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# Ethical Challenges of Animal Biotechnology: Application of Ben Mepham's Ethical Matrix

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**Contents**

# 1. Introduction: Scope Method and Objective of the Study

## 1.1 Background of the Study

In the last century, a number of scientific discoveries marked the arrival of a new era of scientific advancement. For example, information technology and genetic engineering are the mentionable discoveries in the last few decades. During the last few decades, biotechnology has ushered into various technologies; some of these are: (i) bioprocessing, or the invitro manipulation of cells, (ii) recombinant DNA technology, and (iii) monoclonal antibody. Biotechnology has got a long history. Since the beginning of the civilization when human beings learned the art of 'planting crops' and 'breeding animals', they also learned, at the same time, how to ferment fruit-juice into wine, beer, and cheese, how to convert milk into yoghurt, and how to make spongy-bread by using bacteria and yeast. All these activities are the nascent stage of biotechnology. The main objective of biotechnology is to invent new ways of producing adequate food for the world.

## 1.2 Statement of the Problem

Technological development has brought an enormous amount of benefits for the mankind. Apart from this benefit, human beings are also concerned about the unintended environmental, social, and health-related consequences. While take into consideration all these impacts, scientists should take into account consequences of any science as well as accept the greater responsibility for the reasonable application of the scientific result. In the field of biotechnology, many critics argue that it

> "will jeopardize even our past achievements and add numerous incalculable risks to our future. The human body will be commoditized and objectified, becoming a source of patentable raw materials which can be combined to produce tissues and living organisms that cannot develop naturally" (Andrew,1993 :188f).

Such an idea is first expressed by Hans Jonas in his seminal work *The Imperative of Responsibility* (Jonas, 1984). He is of the opinion that (animal) biotechnology has got potential environmental and health risks and negative impact upon the other species of the world. The present thesis draws its focus on the ethical assessment of the application of biotechnology. In this thesis, the following issues are addressed: is animal biotechnology compatible with the norms of animal welfare, environment, and public health**?** In order to spell out the answer to this question, this thesis will explore Ben.T.Mepham's 'ethical matrix' (1996a, 1996b, 2000a, 2000b, 2000c, 2005, 2006 and 2008). Mepham (2000) with his colleagues at the University of Nottingham developed this method in order to facilitate rational ethical analysis and weighing and integrating potentially conflicting values in the decision-making process. The ethical

components, i.e. well-being, autonomy, and justice, are derived from the T L Beauchamp, and T.F.Childress, 'four principles approach' (1994).

**1.3 Framework of the Thesis**

This thesis endeavors to reach the conclusion that biotechnology, specially the field of animal biotechnology, has got a variegated splendor. Section 1.5 of the first chapter gives us an understanding of the concept of animal biotechnology and its different techniques. Because of its wonderful contribution, we cannot avoid the dangerous potentials of this technology. In this regard, I will devote the ethical controversy of this technology in the second chapter. The third chapter introduces 'Ethical Matrix' of Ben Mepham, which is known to be an influential assessment tool of biotechnology.The fourth chapter will focus on the application of Mepham's ethical matrix in some contexts of animal biotechnology, such as bST, transgenic animal, and xenotransplantation.

**1.4 Methodology**

*Animal* biotechnology is not a single issue. Rather, it has become a title for a wide range of environmental, public health, and animal welfare-related concerns. Therefore, the solution of the problem is not simple, but complex and multidimensional. To examine the ethical acceptability of animal biotechnology, we need to assess the impact of this technology and its potential effects upon the four interest factors: consumers, farmers and financiers, treated organisms, and environment. In this regard, I have selected Mepham's *ethical matrix,* which is a practical approach for addressing broader policy issues in this regard. I think that *ethical matrix* is such a theory that it can incorporate the demand of science and the multidimensional complexity of it that exists today.

In order to evaluate the ethical impact of biotechnology in the fields of agriculture and food, Mepham provides this method of analysis that would help one for facilitate ethical decision making. Mepham's method of 'ethical matrix' is two-dimensional i.e. *consequence matrix* and *evaluative matrix*. C*onsequential matrix*, gives a brief description of the assumed or possible consequences of a decision taken upon every affected value, and *evaluation matrix*, on the other hand, provides an overall picture of the ethical status of the issue at stake. Both the approaches can help us articulate an ethical framework for the technologies applied to the animals.

**1.5 Clarification of the Key Concepts**

In order to get a clear idea about the problem, it should be explained well what biotechnology means. The term, 'biotechnology', is first used in 1917 by the Hungarian agricultural engineer Karl Ereky who anticipates the term, 'biotechnology', as a "spirit of molecular research" (Fari

and Kralovanszky, 2006:10). In his research, he states that every living organism has got 'nucleic acids' which are different from each other in their structure. In 1918, Ereky finds a link between nuclear acids and biotechnology. He takes the term, biotechnology as a "technology based upon biochemistry' (Fari & Kralovanszky, 2006:10)**.** The European Federation of Biotechnology (EFB) accepts the term, 'biotechnology', in the sense of the combination of biology and technology — where the term biology is treated as a branch of knowledge of living organisms and technology as a scientific knowledge. EFB defines the term as an

> "integrated use of biochemistry, microbiology and engineering sciences in order to achieve technological (industrial) application of the capabilities of micro-organisms, cultured tissue cells, and parts thereof" (cf Becker, G., 1996 : 1).

In order to develop micro-organisms, improved plants or animals, and to modify food-products, biotechnologies have been used in a wide range of production. This technique is used for transgenic animal's production, commercial products, food production, plant tissue culture, DNA profiling/finger printings, animal tissue culture, pollution control, to safe plants and animal's extinction, prevention-diagnosis, and cure of diseases. According to its use, there are different kinds of biotechnologies can be mentioned as following: a. Industrial biotechnology, b. Environmental Biotechnology, c. Biotechnology as Human Application, d. Health Biotechnology and e. Agricultural Biotechnology. All these types of biotechnology are not my area of focus. Rather, I will focus on animal biotechnology.

There are different kinds of efficient animal biotechnological techniques: 1. Recombinant DNA techniques, 2. Transgenic, 3. Genetic engineering, 4. Cloning, 5. Artificial Insemination. 6. Estrous Synchronization, 7. Embryo Transfer**,** 8. In Vitro Fertilization (IVF), and so on (Mepham, 2005:213-229). In order to make a clear idea about animal biotechnology, different types of animal biotechnologies and its different uses can be explained here:

**a.** Artificial Insemination (*AI*) is a technological development in dairy and poultry industrial production. *AI* is a process of collecting sperm artificially by prompting ejaculation from male animals. It is injected to recipient such as swine, sheep, beef cattle, and turkeys. Specially, in the developed country *AI* has been used in the breed development of pig, horse and sheep (Mepham, 2005:215).

**b.** Estrous Synchronization is a developed form of AI which can more efficiently control breeding. Different kinds of reproductive hormones (such as Progesterone, Prostaglandins, and Gonadotropin releasing hormone (GnRH)) are used in Estrous Synchronization Protocol. The actions used in this technique are: 1. Progesterone: "Keep animals out of heat and extend the

estrous cycle" 2. Prostaglandins: "Bring females into heat and shorten the estrous cycle." 3. GnRH : "Cause ovulation or start development of a new follicular wave" (Hall et.al. 2009:1).

**c.** In Vitro Fertilization (IVF) has been improved for obtaining an adequate number of high quality farm animals. Sometimes IVF is called "fertilization in a test tube". This process involves two steps: in the first step oocytes (embryo) from genetically superior ovaries of a donor are collected. Then it is fertilized in an incubator within a week. In the second step, most of the viable oocytes (eggs) are inserted into a genetically less desirable female (Mepham, 2005: 106).

d**.** Transgenic animals are those which have been altered by genetically engineered with an aim to remove genes from them or to insert genes from other species. There are three techniques for producing transgenic animals: (i) recombinant DNA, (ii) retroviruses-mediated gene transfer, and (iii) embryonic stem cell-mediated gene transfer. In 1981, biotechnologists produced transgenic mouse by inserting the gene for human growth hormone into a mouse's genome (*BIO.* 2007:71).

e**.** Bovine Somataotrophin (bST) is one kind of natural occurring growth hormone. At first, bST was commercially produced in the USA as a GM product to be used in animal agriculture. It is produced by biotechnological engineering through recombinant DNA in cultures of the *Escherichia coli* (Mepham, Kaiser et.al., 2006:32). It helps stimulate milk productivity efficiency. This hormone is injected to a cow once in every two weeks in order to increase 15-25% of the milk it produces (Mepham, 2005:52-53).

**2. Animal Biotechnology and Ethical Challenges**

Different kinds of technologies have been improved in the area of biotechnology. All of these technologies have given a great opportunity to the human beings. Biotechnologies have made it possible to produce more nutritious food and medicine and also to develop a way for growing more food in saline water, nearly draught land, and in stressed conditions. Despite these contributions of animal biotechnology, different controversies have been raised in this regard. All of these bring forth different ethical challenges. What is the environmental impact of this technology? Another ethical challenge is related to animal's welfare and human's health. During the last few decades, there have been different types of arguments are discussed in this regard. In this chapter, each of the arguments and controversy is presented in brief to draw a final conclusion and propose suitability of the ethical matrix at the end.

**2.1 Animal Biotechnology and its Pros and Cons**

The question regarding animal biotechnology is a crucial one. While spelling out the answer to the question, most of the pro-animal biotechnology proponents argue that this technology can adequately remove hunger from the world by producing an enormous amount of food within reasonable prices and also able to eliminate most of the critical lethal diseases. The ethical principle of beneficence also demands such an action as biotechnology demands, which is enable to reduce (remove) global hunger and critical diseases. Gregory Pence (2002), a proponent of biotechnology, upholds the view that as a technology it emphasizes end of hunger. The second major focus of animal biotechnology is related to health, particularly, with the field of modern drug development, vaccines, diagnosis, and other medical concerns.

Regarding the issue of global hunger, different international bodies claim that the world population and our demand have increased rapidly in the recent times. But, our natural resources and, particularly, agro-land has not increased accordingly. In a report made by FAO (2009), it has been mentioned that:

> "By 2050 the world's population will reach 9.1 billion, 34 percent higher than today. Annual cereal production will need to rise to about 3 billion tonnes from 2.1 billion today and annual meat production will need to rise by over 200 million tonnes to reach 470 million tonnes" (FAO, 2009 : 2)

All these data give us the message that in order to feed the ever increasing population in the world, food production will have to be doubled by 2050. How do we respond to this situation? In response to this situation, the new liberalist R. Shapiro states that in order to achieve the required food we need to give greater priority to agricultural research such as food biotechnology (Shapiro, 1999: 28-29). The analysis also claims that we need to require to become concerned about food security of the current increasing global population. Biotechnology in animal farming has the potentiality to produce super-productive animals, which are as to provide the necessary amount of nutritious milk, animal protein, and fat-less meat. It helps us to produce crops in the highly saline and nearly drought soils. This is why, Shapiro argues that biotechnology can help meet the basic rights of global population by contributing to food security.

In respect of Shapiro's defence of biotechnology, we can now raise the following question: is biotechnology the only way to meet the thrust of world food security? While responding to this question, we can explore the information that in every year one hundred tons of corn is turned into bio-fuels and 756 million tons of grains were fed to the animals only in 2007 (Singer, 2009: 121-122). This data implies that we are not producing too little food

and that we do not eat the food we grow. So, claiming to meet the food scarcity it is not essential to produce an enormous amount of food by applying biotechnology. In fact, we have got enough food. However, what we need to do is that we should ensure equal distribution and mankind's fair access to the production.

**2.2 Animal Biotechnology: Ethical Challenges**

Despite potential outcome from animal biotechnology, there are a number of controversies regarding several areas of the application of animal biotechnology. If we concentrate only on the benefits of human beings in terms of the consequences, possibly we will not find any problem in it. There are also dark side of biotechnology (as well as of animal biotechnology), which cannot flight away our insight. A number of ethical experts have realized the adverse effect of this technology. Gerhald Becker compares this drastic implication and the social impact of this technology with

> "the splitting of the atom and the technological exploitation of nuclear power. As with nuclear technology, biotechnology has put enormous power in our hands" (Becker, 1996: 4).

Nuclear power can contribute positively to the well-being of mankind. At the same time, it can destroy innumerable lives of human beings. In the similar way, biotechnology has also got same evil purposes, which would cause "incalculable risks for human integrity, well-being and freedom" (Becker, 1996:5). Some other experts like J. Thomson (1996) argue that these risks can be transformed into moral concerns. He focuses on the 'unintended consequences' and 'ethical concerns' of modern biotechnology, which is "inherently unethical" (Thomson, 1996:123-124).

The development in biotechnology during the last few decades has raised a lot of ethical controversy. Critics have generated different arguments while opposing this technology, which may conveniently be divided into two kinds: (1) intrinsic arguments and (2) extrinsic arguments (Kaiser, 2005:75). Intrinsic argument against biotechnology maintains that biotechnology is "objectionable in itself" (Comstock, 2000: 76). And extrinsic argument focuses on the "allegedly harmful consequences of making GMOs" (Comstock, 2000: 76). In this sense, animal biotechnology is ethically problematic because "it is unnatural to genetically engineer plants, animals and foods" (Comstock, 2002:76). The argument goes like this, biotechnology is the form of 'redesigning an animal' which is the "Playing with God". (Animals) biotechnologies are also break down the natural species boundaries. In the sense of extrinsic argument, animal biotechnology is ethically wrong because of its negative consequences on human beings, animals, and environment.

### 2.2.1 Intrinsic Arguments against Animal Biotechnology

i. **The Argument for Playing with God**

The argument of Playing with God is based upon the concept of 'God's will' and on the relationship among God, nature, animals, and human beings. It is found in the *Bible*. To some extent, this argument is the adherent version of Christianity (Kaiser, 2005:77). C.A.J.Coady (2009) uses the term in a religious sense. He thinks that the view that God himself sets out a plan and makes designs for the universe and human beings is being assigned to observe it. God as an omnipotent and omniscient being, has set out a specific 'roadmap' for the universe, animal kingdom, and nature (Coady, 2009:155-180). But, animal biotechnology tempers the animals' design by inserting a new gene into a species. Thus, in a way (animal) biotechnology breaks down the boundary between the 'realm of God' and the 'realm of humans'.

Is the 'playing with God' argument enough to oppose animal biotechnology? We get responses to such a question in Ronald Dworkin's book *Sovereign Virtue* (2000) in which he argues that in the bio-political context 'the argument for Playing with God' is not 'morally and intellectually honest'. This is not a recent phenomenon to sustain the fight against the hostile nature. Human beings, for their necessity and needs, rearrange nature in the way they find it suitable for them. Biotechnology is such a technology that has essentially become a part of human life. Therefore, the argument for the Playing with God is not a strong stand to stop biotechnology.

**ii. Break-down of the Natural Species Boundaries**

Recently, a conceptual study, "Ethical Aspects of Agricultural Biotechnology" (BABAS, 1999) has shown that any sort of biotechnology is morally unacceptable because of its 'unnaturalness' (AEBC, 2002). The European Commission agrees with the idea that (animal) biotechnology is 'unnatural'. This theory also indicates that the application of biotechnology breaks the natural order of different kinds of species. Something natural is assumed to be valuable and good. But, all kinds of biotechnology or genetic technology temper nature where species boundaries are crossed. The term, 'Natural', is somehow different from the concept 'Unnatural'. The difference can be shown as follows:

> "Nature and all that is natural is valuable and good in itself; all forms of biotechnology are unnatural in that they go against and interfere with Nature, particularly in the crossing of natural species boundaries; all forms of modern biotechnology are therefore intrinsically wrong" (BABAS, 1999 : 10).

Something, which is natural also, means that it is 'normal', 'right', 'appropriate', and 'suitable'. On the contrary, 'unnaturalness' refers to something which is man-made, artificial,

or which is dependent upon our interference with the natural world. 'Unnaturalness' has got a broad spectrum in our modern life. For example, most of the food production, animal farming, clothing, and used materials are the result of unnatural interference of nature. 'Naturalness' and 'unnaturalness' can be characterized as 'non-anthropocentric view' and 'anthropocentric', respectively. The anthropocentric view proposes a careful management of resources along with interference of nature. On the other hand, the eco-centric view holds non-interference in relation with nature. The eco-centric view accompanies the view of 'respect for nature', which does not allow any biotechnological tool as a means of the interference of nature. As an anthropocentric means, biotechnology is the viable example of 'unnaturalness' by which natural integrity of species and the species boundaries are breached.

**iii. Animal Integrity and Animal Biotechnology**

Does animal biotechnology violate the concepts of 'animal integrity'? The Dutch National Committee on Animal Biotechnology presents their argument that biotechnology has got potential negative effects upon animals. For the sake of human benefits, we changed the properties of animals by genetic modification, which is the 'violation of the integrity of the animal'.

Before entering into the objection against the application of animal biotechnology, we will shortly clarify the concept of 'animal integrity'. The concept was not developed in the biotechnological context. Rather, it was borrowed from the field of ethics for making an assessment of the impact of animal biotechnology and the genetic modification of animals. In the Utrecht University, a number of ethicists and veterians give their definition of the term, 'animal integrity'. In the definition, they stress on the fact that every animal has (i) 'wholeness and completeness', (ii) species-specific balance of an animal and (iii) animals have its own capacity to maintain itself independently in the environment suitable to the species (Vries, 2006: 471, Rutgers & Heeger 1999: 41-51, Heeger, 1997: 243-252).

The notion about 'animal integrity' implies that we should not apply any sort of interference upon all these features of animals. The definition mentioned above implies that every animal has got its own 'physical intactness', which is not expected to be interfered. However, genetic engineering and trans-genesis process of animals introduce

> "a gene foreign to the species to a gamete, the wholeness and completeness of the animal […] is altered at its most fundamental level, the genome" (Vries, 2006: 471).

So, it is now understood that any form of animal biotechnology is rather a kind of interference in the 'wholeness and completeness' of the animal. For example, a chicken or a pig has got some characteristic features of its own, which should not be changed by tempering

its original physical intactness. But, breeding and transgenic process applied in broiler chicken and pigs certainly violate the wholeness and completeness of animals.

Rutgers and Heegers have described the second feature of the animal integrity thus: 'species-specific capacities'. They assume that the violation of the second feature is the violation of principle of animal integrity. For example, after the production of a broiler chicken, it grows very fast. But, it cannot move naturally. It grows rather in a very abnormal pace and its biological fitness is not suitable for the environment. All such things upset its biological balance. Rutgers and Heeger claim that "the more the animals lose its species-specific capacities and characteristics, the more serious the integrity violation" (Rutgers and Heeger, 1999: 49). The third characteristic feature of animal integrity is environmentally suitable for the animal.

The moral status of an animal is another prime issue regarding animal integrity. Different questions can be raised in this regard: what is the ethical status of the species? Is there more ethical importance of some species than the others? Besides, there is also controversy amongst the thinkers as to whether animals have any moral status or not. Besides, in what sense should animals be considered morally? Heeger answers to this question thus: "animals have good of their own" and "they have interests, namely in everything that contributes to the realization of their good" (cf. Vries, 2006: 473). Biotechnology intervenes with the intact body of animals and also threatens their essential characteristics. So, it can be said that animal biotechnology does not maintain any good/ well-being of animals.

**2.2.2 Extrinsic Argument**

Extrinsic argument deals with two potential questions: i. Does animal biotechnology violate the criteria of 'animal welfare'? ii. What are the effects of biotechnological application upon the environment?

**i. Animal Welfare.** Before finding out the answer to the first question, at first, we shall have to make the concept of 'animal welfare' clear. The term, 'animal welfare', is used by different types of people, specially by veterinarians, farmers, consumers, and politicians. Veterinarians focus on the physical environment such as shelter and feeding; they also need to measure how the animals are coping with the existent environment (Brom, 1991: 4167-4175). Besides, there are people who think it is important to maintain the psychological status of animals. They are of the opinion that animals have various psychological states such as fear, frustration, and pain, which need to be addressed. It should be taken as part of their primary needs (Duncan, 2002: 643:652). So, it can now be said that the overall physiological and

mental well-being of the animals is called animal welfare. However, application of animal biotechnology affects animal welfare in the following two ways:

(a) By using biotechnology, different kinds of animal drugs and feed additives are produced which have adverse effects on the animal health. In genetic rearrangement, either in the non-sexual or in the sexual exchange, or in the laboratory, unavoidable sufferings of animals is beyond description. A study (BABAS, 1999: 22) shows that after breeding farm animals suffer from infections from Rota-Viruses, which are caused by heavy diarrhea-diseases. These viruses damage their intestinal mucosa. The same study gives an example of the experiments conducted on the pigs through which they were genetically modified. By inserting additional gene copies for growth hormone into pigs, it is possible to bring forth faster growth of the offspring. But, the animals involved in the process suffer from severe arthritis, which affects their health seriously.

(b) Application of animal biotechnology involves such procedures that can cause types of different sufferings for the animals. There are different sorts of proceedings which are related to animal biotechnology. First of all, it encourages the use of a large number of animals within a limited place. Intensive livestock farming is one of them. What happens in this kind of farming is made clear by the statement given by Peter Singer. He opines that there is no tolerable life for the animals who are under in intensive livestock farming. There, throughout the year, animals are crowded in a battery cage, or in the cases of a breeding sow, there they are unable to walk or turn around, there is no way of socializing, sometimes they are thrown out and killed. All these steps are evidences of ill-treatment of animals as these confines them to a limited boundary (Singer, 1989, evidence: 9470). Animals are also deprived of their necessary ethological and biological needs. In this kind of farming, caging, restraining, spacing, breeding, roaring, slaughtering, controlled environmental situation are common phenomena.

Do animals enjoy ‘freedom’ due to biotechnological application? Brambel has produced a seminal report on animal welfare, which refers to the existence of ‘five freedoms’ as the condition of animal welfare. These are : a). “freedom from hunger and thrust — by ready access to fresh water and a diet to maintain full health and vigour”; b). “freedom from discomfort — by providing an appropriate environment including shelter and comfortable resting ”; c) “freedom from pain, injury or disease — by prevention or rapid diagnosis and treatment”; d) “freedom to express normal behaviour — by providing sufficient space, proper facilities and company of the animal’s own kind”; e) “freedom from fear and distress — by ensuring conditions and treatment that avoid mental suffering” (*Brambel Report*, 1965, Report : 2836, cf. Kaiser, 2005 :80). Some

genetically modified animals suffer from pain. They cannot behave normally due to their deplorable physical condition. Application of some specific kinds of biotechnology such as the use of bovine somatotrophin (bST) on animals results in the physical sufferings which seem to be an act of violation of said five freedoms.

**ii. Environmental Concern.** In response to the question (ii), scientists have put forward different kinds of arguments. A study on 'animal biotechnology and environment' accomplished by Krimsky and Wrubel (1996), claims that animal biotechnologies have got an enormous amount of environmental benefits. They argue that in the traditional milking system more cows give less amount of milk and occupy more agro-land, more cows also produce more slurry and manure. On the other hand, the use of biotechnology is helpful in reducing the amount of land required; thus it can keep the land for non-agricultural purposes. Another study has shown that a genetically modified animal generates 'low phosphorus manure' (Goloven, et.al. 2001: 741-745). Usually, feed phosphorus from animal manure is responsible for the pollution of surface water. Low phosphorus contributes TO less pollution. Thus, the use of biotechnology turns into a great environmental benefit.

Interestingly, there are a number of studies which argue that the application of animal biotechnology causes a lot of environmental problems. Application of this technology in the food sector, particularly in milk, meat, and egg productions has made the demand for intensive livestock farming. Various studies have shown that livestock farming, including intensive livestock farming, is responsible for greenhouse gas emission. It also claims that intensive livestock farming (including livestock) is "probably the largest sectoral source of water pollution, contributing to eutrophication, "dead" zones in coastal areas, degradation of coral reefs…" (LEAD, 2006: 17).

**2.3 An Evaluation**

Regarding the intrinsic argument we can explore the following two points at least:

**Firstly**, the central theme of intrinsic argument is that every species has got its own shape and structure, which it gains in a natural way. Natural diversity refers to the existence of particular characteristics of every species. Some animal biotechnologies such as transgenesis and Xenotransplantation break-down the natural diversity of animals, which is not right way of treating them. In response to this criticism, we can mention here theory of Darwin's theory of evolution. According to this theory, the structure and the phase of every species is not static. According to Darwin (1859), phenotypes of species change from one generation to the other over a long period. Various new types of species arose from the species of the past through a process of gradual change. The period of change might be as long as hundreds of years or even

more than that. Species are also changing their physiological structure, either by natural selection or by their adaptation to the environmental changes.

Sometimes, the course of change in the animal occurs in its inner genetic mapping. Most of the theorists of evolution regard this change as a natural process. The natural change of animals might occur slowly over the years. There is another example we can explicate here. Some of the viruses have capacity to bear genetic materials which are very much helpful for gene transformation to another species. This gene can bring a radical change in the new species. This is a natural process of change as it occurs through biotechnological process. So, the idea that is not based on strong arguments as such a break-down of natural species has always been occurring in the animal kingdom.

**Secondly,** sometimes animal biotechnology is considered as unnatural, which is intrinsically wrong. Do we think that in the natural world anything natural is normal or ethical? Regarding this question, we can refers to some of natural phenomena such as earthquake, cyclone, storm, drought, flood, and many other such natural calamities which usually take place in nature and create an abnormal phenomenon. Although it is described as 'natural' should we consider it as normal or intrinsically good? Of course, we do not consider these as normal phenomena. So, something that is natural or formulated by natural law does not always mean that it is arranged or created by the law of order or in a disciplined way. In this sense, the concept, 'natural' does not mean good or normal as it is attributed by the critics of animal biotechnology.

If we look the agricultural crops and food by which we live, we can realize that these are the results of biotechnological formulation. The system of production of agricultural crops is the best instance of biotechnology. Even in the animal kingdom naturally and artificially there is a verity of the forms of biotechnology. We mould the nature for our suitable use by applying certain techniques upon it. So, the techniques for processing nature, the techniques for producing crops, and the techniques for creative survival and progress of dwelling are the essential features of our living.

Regarding the concept of 'extrinsic argument', it has been argued that new technologies used in animals cause pain and sufferings in different ways. But, there are also opposite views to it. Animal biotechnology such as cloning or transgenic technique does not necessarily cause pain to an animal. Rather, it reduces the animal's pain. Furthermore, it can be said that in the conventional system of animal breeding an animal experiences severe pain (EGE, 2008:22). Not only that, the conventional style of domestication also violates 'animal integrity' and 'animal welfare'. For example, in the domestication system, animals are infringed in a limited

boundary; its movement is confined to that area, and its feeding and natural requirements are met and determined from the outside. However, to get a balanced life and physiological growth animals need suitable environment where they can grow naturally and smoothly.

[Bio]Technology (whether it is animal or agricultural) is one of the means of our living today. We cannot deny or oppose it all on a sudden. We need to be careful as well as critical in this regard. Therefore, it is an imperative that we select tools for better assessment for evaluating [bio] technology. In order to assess the ethical issues raised on the application of biotechnologies in agriculture and food production, a number of countries belonging to the European Union have developed a method of decision-support tools. A group of ethical experts has developed a set of ethical tools which is known as Ethical Bio-TA. It facilitates ethical decision-making by the government agencies, the general public, and the financial actors in the food chain (Volkert, 2006: 7). There are a number of ethical tools in the decision-making framework with the potential for supporting the work of public policy decision-makers. They are: Casuistry, COGEM framework, Critical systems heuristics, Delphi method**,** Discourse ethics, Ethical codes/guidelines, Ethical matrix, Multi-criteria mapping, Precautionary principle, Principle based ethics, Risk analysis, Stakeholder analysis, and evaluated ethical bio-technology assessment tools. Ethical Matrix is one of the ethical tools that has developed by T. Ben Mepham and his colleagues from the University of Nottingham**,** will be focused in the next chapter.

### 3. Ben Mepham's 'Ethical Matrix': A Critical Overview

In our previous discussion, we have found that animal biotechnology is a controversial issue from various perspectives. How can we solve this problem**?** During the last few decades, different thinkers have made attempt to find out the proper answer to this question. John Rawls tries to tackle such an issue with the help of "reasonable or justifiable principles'. Such principles should be "acceptable to any impartial competent judge; and they must be intuitively so, even reflecting a 'commonsense rule'" (Rawls, 1951:177-197). Beauchamp and Childress (1979, 1994) developed 'four principles approach' for tackling the problem of biomedical context. In the last few decades, application of biotechnology in food agriculture has aroused significant issues related to public debate. The European Union has paid a lot of attention to this debate. Thus, the issue of biotechnology has appeared to be very important to the policy makers and government agencies. This significant concern about the biotechnology has pursued the ethical experts to invent ethical tools for making assessment of the impact of new

(bio) technologies in food agriculture. This chapter will focus on such an assessment tool namely, Mepham's 'ethical matrix' along with all its pros and cons.

### 3.1 Mepham's Ethical Matrix

Mepham's 'ethical matrix' is one of the formulations of ethical tools for finding out an ethical decision in the areas of food and biotechnology. He introduces this matrix for 'rational ethical analysis' with an aim to assess the impact of new technology of food and biotechnology (Mepham, 1996, 2000a, 2005, 2006). His 'matrix' is a modified version of Tom Beauchamp and Childress's principlism (1979), which offers the following four principles: 1. Non-maleficence, 2. Beneficnece, 3. Autonomy, and 4. Justice. The principles of beneficence emphasize 'practices of good deeds'; non-maleficience refers to the "obligations not to inflict harm", principle of autonomy is the "guiding principle for the recognition of human capacity for self-determination and independency in decision-making" (Bhardwaj, 2003:39); and the principle of justice is based on two things: (1) fair treatment of all, irrespective of race, color, religion, and economic status, and (2) equity in terms of distribution.

Mepham argues that the approach of four principles is quite applicable in the field of bio-medical aspect. He states that it has faced a lot of critiques. Not only that "... the framework is not an ethical theory and does not aspire to be decision-making procedure" (Mepham, 2000a: 167). Rather, the four principle approach provides a set of "substantive moral premises upon which to base reasoning in health care ethics" (Mepham, 2000a: 167) and that it "offers a trans-cultural, transnational, trans-religious, trans-philosophical frameworks for ethical analysis" (Mepham, 2000a: 167). He assumes that the principled approach can hardly satisfy Rawls's "non-intuitive" means of moral judgment. Mepham revises the four-principle approach and offers new ethical tools: "ethical matrix" for the purpose. Such principles can:

> "…suitably translated within the context of food biotechnologies, provides a framework for ethical analysis which should facilitate appropriate public policy-making in democratic societies." in order to assess " the ethical impacts of biotechnologies in the fields of agriculture and food technology" **(**Mepham, 1996 : 105**).**

Four-principle approach is applicable only to the realms of biological science, healthcare, and medicine. But, Mepham's 'ethical matrix' is applicable to the fields of agriculture, biotechnology, and food. In his works, Mepham transforms Beauchamp and Childress's 'four-principles' into three. In the framework of the 'matrix', Mepham combines Beauhamp and Childres's the first two principles (beneficence and non-maleficence) and renames it as the 'respect for well-being'.

### 3.1.1 Framework of Mepham's Ethical Matrix

There are two ingredients in the framework of Mepham's 'ethical matrix': i. prima facie principles and ii. 'interest groups'. In his framework of ethical matrix, Mepham employs three prima facie principles: well-being, autonomy, and principles of justice. These three principles represent three ethical theories. Firstly, respect for the well-being combines the first two principles of Beauchamp and Childress: non-maleficeine (avoidance of causation of harm) and beneficence (provision of benefits and balancing them against risks and costs) represent the utilitarian theory. Secondly, respect for autonomy represents the deontological tradition, which is related to the freedom of choice and respect for the individual's rights. Thirdly, the theory of justice represents the norms of fair distribution of costs, benefits, and risks. This is an application of John Rawls' theory of justice. Mepham has shown his ethical matrix through the following figure:

| Respect for | wellbeing | autonomy | Justice |
|---|---|---|---|
| **Treated organism** | e.g. Animal welfare | e.g. Behavioural freedom | Respect for telos |
| **Producers (e.g. farmers)** | Adequate income and working conditions | Freedom to adopt or not adopt | Fair treatment in trade and law |
| **Consumers (**Availability of safe food) | Availability of safe food, acceptability | Respect for consumer choice (labeling) | Universal affordability of food |
| **Biota** | Protection of the biota | Maintenance of biodiversity | Sustainability of biotic Populations |

Figure 1: Mepham's Ethical Matrix, Source: Mepham, 1996

Mepham states that in the 'ethical matrix' there are twelve individual factors under the following three principles: well being, autonomy, and justice. And there are four stakeholders or interest groups, i.e. treated organisms (animals), producers (farmers), consumers (people), and biota (environment : flora and fauna) on the vertical axis and three principles on the horizontal axis.

### 3.2 A Critical Response to Ethical Matrix

In the case of biotechnology in animal farming, Mepham's ethical matrix has got adequate merit. The principles of this matrix help one to identify the side-effects of application of biotechnology. Particularly, this matrix successfully provides a tool to identify the interest of the treated organisms. For example, the principle of well-being helps one to identify the

animals' welfare; the principle of autonomy helps one to identify the behavioral freedom of the animals, and the principle of justice ensures that an animal has got 'intrinsic value'. All these principles imply that an animal should not be treated instrumentally. By this matrix, we can weigh the harms and benefits of the relevant stakeholders (consumers, producers, and biota). It also helps one a lot to "facilitate appropriate public-policy in democratic societies" (Sayer, 2003: 20).

Despite the successful achievement of this tool, there are some drawbacks in it. Critics have observed that in the ethical matrix, there are three different principles, and four stakeholders. In this context, we can raise some questions: what is the internal link between these different principles? Is their hierarchical or non-hierarchical relationship? Or, are some of the principles more fundamental than others? In the second point, we can raise another question: Is the stakeholders' list mentioned in the matrix sufficient?

In response to the first question, we shall try to give the answer in different ways. Firstly, we can state that in the framework of Mepham's ethical matrix there are three principles, which correspond with three ethical theories, i.e. utilitarianism, Kantian deontology, and Rawlsian theory of Justice. These theories are different in nature from each others. For example, Mepham uses utilitarian approach to define the well-being of stakeholders. At the same time, he uses Kantian principle of autonomy which is deontological in nature. Then he endorses Rawlsian theory of justice (1971). But, the objectives of these theories are different. These different theories have possibility to give different results in different situations.

Now we can raise the following question: Is he arranging these principles hierarchically or non-hierarchically? Suppose, the principles are organized in a non-hierarchical way; then they would be contradictory to each other. If we give priority to the 'principle of autonomy' in a particular context, the outcome would be 'x'. On the other hand, if we apply the 'principle of well-being' (utilitarian approach) in the same context, the result would be different. Different kinds of ethical theories will give different results in the same context. Therefore, we cannot consider ethical theories from non-hierarchical perspective. We consider the principles of ethical matrix from hierarchical perspective: 1.human welfare (for example, food affordability) gets priority over the welfare of animals. 2. the claim of justice for human beings is more potential than justice for animal or biotic organism. 3. the subject of human well-being is more serious than animals' welfare. 4. animal's autonomy is more serious than animal welfare. If we give higher position to human welfare, welfare of animals will get less priority. Again, justice for human beings will not consider equally justice for animals (Schroeder & Palmer, 2003:301). For example, for virtue of well-beings we shall have to consider the well-being of animals, well-being of human beings, and well-being of biota. Sometimes, if any case happens

over the stakeholders, we need to take a decision. But which of the well-beings will get priority? Would we give priority to human beings to animals, and animals to biota? We do not find any specific answer in the many principles delineated by Mepham's ethical matrix. Even he does not tell us how we would arrange the principles regarding the stakeholders.

In the matrix, Mepham uses welfare rather as the well-being of treated organisms and intrinsic value as justice of treated organisms. In case of an animal as a stakeholder, well-being ensures the concept of animal welfare. Usually, animal welfare means not to harm animals unnecessarily, but rather protect them from their extinction, sufferings, or abuse. Animal welfare is placed at the animal experimentation, at the slaughtering house, at the circus, and, so on. The term, animal welfare, is defined "as advocating ''humane use'' of animals, at a minimum thus upholding animal's well-being by prohibiting ''unnecessary cruelty''" (Sztybel, 2000: 44). The concept of 'animal welfare' implies that it is morally permissible to use nonhuman animals for human purposes.

Does intrinsic value of animals imply that we can use them for our purpose? What does it mean for an animal to have intrinsic value? That something has got an intrinsic value means that it is valuable *in itself*. This value is non-relational or independent of any context. However, there are some exponents who opposed the view that value is dependent of any context, which meant that intrinsic value is 'relational' and dependent on a particular context. If value is determined as a relational, there could not be existed any intrinsic value individually and, therefore, no beings could have value in itself or intrinsic value (Simon, 2003: 145). Simon James points out that the concept of intrinsic value can be understood in the relational sense. In this sense, beings and ecosystem can have intrinsic value. According to this view, the value of animals, nature, or any organism is relational, that is "a function of the habitat in which the organism lives" (Simon, 2003: 146). And, he concludes by saying that something has value or that beings should be valued in the sense of as such. Their value should not be considered valuable only to the extent that they are useful to us. James notes that a being can also have an instrumental value in promoting an end unrelated to human interest. It can also be instrumentally valuable to the ecosystem of which it is a part (Simon, 2003:146). In this sense, value is non-relational and non-instrumental. So, intrinsic value attempts to abolish the use of organism. On the other hand, animal welfare provokes one to 'use animals with more humane' attitude and approach. The view of animal welfare indirectly provokes one to think that animals do not have intrinsic value except as economic commodities with extrinsic value. If we maintain this difference in the ethical matrix, we will reach the conclusion with contradictory decisions: from the perspective of animals' well-being we are allowed to use animals humanely

(welfare follows this conclusion), and from the perspective of intrinsic value we should not use animals instrumentally. Mepham's ethical matrix lies in this ethical dilemma.

Mepham's ethical matrix has got a number of principles in it. However, we need a particular one to assess the problems. Matti Hayry (2000) proposes utilitarian calculus technique instead of Mepham's many principles model (ethical matrix). He states:

> "A possible counterargument to my analysis is that by ignoring issues of justice and autonomy, I have reduced Mephams's original model to a mere utilitarian calculus, thereby compromising its status as a matrix which should facilitate ethical decision-making regardless of one's moral views" (Hayry, 2000 : 183).

Hayry argues that if the relevant stakeholders do not suffer for the use of biotechnology, there is no problem in using these. For example, he mentions that if cows suffer for any of the decisions that is bad, and, if the violation of cows' "intrinsic nature" does not bring any suffering, there is no problem at all. So, utilitarian calculation would be the best technique to assess the impact of biotechnology.

The utilitarian principle of ethics emphasizes the production of the greatest good for the greatest number of people. To some extent, the cost-benefit analysis is similar to the utilitarian approach. It is a technique of making decisions based upon the possible outcome of different courses of action. It helps to select an option from various courses of action, which is helpful to increase welfare. In the similar manner, utilitarian calculus also identifies how much welfare is produced by each course of action. As Mepham states, ethical matrix can help us make rational decision. However, many principles in the ethical matrix have possibility to give us different types of outcome. Therefore, it is better to follow the utilitarian principle to avoid the problem mentioned above.

In Mepham's ethical matrix, there are no particular criteria for weighing the side-effects of biotechnology. In order to reach a concrete rational decision, it requires to weigh these side-effects and their large-spectrum benefits also. Any ethical model should not only deal with some harm or negative effect of the scientific contribution. We have observed that Mepham applies his ethical matrix only to identify the negative impact of biotechnological application in animal farming. If we reread his report, or articles, on 'ethical matrix', we shall decipher the following : (1) cow's suffering from the use of bST, (2) this is also subject to health hazards, and (3) it also requires "intensified farming, which in its turn pollutes local environments and highly dependent on fossil fuel, artificial fertilizers, machinery, and transportation" (Hayry, 2000 : 182). I agree with Mepham's theory in one point — suffering of the cows, health risk, and environmental hazards that result from biotechnology in animal farming. However, Mepham does not search

any alternative way to tackle the problem. Recently, Matty Hayry revises Mepham's ethical matrix. He offers the following alternative:

> "*if* rBST could be administered to cows without causing painful side effects, and *if* treated milk would be labeled , there would probably not be sufficient grounds for prohibiting the use of the hormone" ( Schroeder & Palmer, 2003 : 303).

This approach is utilitarian in nature and is able to evaluate the pros and cons of the course of action. Under this technique, we can easily assess the problem and can take an alternative decision if it is required.

**3.3 Is the Stakeholders' List Sufficient?**

While addressing this issue, we can argue that in order to evaluate the biotechnological application in animal farming Mepham takes into consideration the vulnerability of nature, animals, and human beings (producers and consumers). In his list of stakeholders, he does not take into account 'future generations'. In the case of biotechnology 'Future generations' should also be considered seriously. Why future generations? We can try to find out the answer from two contra aspects:

Considering the nature of problem, do the scientists, ethicists, economists, and the world community agree that we should bequeath a habitable place for our future generations? This claim is strongly focused in the Principles 3 of Rio declaration: "The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations" (Jardin, 1999: 478). In 1997 (21October-12 November), the General Conference of the UNESCO meeting in Paris explicitly recognizes the importance of 'future generations' in their Articles (1), (4) and (5).

Philosophers also claim that we have got any obligation to future generations, because they are members of our moral community. Although, there is a temporal distance between the present and the future generations, both of them are the same in the sense of social ideal. There are also some philosophers who think that the present generation does not have any obligation to the people of the future. The negative impact of biotechnology does not only affect the environment and people's health at present, but, also a large spectrum of the people belonging to the future generations. We should be concerned about our future generations. Another problem is also related to this issue. If we do not entertain any alternative technological means to meet our current needs, resources available at present would be exhausted soon. This demand certainly moves us towards the enhancement of biotechnological application in food farming. If we consider the interest of 'future generations', we need to pursue new technology,

such as biotechnology, with an aim to meet the current needs while giving o pressure on our natural resources available at present..

**3.4 Meaning of Sustainability and Ethical Matrix**

In order to assess the impact of biotechnology, three principles — well-being, autonomy, and justice — are applied to the environment. In respect of environmental concerns, three principles imply three important issues respectively: well-being of biota as conservation permitting the 'benefit of the environment', autonomy of biota as biodiversity "permitting the natural ecological interplay of the biota" (Mepham, 2008:57), and justice for biota for sustainability which implies "an intergenerational sense, by respecting the biotic impetus for survival" (Mepham, 2008:57). Mepham uses this sense of sustainability in his ethical matrix.

While anyone uses biotechnology in animal farming, does s/he maintain conservation, biodiversity, and sustainability in the process? There are rival arguments regarding this issue. From the producer's point of view, it is claimed that the application of biotechnology in animal faming is helpful to reduce environmental hazards. For example, by using biotechnology, such as bST in cows, it is possible to produce the required amount of milk from a fewer number of cows. A fewer numbers of cows will produce less slurry and silage (these are responsible for greenhouse gases, and GHG contributes to global warming). From the analysis, it is clear that Mepham uses the concept of 'sustainability' from the eco-centric point of view. To some extent, Mepham does not account for the goal of sustainability only to maintain human life on earth. Because of the human will to fulfill its needs unlimitedly, degradation of the environment will be the consequence. As a result, human existence, including the other species, of this earth will be impossible. This is right to say that we should not cling to the consumptive attitude as the basis of sustainability. Now the question is: how can we lay the foundation of sustainability? Mepham's ethical matrix is very close to the statement made by Rolston III: "humans need to include nature in their ethics; humans need to include themselves in nature" (Rolston III, 2000: 1056). Under this line of thought, it is possible to reintroduce the term, 'sustainability' that coincides with eco-centric worldview.

To ensure the quality of life, is it possible to survive without depending on technological contribution? This is quite an important issue in respect of Mepham's ethical matrix. If we follow the eco-centric sense of sustainability, it is quite impossible to meet the present thrust of global food security. On the other hand, there is direct and indirect devastating environmental impact of animal biotechnology. Regarding the detrimental environmental impact, it can be said that Mepham's ethical matrix is not in favour of biotechnological application in most of the cases. But, we shall have to consider food security in respect of the increasing world

population. We should remember that we are part of the ‘natural world’. In order to live sustainable, we shall have to consider interdependency between human beings and environment. Westra states in this regard: 'Humans are an integral part of the whole of nature, if we destroy the earth, we will destroy mankind' (Westra, 2008: 319).

Under the circumstances, how will we consider the concept of ‘sustainability’? Of course, the value of sustainability is very important in the context of animal biotechnology. But the concept of ‘commodification’ confuses the meaning of ‘sustainability’. Some exponents like Vandana Shiva (1992, 2005), an eco-feminist and activist, argue that commodifcation occurs when ‘the market economy’ plays a role as the paradigm of our economic activities. According to Shiva, market economy diametrically distinguishes between ecology and economics and between nature and people. This dichotomy leads to the increase of the environmental hazards (Shiva, 1992: 187 & 190). So, we need to define the type of ‘economy’ in order to clarify the proper meaning of sustainability. In her book, *Earth Democracy: Justice, Sustainability, and Peace*, she mentions about the three types of economy: Nature’s economy, 2. Sustenance economy, and 3. Market economy (Shiva, 2005: 13-72).

Vandana Shiva states that ‘nature economy’ is the first economy which is related to natural resources. It consists of two things: ecological process and the production of goods. It helps one to meet the people’s basic needs. On the other hand, ‘sustenance economy’ is related to the working place. It provides some conditions which are necessary for maintaining their lives. In the western economy, Shiva states that ‘sustenance economy’ is considered to be of less importance. But, around the world, two-thirds of the population is engaged by ‘sustenance economy’. Craft production, artisanal fishing, peasant agriculture, and indigenous forest economies are good examples of sustenance economy. According to Shiva, both nature economy and sustenance economy are vital for the society.

Commodification of natural resources firstly deprives the poor people and politically weaker group. It also destroys the self-renewal and sustainability of nature. Shiva decisively comes to the conclusion that commodification of natural resources in the system of market economy is responsible for reducing the relationship between nature and people.

Application of biotechnology in animal farming is also the result of market economy. Before making assessment of the impact of biotechnological application in animal farming, we should reshape the economic model — ‘nature’s economy’ and ‘sustenance economy’ — instead of market economy. Market economy encourages more industrialization, more commodification, and more development. All these are threats to ecological harmony and human survival as well. While considering all these factors, Shiva argues that the application

of biotechnology in animal farming seems to be inconsistent with the true sense of sustainability (Shiva, 2005: 29-32). Mepham's ethical matrix has also shown that some biotechnologies are not compatible with the idea of sustainability. In order to assess the impact of biotechnology in animal farming, Mepham's ethical matrix renders more principles in respect of conservation, biodiversity, and sustainability. It is one kind of multiplication of ethical principles and relevant stakeholders.

### 3.5 Concluding Remark

Biotechnology is the contribution of scientific knowledge to human civilization. Its application in different areas, such as in animal farming, raises the question of moral permissibility. To assess the effect of the application of biotechnologies in food-agriculture, Mepham and his colleagues have invented a tool known as 'ethical matrix'. It is claimed that biotechnology has taken the challenges of improving the people's quality of life. But, in assessment, ethical matrix has shown that the application of biotechnology has two aspects: biotechnology is viewed as good, because it tackles the global hunger crisis within a reasonable price; on the other hand, it has got negative impact upon the environment and the health sector.

## 4. Application of Ethical Matrix: Case of Animal Biotechnology

This section considers ethical issues raised by the application of animal biotechnology in the field of food production and for medical purpose. In order to assess the ethical impact of this technique, we have selected some of animal biotechnologies, such as Bovine Somatotrophin (bST), transgenic animal i.e. Xenotransplantation, and animal cloning in livestock farming.

### 4.1. Case of bST

Mepham has chosen the case of bST (Bovine Somatorophin) for some particular reasons. In the first case, this technology involves four interest groups: dairy cows, dairy farmers, consumers, and biota. All these stakeholders are accorded ethical standing. Secondly, in the case of bST there are also opposing factors, such as economic efficiency versus animal welfare, and consumer choice versus public health which characterizes bioethical debate. Thirdly, commercial use of bST is also a political issue (Mepham, 2005: 54). Mepham applies his ethical matrix for using bST in dairy farming:

| Respect for | Well-Being | Autonomy | Fairness |
|---|---|---|---|
| Dairy Farmers | Satisfactory income and working conditions | Managerial freedom of action | Fair trade laws and practices |
| Consumers | Food Safety and acceptability<br>Quality of life | Democratic, informed choice, e.g. of food | Availability of affordable food |
| Dairy Cows | Animal Welfare | Behavioral freedom | Intrinsic value |
| The Biota | Conservation | Biodiversity | Sustainability |

Table 2: The 'ethical matrix' applied to use the bovine somatotrophin (bST) in dairy farming (Source, Mepham , 2005 : 54).

Mepham applies three principles in the case of four stakeholders in respect of the use of bST in dairy cows. By analyzing the table, we can present a brief analysis of the ethical matrix in the context of bovine somatotrophin in dairying cows.

**Dairy Cows**. In respect of *well-being*, organism (here dairy cows) has rights to claim welfare. Now the question is whether the use of bST violates the welfare of dairy cows. Mepham states that different studies have shown that the act of using bST in dairy cows increases the risk of the cow's health. The Monsanto bST production company mentioned in the bST packet label that there are 21 side-effects. Some of these are:

> "Increased cystic ovaries and disorders of the uterus; higher incidence of retained placenta; increased risk of clinical and subclinical mastitis; increased digestive disorders such as indigestion, bloat and diarrhea; increased numbers of enlarged hocks and lesions of the knee; disorders of the foot; and injection site lesions which may remain permanent" (cf Mepham, 1996 : 108-109).

The European Commission (EC) also shows by referring to different research experiments that the use of bST increases the risk of painful disease which results from the inflammation of the udder, and the risk of clinical mastitis and food and leg disorder, due to long-term administration of bST. The use of bST also reduces the reproductive capability of the cows. A number of other risks are also associated with the use of bST, e.g. increased level of morbidity and mortality. Most of the cows loss their bodily strength at the end of the lactation period. Furthermore, the act of administrating injection to the cow is quite stressful (cf. Mepham, 2000a: 613)

There are also adverse side-effects of bST in respect of the principle of *autonomy*. The act of using bST violates animal behavioral freedom. Cows are then fed a high amount of concentrated food which requires to keep them in indoors. So, there occurs the loss of the

opportunity of natural grazing. Different kinds of diseases, such as lameness, clinical mastitis, foot disorder, and other significant risks infringe the behavioral freedom of cows.

Does the use of bST infringe the intrinsic nature of animals? Respect for an animal's intrinsic value does mean that we should not treat them unfairly. This principle claims that a cow as a sentient being should be treated as an intrinsic value. So, we should not merely use it instrumentally. But, "bST use infringes the nature of the animals" ( Mepham, 1996 : 109).

**Dairy Farmers**. Regarding *well-being,* it should be mentioned that the farmer' welfare depends on their satisfactory income and working condition. In order to increase economic benefits, dairy farmers use bST for yielding milk of cows. Here economic benefits represent the welfare of dairy farmers. The *autonomy* of dairy farmers implies that they have got freedom of choosing any farming system. Farmers have got freedom regarding the use of bST. Mepham, in another study of his with Millar et.al, shows that in the United Kingdom 79% of the dairy farmers do not consider bST use in dairy cows as 'ethically acceptable'. In respect of *justice*, it can be said that the dairy farmers should be treated fairly by trade laws and practices (Millar, et. al., 1995: 195). It should also be mentioned here that they have got the right to get fair prices for their products.

**Dairy Consumers**. The concept of the consumer's well-being refers to the welfare of the consumer. It refers also to the protection of food from being poisoned or by any other harmful agent. Mepham mentions that in different studies that respect and infringement of the use of bST has been emphasized. FAO and WHO have jointly found out that bST can be used without any applicable health risks to consumers (Mepham, 2000: 96). But there are also countervailing effects of bST use upon the dairy cows. IGF-1 and related proteins are present in the milk from bST treated cows. IGF-1 is responsible "to gut pathophysiology, particularly of infants, and to gut associated cancers' and the association between circulating IGF-1 levels and an increased risk of breast and prostate cancer" (Mepham, 2000:96). Some other studies have shown that the milk from bST-supplemented cows has got allergic effect upon the human body. In these sense, bST-inserted milk is not safe for the health of the body of human being.

Regarding consumer's autonomy, it can be said that consumers have got the right to choose whether or not they would consume bST-used dairy products. According to Mepham, consumers' autonomy requires two conditions: firstly, there should be 'voluntariness of consumer'— it means that one has got the freedom to choose to purchase anything, secondly, s/he prefers that the matter of freedom of choice can be ensured by the producer's act of disclosing the information of the products: whether the products are labeled as 'bST-treated cow milk' and 'non-bST-treated cow milk' (Mepham, 2005:59). In order to realize the

consumer's autonomy, labeling is an important factor while choosing the product. Justice of the consumer in respect of the use bST means that there should be affordability of milk at a reasonable price. Accordingly, if the use of bST can help our power of afford to buy food, then it can be said that consumers are benefitted by this technology.

**Biota**. Using bST in dairy cows has got both positive and negative impact. First of all, its use affects the natural environment. It encourages the intensification of farming, thus resulting in a fewer number of farms. However, these farmers are much larger in size and, consequentially, these appear as the sources of pollution. The silage run-off and excessive fertilizer from the farm jeopardizes biodiversity and sustainability of environment (Mepham, 2000:613). On the other hand, it has been claimed that the use of bST can help us in an act of curling environmental pollution.

By using ethical matrix, we can reach two diametrically-opposed conclusions: the positive and the negative impact of the use of bST in dairy cattle. A producer can gain more financial benefits by using bST. However, the health risk of the consumers should be taken into account seriously. In the case of dairy cows, the use of bST increases cow's milk productivity, and thus, provides economic benefit to the dairy farmer. In respect of the well-being of the dairy farmers, this is the positive ethical impact of bST. This technology helps us getting more benefits from a less number of cows. However, this will have run-off reduced slur and wastage. Mepham describes this as the 'respect for a principle' (Mepham, 2000a:613). On the other hand, the use of bST has got some negative impact: giving extra metabolic and other load 'infringes' the welfare of the animals. According to Mepham, this is the 'infringement of a principle'. For example, the use of biotechnology (i.e.bST) in animal farming affects environmental sustainability in two different ways. According to Mepham, **firstly**, bST is profitable in terms of economy to the farmers and therefore, it leads to a concentration of the highly intensive dairy farms. Intensification is also responsible for the existing environmental problem. **Secondly,** bST has got negative effects upon the environment. It depends on the "fossil fuels, artificial fertilizers, farm and industrial machinery and transportation" (Mepham, 1996: 111).

The process of 'finding the facts' helps the user identify the problems that have arisen from the use of a particular biotechnology. Who will be affected? Which of the effects is best-off? The second step in 'best reasons morality' is 'weighing the facts', which deals with the three ethical principles of matrix: well-being, autonomy, and justice. The use of bST use in the dairy cattle raises some ethical debates. The ethical principles can help the users, producers or even policy makers to weigh the problem. In this regard, we can study the example of Bovine

Somatotrophin: 1. Using bST in dairy cattle affects their wellfare, 2. Question of producer's and user's financial benefits due to the use of bST, 3. "Ethically concerned producers are economically harmed." 4. "Ethically concerned producers are potentially coerced" and 5. Ethical issue is related to biotic conservation (Schroeder and Palmer, 2003: 300).

**4.2. Case of Transgenic Animals**

The development of animal biotechnology has improved transgenic animal productivity, animal breeding, and the treatment of diseases. Besides, there is also the utility of this technology in healthcare and food production. Transgenic animals, such as cows, pigs, and lambs, have been genetically modified for healthier meat production. It has been claimed that transgenic animals can reduce fat. Xenotranplantation is another important use of transgenic animals. In human transplant surgery, tissues and different organs of transgenic animals are tailored as these are very similar to human cells. However, this act involves ethical concerns in respect of animal welfare particularly the ways we cause their harm and sufferings. The application of this technology has got both long or short term environmental and health impact. We can make a clear sense of this problem by applying Mepham ethical matrix in this regard.

| Respect for | Well-Being | Autonomy | Justice/Fairness |
|---|---|---|---|
| Treated organism | Avoid unnecessary pain | Behavioral freedom | Intrinsic value |
| Producers | Satisfactory profit | Democratic, informed choice, e.g. of food | Availability of affordable food |
| Consumers | Improved quality of life | Informed consent | Fair access to genome organs |
| The Biota | Conservation | Biodiversity | Sustainability |

Table 3: The 'ethical matrix' applied to transgenic animal

**Animal**. Is the act of producing transgenic animals compatible with the concept of animal welfare? Through this technology, it is possible to increase animal's well-being, which is affected by deleting the critical diseases of animals which can reduce the high range of animal mortality and also reduce sufferings of animal by the practice of castration and dehorning the agricultural animal (*BIO*, 2007 : 71). By applying DNA and antibody-based test, it has become possible to diagnose some infectious animal diseases such as, brucellosis, pseadorabis, blue-tongue, foot-and-mouth diseases, avian leucosis, trichinosis, and so on. Farm animal diseases — classical swine fever, foot-and-mouth disease, and bovine spongiform — can be managed casually through the new improved technology of animal biotechnology. Practising animal biotechnology in producing transgenic animals for livestock purpose is helpful in improving animal health. This technology is capable of preventing and diagnosing poultry and livestock

animal's diseases. And, quick prevention and diagnosis ultimately improve the well-being of animals. Genetic finger-print — a genetic analysis of animal pathogen — is helpful in identifying the sources of the outbreak of diseases, which is quite helpful to monitor the spread of the disease. All these examples show that animal biotechnology offers potential well-being of the animals.

Some other studies (EGE, 2008) also show that the genetically modified animals are found to be affected by physiological, anatomical, and behavioral abnormalities. Such animals have got poor survival rate of fetuses. They also experience short-life span and critical health risk. For example, the introduction of human GH to Beltsville pigs results in the high rate of mortality, arthritis, gastric ulcers, infection, degenerative joint disease, and drowsiness (EGE, 2008 :12).

The genetically modified transgenic animals have also been the target of attention while the purpose of public health is taken into consideration. The ethical controversy of killing animals raises the question about its acceptability. Ethics as an ecocentric sense that raises some questions as to whether we are allowed to modify the components of ecosystem. One most important question is that does the genetic integrity of (transgenic) animals have an intrinsic value that we should not change the form of them? In respect for telos, genetic engineering infringes the nature of animals and its intrinsic value.

Justice in respect of animals indicates the telos of animals. The teleological approach to animals refers to "their design, purpose, or final cause" (Munro, 2001:315). Mepham uses the term, 'telos', in the sense of 'intrinsic value', which refers to the idea of 'integrity'. In different literatures, 'integrity' is used differently. However, the central tenet of this term is "wholeness, fullness, or "unalterdeness" of the animal..." (CeBRA, 2005:16) Telos is also a reflection of the intrinsic characteristics of animals, but genetic tempering affects the design and purpose of animals as well as their intrinsic characteristics. Technological enforcement disrupts the homeostatic processes of animals. In other words, the process infringes the intrinsic nature of the animals by controlling their normal body function. Thus, biotechnology is a potential violation of 'animal integrity' as well as intrinsic characteristics (cf. Bruce, 1998 & Gjerris, 2005:79-93).

**Producer.** Animal biotechnology can provide great well-being to the producer in terms of economic benefits. The act of biotechnology providing them with less feed (feed is also biotechnologically developed) bought at reasonable prices results in getting more meat, more milk, more eggs, and more wool.

**Consume**r. In everyday life, there are a lot of well-beings that come from the application of animal biotechnology. All these go to the doors of the consumers. Transgenic animals are produced for various purposes. First of all, this technology makes a contribution to the improvement of nutritional value and resistance against critical diseases. For example, pigs, rabbits, and horses are used to produce such products as blood, thinner haparin, anti-venoms, and drug protein. Through this technique, it is possible to produce such therapeutic proteins or antibodies by modifying animals. Transgenic animals are potentially used particularly for curing cancer, hemophilia, rheumatoid arthritis, etc.

Xenotransplantation is another use of transgenic animals. For kidney, heart, and other organs-related diseases, today there is the solution through the replacement by the donors such as pigs and other transgenic animals whose organs and their apeutic cells can be used for the purpose. During the last few decades pigs, heart valves are successfully used as substitutes for the damaged heart-valves of human beings. However, the risk of Xenotranplantation is another problem of animal biotechnology. There are possibilities of transmitted infectious diseases from one species to another. Some studies show that in the year 1999, 160 peoples received pig cells as part of treatment and they did not show any health hazards (*BIO*,2007:37). Furthermore, when scientists prepare the organs of animals for Xenotransplantation, they are required to give close attention of the health hazards. In order to avoid health hazards, scientists successfully deleted the gene which is responsible for immune activity from transgenic animals. For this reason, the organs of transgenic animals are not infected by the virus or any lethal micro-organisms. Thus, in this way consumers' well-being can be ensured.

Safety and informed consent would be the possible requirement for consumers in respect of autonomy. Consumer autonomy can be achieved when they get sufficient information about the transgenic animal's products.

Consumer interest can be understood in terms of justice, particularly distributive justice. How are consumers benefited from the application of animal biotechnology in producing transgenic animals? Around the world there is inequality, and most of the people are not capable to afford transgenic organs for their treatment, which are necessary for them. In order to work towards better social equity, it is essential to minimize the impoverished condition. John Rawls argues that no one knows in which economic conditions one will be born. Therefore, every member of the society should wish for equal exposures to risk and that everyone should have the equal opportunity to grow up in an environment that is free from infectious diseases (Rawls, 1971:448). The theory of justice reveals that every person in the world, irrespective of all conditions, should have the opportunity to use transgenic animals'

organs while these become a necessary to them. Sometimes people do not have had the benefits from transgenic animals due to their economic deficiency. In this situation, consumers can be benefited through the reduced prices of the product and the increase of the level of consumer's power to afford such a product.

**Environment (Biota).** Biotechnology in animal sector has brought a dramatic change in the livestock farming in terms of environmental context. The act of improving animal biotechnology offers such developed feed that disposes lower amount of phosphorus and nitrogen in animals' slurry and manure. Some studies show that the normal feeding of dairy cattle disposing 160 million tones of manure annually with high range of phosphorus and nitrogen causes surface and groundwater pollution. But, genetically modified animals can digest feed and dispose less slurry and manure with minimum pollutants. Biotechnologically developed pigs are one such transgenic animals that added gene and enhanced salivary phytose and grown with phosphorus digestibility and retention of phosphorus (BIO, 2007:74-75). In the case of conserving the endangered species, biotechnology shows good results. Transgenic animals are environmentally friendly. Recently, genetically modified EnviroPig$^{TM}$ produce less slur and manures and have lower levels of phosphorus contents which are the causes of environmental pollution.

Reproductive and cloning technology is helpful to conserve the endangered mammals and birds. Omha Zoo veterinarians used this technology (particularly embryo transfer and animal insemination) on three Bengal tigers and Siberian tigers (as a surrogate mother). The endangered species of European mouflon — a smallest wild sheep — has genetically multiplied the number of this species at the University of Teramo, Italy, in 2001. Indian ox-like guar — an endangered species — has been saved by the process of cloning. Recently, the endangered species, Giant Pandas, are being reproduced by using trans-species cloning technology. In 2005, water buffaloes, Arab's champion horses, and Monglian gazelles were cloned to multiply their number.

**5. Concluding Remark**

Animal biotechnology has got various purposes in relation to food and medicine. Mepham's 'ethical matrix' does not see any convincing reason to use animals. It is also used to experience the use of animal biotechnology for medical purpose. For example, in case of xenotransplantation the organ of transgenic animals can be introduced if they do not derive any health risk of the receptor.

Various problems generated through the application of animal biotechnology can be experienced by ethical matrix. The application of ethical matrix in the case of bST has shown

that there are enormous side-effects and adverse impact upon the animals and the environment. However, compared to its technological contribution, a transgenic animal has got less effect on different stakeholders. In this regard, we can raise a pertinent question: does ethical matrix provide any concrete ethical decision regarding animal biotechnology? Do we accept it or regret it as unethical means? In any of the products or contribution of animal biotechnology, there is the violation of three cells: animal's well-being, animals' behavioral freedom, and the telos or intrinsic characteristics of animals. By observing a number of studies, we can draw the argument that animal biotechnology affects animal welfare.

The potential argument comes back to the philosophy of Peter Singer (1985) and Bernard Rollin (1987). Both the philosophers agree that animals should be considered as moral subjects and that any action causing pain is ethically unacceptable. EGE opinion also explicates the sufferings of biotechnologically developed animals which affect animal welfare. Some eco-centric philosophers recommend the extension of moral values to other animal species ( Naess, 1984). All these studies defend the view that animal biotechnology affects animal welfare and, therefore, it should not be acceptable.

The application of ethical matrix in different cells gives different results. In respect of animals, we have got the opportunity to consider the positive and negative consequences of animal biotechnology for their well-being, behavioral freedom, and physical integrity. And, we can assess negative and positive effects of the biotechnologically developed products upon the environment. In respect of the producer, it may be said that ethical matrix provides a judgment of possible economic benefits. Ethical matrix also pays an attention to the consumers' rights. On the one hand, it makes us alert about the hygiene and safety of aspects production, transparent information, and free choice by labeling the product. The principles of justice in the matrix are others important factors of balancing different aspects related to the production of animal biotechnology. For example, the principles of justice indicate what kinds of technology the producers should receive. These also ensure their equal rights of fair access to the free market. At the same time, justice also looks at the animals and environmental integrity in the sense of intrinsic characteristics. Thus, ethical matrix can consistently help us reach a decision by assessing the negative and positive effects of different stakeholders.

Throughout our discussion, we have found two different outlooks on biotechnology. On the one hand, it can be said that it has got various and wonderful splendors, which can be enhanced in many different ways. Its enormous contribution to life and it's some particular achievement in the medical sector and in the food varieties has given this technology a tremendous input to human life. We can mention here the following: this (bio) technology has

made it possible to save a child from polio by inventing polio-vaccines; it can save life of those people who are affected by infectious diseases; it is also able to provide protein and food at reasonable prices. On the other hand, it should also be mentioned that as a technology it has got a lot of adverse effects upon human health, the environment, and the individual's autonomy. This is why it should be discouraged in every way possible. In this circumstance, where should we stand? Should we ban any kind of practice of animal biotechnology? Or, should we encourage this technology? Mepham's ethical matrix provides us with a tool to assess the problem. Mepham himself also states that ethical matrix helps us to facilitate rational decision-making. Different principles of ethical matrix give us different consequences. People can approve the use of bST in cows for yielding milk, producing transgenic for various purposes.

We have also observed that ethical matrix warns us that the use of animal biotechnology has both positive and negative impact. For example, (i) diseases like fibrosis, thallassamia, and muscoviscidosis that we might inherit from our ancestors can be detected by using genetic testing, (ii) vaccines and some other medicines such as insulin meant for curing diabetes are produced by introducing human genes into bacteria, (iii) in order to produce organs for human transplants it is introducing human gene into animals: by using such techniques pigs are used for human heart-valves transplant (iv) large use of animal biotechnology can be recommended in food production. For producing food with high protein, for changing the taste of food, and for producing adequate food by investing lower productive prices are the causes of applying animal biotechnology in our day-to-day world. Ethical matrix, as an ethical tool, shows us the way through which we can detect its adverse effects and enormous benefits. We can also assess which of the animal biotechnology has got longer adverse effects, and which one has got enormous benefits. Ethical matrix provides us with an ethical solution to this problem. In the example mentioned above, it is seen that 'ethical matrix' gives us a judgment as to which of the application should be ethically acceptable.

In conclusion, it can be said that ethical matrix is based on the weighing of pros and cons of the fact. It leads us to the conclusion that there are no short curt ways to reach an agreement on the application of animal biotechnology. There are various contexts and controversies including the relationship between technology and societal norms, and the relation between animal integrity and human beings, and the question of substantial equivalence between technologically-developed products and naturally-developed products.

Ethical matrix has shown that the process of using bST, transgenic animals, and other biotechnological products involves a number of ethical concerns that come to play when decisions are to be taken concerning the application of animal biotechnology. The fourth

chapter has shown that ethical matrix makes an assessment of the effects of animal biotechnology on the relevant stakeholders. The ethical concerns involve a broad spectrum of decisions. For example, today biotechnologically developed animals are used for human's benefits and purposes. Some particular ethical concerns, specifically animal welfare, animal freedom, and animal integrity, are involved in this issue. Ethical concerns such as the well-being of mankind, food safety, and fair access to the products are connected with the idea of human beings as users of animal biotechnology. Environment is an important issue of animal biotechnology. In this arena of thinking, environmental pollution, degradation, biodiversity, and sustainability are some of the key issues. It is, therefore, imperative to follow ethical norms in animal biotechnology. Finally, it can be claimed that the debate might be inevitable only because none of the ethical tools or theories can materially represent the problems at all to facilitate the ethical debate about animal biotechnology.

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