New technology transfer and technology diffusion mechanisms for agriculture

2. Carliene Brenner, ***Integrating Biotechnology in Agriculture: Incentives, Constraints, and Country Experiences****, OECD Publications, Paris, 1996. Website: http//www.oecd.org/dev/cendev/index.htm.*

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may be required, involving various public and private partners.

Health Care

Population growth and rises in life expectancy are placing strain on health care systems, with all countries becoming conscious of the limits to resources in health care.

Biotechnology offers the prospect of resolving health problems more effectively through deeper understanding of living matter and the disease processes. It forms an integral part of modern medicine and drug development, production and delivery, including vaccine design. It offers improved diagnostics, both for human disease and for monitoring water quality and waterborne diseases. More specific and rapid testing could have important epidemiological benefits.

The OECD has developed statistical tools and definitions for the comparison of expenditures in a sector that absorbs a growing proportion of national budgets. Recently attempts have been made to review the efficiency and effectiveness of expenditures. As the diffusion of new scientific and technological developments is clearly worldwide, the assessment and evaluation tools being reviewed or developed at OECD have universal relevance.

Biotechnology for health care has tended to concentrate on applications of interest to the developed economies, its research priorities focused on market potential. Yet the needs of the developing world (in sanitation, nutrition and so on), and the potential of biotechnology to address these cost-effectively, are enormous. Benefits from new technologies always depend on basic health services and infrastructures, and will have to be evaluated against such variables as the prevalence of disease, costs and outcomes. Improving the management, evaluation and adoption of new biotechnologies in health care is a priority at the OECD.

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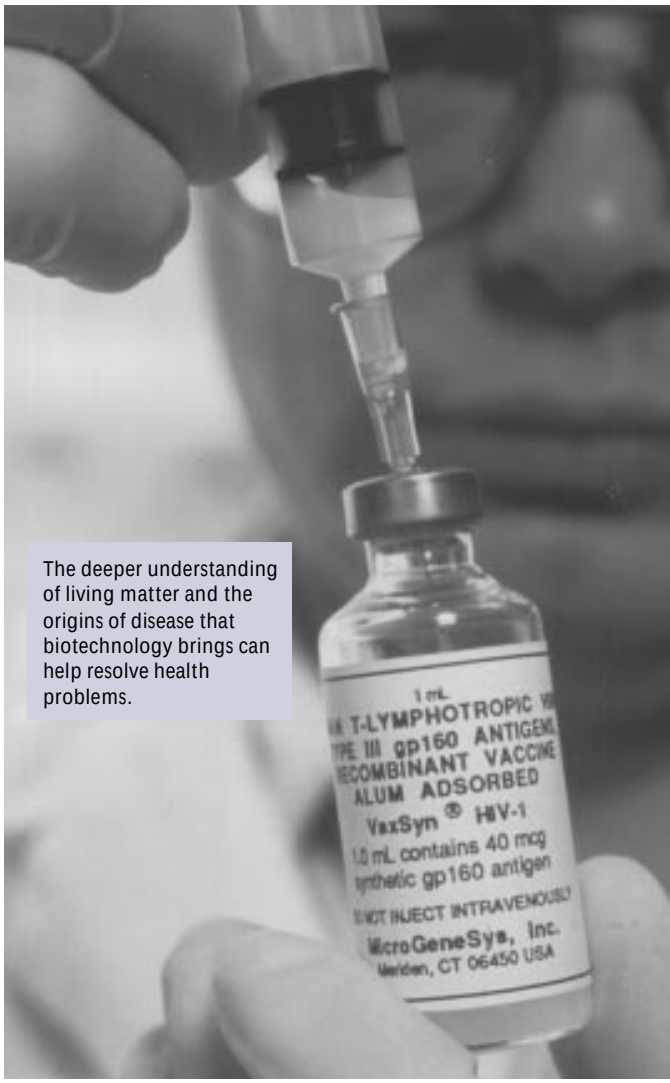
As these technologies are applied, there will be unforeseen side-effects and policy implications. Unwelcome developments will reinforce the suspicion which in some regions has already delayed the adoption of new techniques and products. Public perception, information, confidence in the industrial and governmental systems on which public safety depends, are sensitive topics. Policies that encourage transparency and build trust are essential. ■



The deeper understanding of living matter and the origins of disease that biotechnology brings can help resolve health problems.

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