
Issues and Controversies Concerned with the Practical Ethical Discourse of Biotechnology

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Abstract

Over the past decade the biotechnological world has changed the way we lived and emerged from the research laboratory to the market and has reached to the consuming public and government. The biotechnological advancement is widely debated, contested, widely criticized and has been popularly controversial with regard to ethical uncertainty it confers. The potential risks associated with the assessment of biotechnological methods and bioindustry products, about whether and how bioethics should influence public policy is always sceptical. Advances in biotechnology and medical science, especially breakthroughs in cloning and stem cell research, organ transplants and the availability of embryological tissue for research, creation of new genomes and genetically engineered biologically active substances have raised great expectations for curing diseases, repairing damaged body tissue and organs, enabling conception at advanced age and selecting embryos based on genetic diagnosis. However, protection of the rights of the first 'pioneer' patients and prevention of the introduction of dangerous animal pathogens into the human population is an issue of major concern in this area. Risk assessments analyze the relative risks posed by possible toxic, pathogenic, and ecological effects of biotechnology and bioindustry. Bioethics examines broad issues such as animal rights and welfare, human testing, and the potential effects of genetically engineered species on other species and the environment. The inherent conflicts involved in how biotechnology develops as an industry and its stand in the ethical questions and public policy positions need to be discussed and adopted.

Keywords: Biotechnology, Genetic Engineering, Medicinal Science, Bioethics.

1. Introduction

The Convention on Biological Diversity has defined "Biotechnology" as any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use. The science of "biotechnology" can be conveniently categorized under conventional biotechnology and modern technology. Under conventional biotechnology, the areas included are cross breeding, fermentation, stem cuttings, hybrid and conventional breeding. While in modern technology fields of cloning, transgenic, genes, genetics, genetically modified food (GMF), genetically modified organisms (GMO), modified organisms (genetically modified), in vitro, DNA, stem cells, tissue culture, genetic engineering and genomics are incorporated.[1]

Biotechnology promotes two different perspectives, one in which some things are viewed as extremely good and

needed to be encouraged or pursued further, and other things that are dreadful and should be forestalled or eliminated. The ethical questions raised by biotechnology are of a very different nature. Though, society and individuals will be benefited in many ways from technology, yet at the same time, other ethical considerations must be considered. Ethical concerns exist about justice, and how fairly these technological benefits are distributed-both within society and around the world.

While biotechnology can greatly improve the quality of life, it should be emphasized that this new technology should be approached with an appropriate mixture of enthusiasm, sensitivity to social issues, and acknowledgement of the potential and power of biotechnology. While biotechnology can provide useful tools for combating disease, hunger and environmental contamination it can also raise

important ethical issues. These issues can evolve quickly as more development and uses of biotechnology occur. Ethical issues that arise from modern biotechnologies include the availability and use of privileged information, potential for ecological harm, access to new drugs and treatments, and the idea of interfering with nature.

The term “ethics” applies broadly to the normative bases for human action, for judgments about the acceptability, advisability and justifiability of practices, and for criteria of responsibility and justice. Normative bases stipulate ideals, values or standards that ought to be reflected in human conduct, and may be distinguished from matters of fact that may also form a component of the basis for action or judgment in a particular case. The term “ethics” is itself open to conflicting interpretations. On the one hand, ethics deals with almost universally recognized norms that are both implicit within everyday social interaction and explicitly articulated in public sources such as legal or professional codes of practice, religious texts, folktales, literature and philosophy. On the other hand, the ethical dimension of conduct and reflection is often characterized as inherently personal, introspective and inherently unsuited to public discourse.[2]

Ethical issues are not merely matters of opinion, or that they are wholly subjective judgments that are inherently irresolvable in a public forum. The expressed perceptions and concerns of the public can be developed into statements that are more clearly applicable to the real decisions that must be made regarding science and public policy [3]. The average member of the lay public is especially constrained by resources and is unpracticed in extending ethical viewpoints beyond their initial expression. Advocates, scholars and participants of special forums and committees can take the process of discourse ethics a number of steps beyond the initial expressions of approval or disapproval. We may interpret this as practical ethical discourse. While falling short of the unrealizable ideal case in which all objections are fully answered, practical discourse attempts to treat ethical issues with the seriousness that they demand.

Biotechnology/bioethical issues are not simple. The underlying science is complex, as are the resulting issues. Bioethics is a new field that is developing right along with biotechnology. The scope of bioethics can expand with biotechnology, including cloning, gene therapy, life extension, human genetic engineering, astroethics and life in space, and manipulation of basic biology through altered DNA, XNA and proteins. These developments will affect future evolution, and may require new principles that address life at its core, such as biotic ethics that values life itself at its basic biological processes and structures, and seeks their propagation.[4]

The growth of technology is revolutionizing the way we conduct our lives and is challenging the established legal principles, which are struggling to adapt to rapid

technological advances. However, the advent of genetics has opened exciting opportunities in the biotechnology sector, because of its numerous applications, which range from improvement of human health and food production to reduction of environmental damage. These opportunities are also coupled with controversies that not only challenge the laws within which our society functions, but also our ethical and religious beliefs.

Each biotechnological innovation is much more than one item of health, agricultural, and industrial biotechnologies, whose ethical and social issues would have been addressed once for all. On the contrary, in order to gain public confidence, regulatory authorities must, and often do, address the ethical, social and technical issues of each innovation as such.

The race between science and the law is centuries old. It has greatly intensified with the rapid progress in science and technology. In the early days, science and law came into conflict because scientific theories and the prevailing concepts of law were immeasurably divergent. Today, the issue is not whether scientific postulates that are contrary to rule of law should prevail, but the extent to which law and government, should influence scientific progress.

The legal issues in the biotech industry relate to discoveries in genetics, such as the patentability of genetic information, the conduct of clinical trials involving gene therapy, the approval process for new drugs, proteins and other biological components and cloning. Other issues include tissue engineering, foetal tissue research, confidentiality of patient health information, bio-engineered food and conflict of interest disclosure requirements for researchers.

“Biotechnology is mentioned as having powerful social, economic, and political impact but that it should be used with prudence, objectivity, and responsibility [5]”. The development and regulation of biotechnology has triggered many discussions from different academic fields, such as economics, law, politics and even history.

The classical division between science and society does not seem to operate, when biotechnology is seen through an ethical lens. Science, indeed, could provide no adequate, technical answer to the questions that relate to moral values such as dignity, justice, autonomy, integrity and freedom or to notions considered absolute, such as nature, biodiversity, humanity, animal welfare, health, knowledge or individual interest. Quite often, ethical values conflict with one another, and produce dilemmas through which the public, researchers or regulators must find their own way.

2. Biotechnology and the public opinion

To begin with, majority of the public is generally optimistic about the ability for biotechnology to improve our quality of life. Biotechnology is viewed by many as the frontier of the next revolution with enormous social and economic consequences. Public debate on biotechnology is

embroiled in controversy over the risks and benefits associated with this emerging technology. Supporters of biotechnology highlight the potentials benefits to society via reduction of hunger, prevention of malnutrition, cure of diseases and promotion of health and quality of life [6]. Opponents often view its use as an unnecessary interference with nature that has unknown and potentially disastrous interactions with human genetics and natural ecosystems [7]. As biotechnology research continues to make progress, science and industry are poised to bring a wide range of products that may have significant influence on how we organize our production of food, fiber, feeds, fuels and pharmaceuticals. However, public attitudes towards biotechnology are divided and the debate over the desirability of this technology is far from over.

This paper reviews the considerable pros and cons in public approval of the use of biotechnology in different arenas discussed here under:

2.1 GM crops and GM food

GM food if they considered them positive under one of these dimensions: ethically, as, for instance, it is claimed GM crops could help feeding poor nations, protect biodiversity by diminishing pesticide use or help develop new effective medicines and biofuels; socially, if they were considered economically useful for a nation, or if vitamin-supplemented GM food were deemed of public utility; individually, if consumers thought it implied lower cost, more flavourful food, or crops that are easier to sow. In all these cases, risk could be tolerated to a different extent.

The "humanitarian" argument is not new, yet it has become more influential as scientific progress seems to go in this direction, working on drought-resistant, climate-specific or vitamin supplemented GMOs for instance. The media has given voice to the idea that "the Developing World Simply Can't afford to do Without Agricultural Biotechnology" [8] and that GM crops could alleviate hunger or malnutrition.

2.1.1 Roadblocks

The public opinion is in great part ill-informed, both of what GMOs are and is not, and of the regulatory system adopted to ensure health and environmental safety. One source of the adverse positions against GMOs is as set of irrational representations concerning what they can or cannot do. Technical education is necessary, though neither the media, nor public consensus conferences have proven effective enough in the long term.

As the intense debates in India have shown, the GM industry has suffered from ignoring or underestimating local/national cultures and ethical values. Indeed, in India, the temporary success of international NGOs between 1999 and 2001 could partly be explained by their ability to identify "the ancient right to save and exchange seeds from previous harvests" as a very efficient ethical theme. The cultural attachment to national products and typical local "terroir"

food is also an element NGOs have insisted upon in Japan, Italy and France, and which limits GM development.

Organization of political power. In countries where decisions are not national but can be taken by local or regional authorities, as in Italy, Germany or Japan, opposition to GMOs is not only based on economics, ethics and safety grounds but also on local interests and deals. Local elect officials might wish to satisfy their electors when they institute GM-free zones.

In European countries such as France and Germany, NGOs and small farmers consider that GM expansion would lead to massive corporate control of agriculture. The politicization of the GM debate is not to be desired by GM producers, as it creates delays and often limits cultivation and marketing possibilities. However, when such political and social considerations undoubtedly affect the general public, technical education on GMOs cannot be the main answer to adverse reactions from the public. Consensus conferences, as they happened in Nordic countries and the UK, have incidentally driven members of the public to explicit their views on society, what they desire from it and how freedom of trade and ethical concerns should be combined. In the UK, the 2003 conference has led to positive views on GM organisms, which the media has been actively echoed.[9]

2.1.2 Accelerators

Drought-resistant, climate-specific or vitamin-supplemented GM organisms inspire support from actors in developing and developed countries, such as the Nuffield Council on Bioethics in the UK. Developed countries are willing to fund and support research in GM organisms based on humanitarian prospects. In developing countries, national support depends on the ability of GM crops to fulfill their promises in the long term and convince farmers.

In many cases, public regulation is an asset in the development and marketing of GMOs. Provisions regarding health and environmental safety issues are most useful tools in ensuring public confidence. In the USA, trust in the FDA regulation system is an important element in the general public acceptability of GM food. In Europe, new coexistence provisions are reshaping the debate, from health and safety issues to the world of free-trade and liberal economy. All public regulation is not always well addressed. In China, for example, unrealistic coexistence provisions have detrimental effects both on public confidence and on the GM industry. By contrast, EU and US public regulations are the objects of discussions with stakeholders. Though such discussions do not accelerate the diffusion of GM organisms through time, they consolidate it into legal and reassuring frameworks in the long term.

Building constructive alliances, ex., a constructive cooperation between farmers of Andhra Pradesh and the GM industry has reshaped the debate and led to farmers claiming their right to choose what they consider the most efficient seeds. Such cooperation is an asset for the GM industry in

developed countries, as it avoids a politicization of the debate, and provides answers to fears of corporate control over agriculture.[10]

2.2 Biomass energy and biofuels

Use of Biofuel technology inspires pragmatic views, as they combine political, economic and social interests are influential as they enable an effective acceptance and promotion of biofuels. Ecologic considerations, aiming at the reduction of carbon emissions, have been influential in these decisions, together with the political will to ensure national energy security by addressing concerns about the high price of oil, forthcoming energy supply shortages and national dependence on foreign fossil energy. [11]

One of the major concerns is the competition between food and energy for agricultural resources. According to these associations, a compromise needs to be struck, between reducing carbon emissions through political support for biofuels and bioethanol and protecting colossal tracts of agricultural land from being turned over to biofuels. Tension between the need for energy and the need for food and feed, as an aggressive biofuel scenario could lead to massive rises in the world prices of commodities such as cassava, maize, oilseeds, sugarbeet, sugarcane and wheat. [12]

Concerns have also been expressed that the global support for biofuels, leading to rising food prices, would create temptations for farmers to cultivate once virgin lands, deforestation which is further considered a major cause of climate change and global warming. The environmental impacts of massive-scale biofuel production would therefore be quite negative if forests were to be destroyed in great part.

2.2.1 Accelerators

The public opinion is generally positive on biofuel development and often associates this energy with considerations of global warming and other ecological issues. As public concerns for such issues are expanding accelerating the implantation of biofuels in the transportation area, however, would be useful to give it a more “sustainable” orientation.

The current dependence on foreign oil is a major argument in the USA in favour of biofuel promotion. The general public is well aware of the economic and national security consequences of such dependence, and willing to see them reduced. The effectiveness of this argument, nevertheless, depends on whether the dependence on foreign oil will be eventually reduced by increasing the use of biofuel.

The current wave of public policies promoting biofuels is very positive, not only on economic terms, but also regarding public acceptability. Governments use biofuel promotion as a tool to convince that ecological issues, national security and economic dependence on foreign oil are needed to be addressed. This will certainly accelerate biofuel development in the years to come as long as the public and

the media are convinced. Once again, orienting biofuel towards more “sustainability” will be very useful for its massive development

2.2.2 Roadblocks

Not all individuals take their decisions from ethical grounds or act as citizens of the world. Effective acceptability of biofuels depends on the price the consumer will have to pay. Where biofuels are seen as valuable for ecology or national security, individuals or national governments might accept to participate to a greater extent. Research is necessary on how much actors sharing such views may be willing to pay, in order to identify to what extent the price of biofuels is an effective roadblock for its implantation.

There is great probability that a world-wide increasing demand for biofuels will lead to actively generating biomass through genetic engineering. NGOs are starting to consider this aspect, and many share an opposition against GM crops and foods and would certainly battle against such massive engineering. More importantly perhaps, the public opinion, already wary about GM food, would very probably react negatively to GM biomass.

First-generation biofuels inspire critics and caution from NGOs and European Green parties, for their possible or effective ecological, economic and social negative impacts. The media focus on these aspects is expanding. Awareness from the public opinion will take time, and will probably happen at a moment when biofuels are massively used. When this happens, will the public accept such negative impacts, as it has generally done with fossil fuels, or how negatively will it react? The competition between fuel and food might be attenuated by developing more eco-sustainable biomass derived from other sources than food crops. Such attenuation, though, needs early preparation; otherwise transition costs towards such sustainable biomass could be very high.

2.3 Bioprospecting

Bioprospecting is the exploration of Indigenous communities and appropriation of natural resources may cause collateral damages to ecosystems and societies, including slavery, forced relocation of populations, and genocides [14]. The modern bioprospecting industry is certainly very far from such outrageous attitudes. Its economic aspects, however, have led to diverging ethical and social views on such issues as whether knowledge is being commoditized, whether it is acceptable to patent living organisms, innovations derived from traditional local knowledge and active ingredients from plants considered sacred, and whether the industry should share benefits with local communities that have served as stewards of these environmental resources and protected them for generations.

2.3.1 Promoters

Through the Convention on Biological Diversity, the recognition of Community Rights positively leads to more equitable sharing of benefits and enables positive cooperation between industry and local/indigenous associations and

populations. This leaves the possibility open for the media – and particularly the media from developing countries - to represent such research in a more positive manner.

2.3.2 Restraints

Identifying proper indigenous and local stakeholders often proves difficult as it is found that research has often been hampered by pressure groups whose legitimacy was unclear.

Agreeing on benefit-sharing terms is often uneasy.

2.4 Transgenic and cloned animals and their welfare

The development of transgenic and cloned animals inspires concerns in the public mind. Biosafety issues, concerning the open release of these animals in the environment or their use in feed or food are commonly shared by genetically engineered crops and animals. Another concern is that such research could push humanity on a "slippery slope" and constitute the first step towards giving birth to transgenic or cloned human beings in a not so distant future. Applying modern biotechnology to animals, however, has also revealed original public concerns relating to animal welfare and animal integrity.

2.4.1 Promoters

Respect for medical research is generally high, and most of the public is willing to delegate decisions to experts in this field.

Integrating animal welfare advocates into regulatory institutions. In the UK, the Animal Procedures Committee (APC) includes members from animal rights associations to advise the Government on animal welfare issues. This provides valuable insights from NGOs and drives them to express constructive propositions much more than adverse vocal opinions.

Cooperation with other NGOs: disease advocacy groups and associations. Disease associations, benefiting from positive public opinion and media focus, are in favour of more research on cloned and transgenic animals. In France, the AFM has vigorously claimed more research was necessary, notwithstanding the necessity to ensure animal welfare when possible.

2.4.2 Restraints

Such massive rise, counterbalancing a general decline in the use of animals for research, has not yet gained much attention from the media. In countries where animal welfare is a very sensitive issue, as Germany and Denmark, one must communicate on the usefulness of creating and using transgenic and cloned animals. In most countries, respect for animal welfare rules (3 R Doctrine) is left in the hands of researchers, with little or no supervision from public authorities. Thus, these actors must be able to communicate on such topics when necessary.

Ill-conceived regulation. With biotechnology issues, it is not unfrequent for governments to consider one situation as similar to another one because of its novelty and uncertainty. At times, this can lead to ill-conceived public

decisions and create blockage for artificial reasons. In Italy, for instance, between 1997 and 1999, the merging of animal cloning and human cloning into a single ban has dramatically impeded research. Such abstract public regulation has had negative effects on the development of cloned and transgenic animal's research and was not based on arguments specific to such research.

2.5 Private genetic information

Genetic testing help medical professionals diagnose genetic conditions, propose adequate treatment, predict the risk of a genetically-induced pathological disorder, and allow parents to make more informed decisions concerning their health and reproductive choices. Major issues, however, have been raised concerning the ethical implications of obtaining, storing and using genetic samples and information. These include respecting the autonomy of the person who submits to a test, ensuring his or her right to fully informed consent, privacy and confidentiality, accepting decisions to know and not to know, and the freedom to withdraw from research protocols at any time. There are also dilemmas surrounding the usefulness and benevolence of obtaining and providing information where no proper treatment is available, where it gives indications in terms of risk and probability in the long term and where it might induce persons in good health to change the representations they have of themselves and of their own abilities and future.

2.5.1 Accelerators

Public confidence is generally high. The public is keen on hearing about innovations in the genetic field of medicine. Many national and international rare disease advocacy groups are pushing for genetic tests more accessible and more affordable. Cancer associations are also promoters of genetic tests in the USA and less-developed countries such as India.

2.5.2 Roadblocks

Some public regulations, as the French Bioethics Laws, consider genetic testing or genetic information as exceptional in some ways, as compared to other medical tests and information. Although this is often the case for the moment, the expansion of pharmacogenetics will very probably make a great part of genetic testing and information more common and trivial. Thus, such over-protective regulation could hinder future research and treatment and be detrimental to the general good.

Debates on whether health and life insurance companies should access genetic information are numerous. Regarding health insurance, discussions in the USA are intense and strongly limit the interest of the public in genetic testing. In other developed countries, debates mostly concern life insurance access and premiums and do not clearly limit the public's willingness to take a test.

2.6 Stem Cell Research

Since embryonic stem cell lines were first produced in 1998, ethical issues and controversies have been raised

within the general public, influential groups and public policy arenas. Embryonic stem (ES) cell research has inspired specific concerns, while adult stem cell research has mostly raised scientific questions relating to its efficacy. Interestingly, however, the public opinion is globally quite favourable to stem cell research, and adopts a utilitarian view, such that it seems an ethically acceptable trade-off to destroy embryos for the future prospect of saving human lives or curing diseases [17].

2.6.1 Roadblocks

Opposition to ES cell research happens mostly on religious grounds. Many religious groups, however, approve of ES cell research for medical purposes. Roman Catholics and US White Evangelical Christians are the two most influential groups against ES cell research. In developing countries, such research is usually not a religious issue, except with the Catholic Church, whose influence is strong in Brazil. Thus, major progress in this field would more easily happen in countries such as China, India or Japan, depending mainly on scientific capabilities.

Human reproductive cloning and human nuclear transfer are submitted to a general public prohibition in Germany, Italy, Denmark, Norway and Brazil, as if the two raised identical ethical concerns. Countries such as the UK, Finland, Sweden, Japan, India and China avoid such confusion and might attract and train highly qualified researchers.

2.6.2 Accelerators

Apart from Germany, Italy and Norway - where media focus is quite differentiated - the media is usually in line with the public opinion, mostly considering the utility of such research and insisting on accomplishments and high hopes.

The French AFM advocacy group supports and funds I-Stem, a stem cell laboratory managed by public researchers from the INSERM. AFM benefits from positive attention in the media, credibility at the government level, and gives researchers an ideal opportunity for developing ES cell research.

Modern biotechnology, with its focus on molecular biology and its concern for increasing human health and life spans, is all about the future. This biotech future presses in daily, sparking imaginations. At the same time, it elicits wariness or even fear that humanity is gaining too much power or too little choice over human evolution and destiny. The political climate, permeated as it is by a ferocious "moral approach" to science policy, heightens this public concern. We seem to have lost our capacity for rational discourse in the public arena. The biotech industry has increasingly realized that not only regulatory schemes but also contentious public and political debate can either enable or constrain research and development.

Researchers benefit from great freedom, as the general public regulation frame is able to dynamically adapt

to progress and social needs. Many biotechnology innovations are claimed to match ethical needs. Biofuels should contribute to the protection of the environment, genetically modified food and crops could participate in a fight against hunger and malnutrition, genetic testing is an asset for the autonomy of the patient and would enable personalized and tailored medicine, engineered animals could improve medical knowledge and stem cell research save human lives. These innovations, however, could be used in unethical ways, as any instruments. Diverging views, therefore, should not be simply considered useless and temporary, or caused by deficiencies of knowledge or rationality.

3. Environmental biotechnology

New environmental challenges continue to evolve and new technologies for environmental protection and control are currently under development. Also, new approaches continue to gain more and more ground in practice, harnessing the potential of microorganisms and plants as eco-efficient and robust cleanup agents in a variety of practical situations such as [13]:

- Enzyme engineering for improved biodegradation
- Evolutionary and genomic approaches to biodegradation
- Designing strains for enhanced biodegradation
- Process engineering for improved biodegradation
- Re-use of treated wastewater
- Biomembrane reactor technology
- Design wastewater treatment based on decentralized sanitation and reuse
- Implementation of anaerobic digestion to treat bio-waste
- Biodevelopment of biowaste as an alternative and renewable energy resource
- Emerging and growing-up technological applications of soil remediation and cleanup of contaminated sites

Along with a wide group of technologies with the potential to accomplish the objectives of sustainability, biotechnology will continue to play an important role in the fields of food production, renewable raw materials and energy, pollution prevention, bioremediation.

Since environmental biotechnology proved to have a large potential to contribute to the prevention, detection and remediation of environmental pollution and degradation, it is a sustainable way to develop clean processes and products, less harmful, with reduced environmental impact than their forerunners, and this role is illustrated with reference to clean technology options in the industrial, agro forestry, food, raw materials, and minerals sectors.

Since some new techniques make use of genetically modified organisms, regulation to guarantee safe application of new or modified organisms in the environment is important.

A wide range of biological methods are already in use to detect pollution incidents and for the continuous monitoring of pollutants, but new developments are expected. Environmental and economic benefits that biotechnology can

offer in manufacturing, monitoring and waste management are in balance with technical and economic problems which still need to be solved. All this is being achieved with reduced environmental impact and enhanced sustainability.

An evaluation of the consequences, opportunities and challenges of modern biotechnology is important both for policy makers and the industry.

4. Disadvantages and Ethical Issues

4.1 The involvement of humans

Whether we like it or not, humans will be involved in research surrounding Environmental Biotechnology. The level to which this could be an ethical concern depends on if consent was given and if there is potential harm caused from the research.

4.2 Animal Experimentation

There is no doubt that animal, just as humans do, experience pain and suffering. As a general rule, the harm done to the individuals of the experiment should be logically justified by the benefits that the results bring to society in general.

4.3 Risks to Environment and Biodiversity

Like any experiment, there will most likely be risks to the test subjects; which is, in this case, our environment. When considering ethics, the risks of the experiment must be taken into consideration, weighed against the benefits. An example of an environmental risk is the possible introduction of invasive species to the territory in question. Is it worth the pain to put our environment at risk?

4.4 Exploitation

Environmental Biotechnology is often put into question because it may be considered an exploitation of Aboriginal people and knowledge (specifically the Aboriginal people who claim the territory in question as their own).

4.5 Therapeutic cloning

Therapeutic cloning refers to the production of human embryos for the purpose of research. It has also been applied to create new organs or tissues for transplantation into a waiting patient with possible applications in the treatment of diseases like diabetes, Alzheimer's disease and even cancer.

These two types of cloning – there is a third type known as gene cloning, by the way – are at the center of heated debates. If you wish to cast your vote on the pros and cons of cloning, it is important to acquire as much reliable and relevant information and education on the matter.

Pros of Therapeutic Cloning

- 1) Therapeutic cloning can help create vital organs. This would be helpful for people suffering from kidney and other disorders, who are forced to wait years for a replacement organ.
- 2) When organs are made out of a patient's own cell, doctors do not have to worry about organ or tissue rejection by the immune system of the patient.
- 3) Stops the wait time for organs and patients then do not risk losing their life while waiting for an organ.

- 4) Therapeutic cloning may be helpful for preventing diseases; research in this area of therapeutic cloning is still being preformed.
- 5) Organs would have an exact match of the patient's DNA.
- 6) No need for organ donors and no surgery required for the second party.
- 7) Allows for researchers to test cures for certain diseases, such as, Parkinson's and diabetes.
- 8) Researchers can study the regeneration of organs.

Cons of Therapeutic Cloning

- 1) Adult cells are limiting, so therapeutic cloning relies on stem cells extracted from the embryos. Just a small portion of stem cells are usable.
- 2) Some cells mutate and cause tumours in patients.
- 3) In order to cure disease, millions of eggs are needed. We do not currently have this type of supply of eggs.
- 4) Many people believe it is ethically wrong and against "gods" wishes.
- 5) Extracting eggs from a female is costly and painful for the woman.
- 6) The cost of therapeutic cloning is very high.

5. Industrial biotechnology

Industrial biotechnology is gaining supporters among environmentalists as a way to make significant cuts in greenhouse-gas emissions and eventually move to a society free from fossil fuels. Industrial biotechnology holds great promise to solve global challenges, offering new potential for meeting the world's demand for food, feed, fuel, materials, and more while reducing our impact on the environment. Industrial biotechnology, also known as white biotechnology, is the application of modern biotechnology to the sustainable production of chemicals, materials, and fuels from renewable sources, using living cells and/or their enzymes.[2]

Nanotechnology

Biotechnology can be broadly defined as the use of specially bred living organisms to solve problems and produce new products or, more narrowly, as the intentional alteration of living organisms by manipulation of their DNA. Among the areas highlighted in this field are advances that might be made in nanomedicine, biomolecular motors, and the use of biotechnology/nanotechnology to clean up the environment, increase food production, and create materials such as new plastics and chemicals.

Nanotechnology in medicine

The use of nanotechnology in medicine opens the door to many great possibilities. Applying nanotechnology in medicine could revolutionize the way we use medicine to treat disease and tissue damage. For example, nanobots could be injected into the bloodstream to help cells fight harmful microorganisms and cancer cells when the immune system isn't working properly.

Here is a list of some ways nanotechnology could be used in medicine:

Drug delivery:

Using nanomachines to deliver drugs to specific locations in the body could be more effective than consuming

pharmaceutical drugs or injecting drugs into the body. For example, nanobots could be loaded with certain DNA codes or drugs that are lethal to harmful microorganisms. When the nanobots are injected into the body, they can destroy harmful microorganisms by attaching themselves to them and injecting lethal doses of drugs into their body.

Detox

Nanites or nanobots could be used to absorb toxins and remove these toxins from organs and the bloodstream. A person who has a weak immune system and liver problems should benefit a lot from this type of nanomedicine.

Monitor health condition

Scientists have found that some nanomaterials have the ability to detect certain drugs and nutrients. With better understanding of nanotechnology, scientists could create nanomachines that have the ability to detect the levels of chemicals and nutrients in the body. This can be very useful for diagnosing disease and health conditions and finding ways to treat them.

Tissue repair

Nanomachines could be equipped with DNA or certain healing chemicals to heal damaged cells and tissues. As the cells and tissues are healed, it makes it easier for the body to recover from injuries.

Nanotechnology and cancer

Some universities are developing and testing nanosensors that have the ability to detect very low levels of cancer cells. These nanosensors are more sensitive than traditional cancer tests, making them great for detecting cancer at an early stage. Using nanosensors to detect cancer can reduce cancer deaths, because the sooner cancer is diagnosed, the easier it is to treat it.

Another method for treating cancer using nanotechnology is to equip nanobots with certain compounds, proteins and chemicals that are lethal to cancer cells. When these nanobots are injected into the bloodstream, they can seek and destroy cancer cells without harming healthy cells and tissues.

Researchers have also found that certain nanoparticles combined with gold nanoparticles are effective for starving cancer cells. These special nanoparticles are created to look like HDL cholesterol, so that when they attach to a lymphoma cell, they prevent cancer cells from attaching to real HDL cholesterol, causing cancer cells to starve to death. Another way to use gold nanoparticles to destroy cancer cells is to attach anti-cancer RNA molecules to gold nanoparticles and apply them to the skin or inject them into the body. As the nanoparticles penetrate the body of cancer cells, they can stop them from producing proteins and therefore preventing cancer cells from growing.[20]

The dangers of nanotechnology

Nanotechnology has many great potential but in the wrong hands it could be weaponized to destroy the human body. In addition, relying too much on nanotechnology can

weaken the body's natural defense systems, making the body dependent on nanotechnology to survive

The Pros of Nanotechnology

- Nanotechnology can possibly eliminate excess trashes by turning them to something new, eliminate various diseases, and lead to amazing medical breakthroughs, clean the environment, eliminate the needs for landfills, and even remove various air toxins.
- This technology will allow humans to create anything lighter, stronger, better, and cheaper.
- Nanotechnology can stop diseases internally, and even slow down aging process.
- People will never need to disrupt or obliterate the environment since they can use unused things and left over things that have been used up already. Such nanorobots can create almost anything without the need to destroy the forest and buy oil from the foreign countries.
- Economic nanotechnology will create more jobs since there will be a great demand for highly skilled workers, researchers, and more teachers.
- It will pave a way for businesses and companies to see, install, and repair products that are using nanotechnology.
- Improved product features like water proofing, flexibility, durability, quick charging, scratch resistance, and better displays among others.

With all these benefits, it is easy to say that nanotechnology can prove to be very beneficial for people and for the entire world. However, this technology still has drawbacks that must be taken into account.

The Cons of Nanotechnology

- Jobs and employments will be lost at a very alarming rate since nanorobots can do a lot of work much faster and more efficiently as compared to human counterparts.
- The nanorobots can also be used as dangerous weapons by the terrorists, as these robots are nearly untraceable.
- There are also severe health problems if nanorobots land up inadvertently in the human body. There have been reports and cases of employees or workers at paint factories suffering from lung diseases due to the inhaled nanoparticles.
- With nanotechnology, there is the possibility of developing self replicating weapons.
- Strong sets of new ethical standards are needed in order for this new technology to be properly governed. Some believe that people do not have capability of watching over this new technology, which can lead to issues and problems that can affect the people especially the world.

1.8 Dealing with ethical issues

Because biotech innovations may eventually involve germ-line manipulation, the actions we take today may affect every future generation of human beings, making the coming generations stakeholders in our ethical analysis. Consideration of transgenerational consequences may impose limits on what we do now in the interest of those who come after us. Minimally, we should not knowingly inflict harm. Many indigenous peoples speak of responsibilities that extend

to the next seven generations. There is moral wisdom for us in that approach. As we approach cutting-edge issues in biotechnology, this very ancient moral wisdom can serve us well.[22]

As there is no single set of ethical principles sufficient for building a more equitable and ethical use of biotechnology, the following actions are recommended that individuals, states, corporations and voluntary organizations in the international community can take:

- Creating the mechanisms to balance interests and resolve conflicts
- Supporting and encouraging broad stakeholder participation in policies, programs, and projects
- Encouraging individuals, communities and nations to engage in dialogue, and ultimately, to do what is ethical
- Developing and disseminating widely the information and analyses necessary to make wise and ethical decisions
- Ensuring that decision-making procedures in international food and agriculture policy are well understood and transparent
- Fostering the use of science and technology in support of a more just and equitable food and agriculture system
- Ensuring that programs, policies, standards and decisions always take ethical considerations into account so as to lead to enhanced well-being, environmental protection and improved health.
- Developing codes of ethical conduct where they do not currently exist.
- Periodically reviewing ethical commitments and determining whether or not they are appropriate, in the light of new knowledge and changes in circumstances.

6. Conclusion

Despite the diversity of ethical issues in biotechnology, there is a need to understand beliefs and doctrines as this allows coexistence within and across societies, and prevents social conflict. A technology's acceptance is based not only on technological soundness but on how it is perceived to be socially, politically, and economically feasible from the viewpoint of disparate groups. An understanding of ethics helps determine what information is needed by society and how to deal with different opinions. A process of negotiation based on trust is essential to enable stakeholders to participate in debates and decision making.

People's perception of biotechnology and their approval of its use in various sectors of biotechnology are influenced by their socio-economic characteristics, social/political and religious views, their education and scientific knowledge. The public are generally optimistic about the potential of biotechnology to enhance the quality of human life and are broadly supportive of the use of this technology in majority of day to day life events.

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