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Biotechnology and Society

Some Recent Scientific Approaches

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Abstract: *In this brief paper the author discusses some important aspects of biotechnology and its applications. He points out the many blessings it can bring and the harm it can inflict on humans and the environment, and hence the pressing need to develop an appropriate ethics. After going into some of the ethical issues involved, the paper concludes that the best course of action is not a cessation of innovative research but rather a continuation of it with prudent sensitivity to sound moral and ethical principles.*

Key Words: *Biotechnology, Biodiversity, The Human Genome Project, Ethics And Morality*

Introduction

Biotechnology is an enabling technology, having broad applications in many diverse aspects of basic research, industry and commerce. In the early stages of science, theoretical knowledge was developed by keen observation and critical analysis. But in later stages more importance was given to the application of the theoretical knowledge for the well-being of society. Biotechnology is the application of biology in different fields like agriculture, food, medicine, and other commercial applications.

Ethics and Biotechnology

We can define ethics as the logical pursuit of justifications for our actions. As a discipline, ethics provides us a set of guiding principles

against which actions can be evaluated. The word 'ethics' represents moral principles, values and beliefs. The word 'moral' stands for 'right and wrong conduct.' Ethical implications of biotechnology involve considerations and reflections regarding right and wrong conduct of biological applications. Modern biotechnology is still in its infancy having arisen within the last twenty years and only having blossomed in the last ten years. Biotechnology and ethics is a topic which needs to be constantly reviewed in the light of the rapidly expanding science of biotechnology.

Genetic technology harbours the potential to change the human species forever. The quest for the location of the human gene is the Human Genome Project, which enhances the status of the human race by getting rid of diseases and unwanted genetic traits. The Human Genome Project empowers genetic scientists with a human biological instruction book. The genes in all our cells contain the code for proteins that provide the structure and function to all our tissues and organs. Knowing this complete code will open new horizons for treating and perhaps curing diseases that have remained mysteries for millennia. Alzheimer's disease, the most common cause of dementia, is an important focus of current medical research. But along with the commendable and compassionate use of genetic technology comes the spectre of both shadowy purposes and malevolent aims. Additionally, finding the DNA sequences underlying such common diseases as cardiovascular disease, diabetes, arthritis and cancers is being aided by the human variation maps generated in the Human Genome Project in cooperation with the private sector. These genes and human variation maps provide focussed targets for the development of effective new therapies.

One of the greatest impacts of having the sequence is that it opens up an entirely new approach to biological research. In the past, researchers studied one or a few genes at a time. Today with the whole genome sequences and highly sophisticated technologies scientists can approach questions systematically and on a grand scale. They can study all the genes in a genome, or all the transcripts in a particular tissue or organ or tumour - how tens of thousands of genes and proteins work together in an interconnected network to orchestrate the chemistry of life. Biotechnology has got an immense role in agriculture and animal husbandry by introducing specific gene or modifying gene for tolerance to various conditions. It can produce high yielding, disease resistant and

good varieties of organisms for generation after generation. It is on the multitude of chemical and genetic resources that the future of biotechnology rests.

The ethical value of biotechnology can be seen in its ability to improve agriculture, and thus feed the hungry in the world. Agriculture must feed an increasing human population forecast to reach 8,000 million by 2020. Although the rate of population growth may steadily decrease, the increase in absolute numbers may be such that the limit of the carrying capacity of agricultural land could soon be reached, given current technology. But if properly focused, biotechnology could offer a responsible way to enhance agricultural productivity today and in the future. Biotechnology could help to solve many problems limiting crops and livestock production in developing countries.

Some Benefits of Biotechnology

Biotechnology, combined with advances in the understanding of molecular and cellular biology is aiding agriculture and food production in many ways. A key benefit is that biotechnology tools reduce the time required to deliver conventional product traits and improved foods to market. Biotechnology tools reduce years of crop field-testing and trait-selection to months of laboratory testing and selection. This significant reduction in time benefits both growers and consumers. A second benefit is that in biotechnology production traits are integrated into plants. This allows growers to reduce production costs and time, increase their efficiency; and control pests in an environment-friendly way. For example, specific traits protect corn plants from damaging insects. This helps farmers increase productivity, and it reduces the need for chemical sprays. A third benefit is that biotechnology provides plants that supply better nourishment for livestock and expanded nutritional choices for consumers. These benefits are not limited to the upper strata of our society only. The Food and Agriculture Organization (FAO) says that national programmes need to ensure that biotechnology benefits all sectors, including resource-poor rural populations, particularly in marginal areas where productivity increases will be more difficult to achieve.

The Pacific Basin Economic Council (PBEC) recognizes that with growing populations and limited resources, it is critical for the Asia-

Pacific region to find more efficient ways to feed its people. PBEC therefore applauds recent progress made by APEC (Asian Pacific Economic Council) toward an open and efficient food trading system designed to provide more food for more people at a price they can afford, while increasing wealth for all economies in the Pacific Basin. One important element of the APEC Food System is that it is committed to expanding the tools used to bring sustainability to agricultural production. One such tool is biotechnology.

Biotechnology and Biodiversity

Biotechnology is also concerned with biodiversity. Questions like 'Will genetically altered organisms upset the balance of populations in natural ecosystems? 'Will modified organisms transfer their altered genes to wild relatives or reduce biodiversity?' may be clarified by explaining what biotechnology does with biodiversity. Biotechnology can contribute to the conservation, characterization and utilization of biodiversity, thus increasing its usefulness. Some techniques such as *in vitro* culture are very useful in maintaining *ex situ* germplasm collections of plant species that have asexual propagation (e.g., bananas, onions, garlic) and species that are hard to keep as seeds or in field gene banks. Related techniques are also important for the preservation of animal biodiversity through cryopreservation of semen and embryos, coupled with embryo transfer and artificial insemination. At the same time, however, biotechnology may reduce genetic diversity indirectly by displacing land races and their inherent diversity as farmers adopt genetically uniform varieties of plants and other organisms. Biotechnology is rapidly developing as a tool in so many areas of potential benefit to the environment. The basics of biotechnology rely on the manipulation of the biological principles of nature. Because of the broad applications, a cooperative regulation based on a consensus between the viewpoints and approaches of different agencies is essential in this field. The principal concern is environmental release of genetically modified organisms.

Some Critical Views

Cultural models criticise some bio-technological alternatives as inhuman or ecologically harmful. The concrete paths of individual technology developments result from the interaction of various selected

and limited conditions. Innovation in technological action always includes potential failure, unknown risks and non-intended effects. There are two ways to handle this: prohibition of every new technology to avoid any possible mistake (tutiorism - taking the safest way) or permission for new technological actions, provided that the acting parties are made responsible for their actions, in both positive and negative cases. This implies the demand for a technology assessment of effects in case of failure of the technological action, legal liability, and the obligation to research into the risk-potential of innovative actions, which means research on safety. Because no particular risk of genetic engineering in cultivation compared with conventional methods has been shown yet, tutiorism in this field of technological action cannot be defended.

The question of how to allocate responsibility for innovations is highly complex, defying any easy answer. Science basically is the process of inquiry into the unknown. It usually begins with observation, followed by experimentation. Scientists formulate hypotheses, plan and conduct research experiments, evaluate their findings, and draw conclusions based on their results. It is both a process and a journey into a discovery.

Research and Ethics

Ethical, legal, and social issues that arise from almost all types of researches are:

- How will we *use* the information we obtain?
- Will it create new materials, new inventions, or new products that will affect our lives?
- Could some of those products be harmful, and if so, how do we control their use?
- Is there a *right* or *wrong* in the types of experiments we want to do?
- Does the answer depend on our personal or religious beliefs, on cost, or on other considerations?

Scientists often have as hard a time with these issues as you and me. Indeed, by using the process of inquiry and observation, scientists

can easily run into conflict with what is currently thought or believed. Sometimes their work leads to discoveries that can cause great good or serious harm at the same time, e.g., nuclear reactions. But in spite of this, history shows us that humans have always pursued the unknown. Whenever a situation presented the possibility of discovery, of new knowledge, it always has been explored. Today we are faced with wide sweeping interest in exploring everything from the very large (our universe) to the very small (our genetic structure) and we have an amazing array of tools, from telescopes to electron microscopes, with which to inquire.

However, exploration today involves important decisions.

- What is the best use of our resources?
- How do we determine and evaluate th e possible *benefits* of scientific discovery?
- In order to better understand and participate in this decision making process, we need to educate ourselves in science and in the ethical, legal, and social issues of research.

Concluding Remarks

The ethical issue arises when the harmony of a society gets disturbed. Much of the controversy is around the unknown. Some people are concerned that biotechnology will produce unforeseen problems in human or environmental safety. The issues of how we treat one another and the world around us in a responsible and ethical way cannot be dicided through nature. They are human issues and values. The advantage and disadvantage of biotechnology depends upon the way it is applied. The choices are always with us, and need not be created by biotechnology. In order to create opportunities for the application of innovative new biotechnology products, appropriate regulations in environmental and health-related research areas should be promoted. So the question is do we stop and do nothing, or do we proceed cautiously and adapt as we get more knowledge?

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