

Application of Biotechnology to Address Environmental Issues

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Abstract

The biotechnology is the technology with the research and innovation with the living cells and organisms. Introductory section deals with the brief background about the biotechnology and its implications to address the environmental issues. The key environment concern today is reducing the carbon emission and global warming. In the next section the material and those that has been used to prepare this research paper. It had been categories into four more parts the research design part, research type, data collection types as well as the techniques. The research design that has been used here in this research is the qualitative and the data has been collected on the basis of secondary data analysis. Results section of this research has described about the rationale of in-depth analysis with the help of adequate graph. Graphs are based on the carbon emission on the basis of the generation and the biotechnological developments country wise. Importance of the biotechnology and the challenges both have been covered here in the results section. Finally this discussion has been concluded with a brief discussion part which had discussed all the necessary finding and outcomes of the research paper.

Keywords

Biotechnology, carbon emission, environmental issues.

INTRODUCTION

Technological revolution has been taking place in various sectors whether it is the supply chain, whether it is the industry. Similarly, technology related to studying and manipulating the living creature for the benefits of mankind is termed as **biotechnology** [1]. Recently the whole world has witnessed the worst pandemic of the century and to fight against the pandemic researchers and medical experts have burned the midnight oil to bring out a medicine or vaccine against the corona virus. Here, **biotechnology** has played a critical role in developing the vaccine. On the basis of the time period the **biotechnology** is of three different types: ancient **biotechnology**, classical **biotechnology**, and modern **biotechnology**. The ancient **biotechnology** is called the ancient **biotechnology** as it is taken of pre-1800 era and classical **biotechnology** is of the period after 1800 and the modern **biotechnology** can be taken in accordance with the current especially after the Second World War. Today there have been a lot of current issues related to the environment as the overall population of the earth has increased drastically. As of the year 2022 the total population of the earth will be 8 billion and it has also been given the view by many of the experts that this will raise further in future [2]. Due to this significant rise in the human population the human needs has also increased and for that best source is to utilize the natural resources that are available everywhere.

Utilizing the natural resources is easier but there is an implication when the exploitation of the natural resources happens at a large scale. The environment issue comes up and they are like increasing of the carbon emission, releasing of the greenhouse gas and melting of the polar ice caps. Technology has been used here and these technologies are

more focused on improving sustainable practices like the promotion of solar power, tidal power, Hydel power and other green technologies. Technology regarding the usage of the technology in addressing the **environmental** issues can be benefitted by **biotechnology** as it is always better to research and find better source and technology in the market. The most effective way for using **biotechnology** in addressing the problem with the environment is to use and develop the bio-fertilizers so that the pollution due to the chemical fertilizers can be reduced.

Biotechnology is also used in sewage treatment plants that basically pollutes the water and damages the lives of the marine lives. Preparing the bio fuel is totally a new concept and the research is ongoing but the aim of the creation of the bio fuel is quite clear as it aims in reducing the carbon footprints. Animal **biotechnology** is often used by the animal breeder like genome editing so that cattle which they are rearing can bear the heat of the surroundings [3]. Such types of cattle have shorter hair growth; this generally helps them to regulate their body temperature. The cow dung is a rich source of natural fertilizer but at the same time it also releases greenhouse gas namely the methane gas. If it is used as a bio fertilizer it can be said that in future its implication in the environment will be less. All of this has been given are some of the useful applications of **biotechnology** in addressing the **environmental** issues.

MATERIALS AND METHODS

Research design

Research design in a research study is important as it provides a framework of the way the research will be conducted or it will go through out. For preparing this research, the research design that has been used is qualitative

research design. The topic is about the application of **biotechnology** in addressing the issue of the environment and for that the theories, articles and journals are necessary to understand its significance. For that reason the research design that has been used for this research is qualitative analysis. It will include the important chart and graph that will be used to understand the research topic. The quantitative research method is also useful as it includes conducting the on the spot survey and conducting the interview of the people [4]. All of this has not been done and it has focused majority on the qualitative research design.

Research type

The research type is the type that describes which type of research has been performed. In this research topic which is based on **biotechnology** the research type that has been used is the secondary research type. The topic is quite theoretical in nature and the research designing that has been used for the research is qualitative therefore the research type which should be used here be secondary it will include the data from the journals, article and survey that are provided in various websites.

Data collection techniques and analysis

For the research of any of the research topics the data is being collected on the basis of two distinct methods namely the primary data collection method and the secondary data collection method. In this research topic the data collection method that has been used is the secondary data collection method. The data analysis method that has been used here for the proper analysis of the data is the thematic data analysis [5]. For doing qualitative research the best and effective way of collecting the data is the secondary and the thematic analysis is the most preferred method. Thematic data analysis will be done here with the help of the themes which will be prepared according to the research topic and its aims & objectives.

Inclusion and exclusion criteria

Table 1: Inclusion and exclusion criteria

| Inclusion criterion | Exclusion criteria |
|--|---|
| <ul style="list-style-type: none"> Data that has been used here for this research is on a secondary basis. Authenticated and recent journals had been used in this research. The research type that has been used is qualitative research type. | <ul style="list-style-type: none"> Data collection that had been excluded from the study is primary data. One to one interview with the expertise as well as the common people have been ignored. Quantitative research type has been excluded from this research. |

RESULTS

Challenges with modern biotechnology regarding the environmental issues

Biotechnology is very useful technology and it is equally beneficial in addressing **environmental** issues but at the same time there are some cons regarding **biotechnology**. These challenges have the tendency to address the **environmental** issues and those challenges are like it had a high research and development cost, it also had low research and development productivity [6]. Most of the biotechnological research and development are more focused on the countries which are developed.

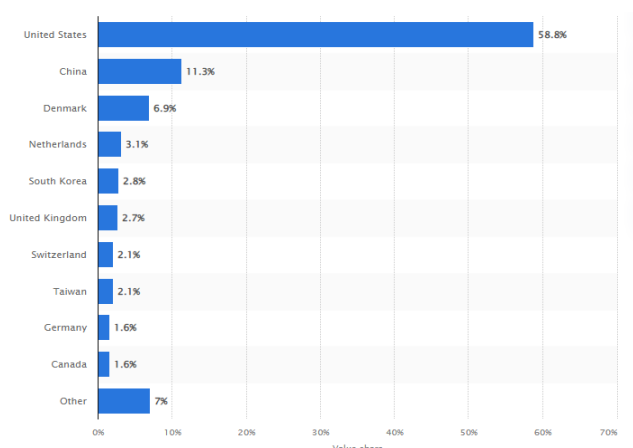


Figure 1: Value share of the biotech sector globally in the 2021

A graph had been provided and it had aimed to provide a brief idea of which country has the highest share of the biotech industry. The number one country regarding this is the USA which has the highest share of the biotech globally which is 58.8% and it is the highest [7]. The next country in the race of **biotechnology** is China, then Denmark with 6.9%, and then Netherlands. The thing is worth noticed that there is only nation that is China which is emerging economy and except that all other are developed nations. These countries have enough money to spend on biotech as its research and development is expensive and many times there is very less possibility for getting the results. The best example is the research and development of the covid-19 vaccines as the pharmacy company had invested billions to get the vaccines made in the due time of one year.

Biotechnology is based on research and development and the research and development includes a lot of investments. At the same time it is also said that the biotechnological products have to face new challenges that emerge with respect to the time. The microbes and enzymes had to sustain in harsh conditions therefore it can be considered as yet another challenge with **biotechnology**. It could with the help of an example as if a vaccine is developed by a pharmacy company against a particular virus and it may be the most effective medicine against that disease. But in future up to what extent the medicine will be effective especially if the

viruses mutate it. These are some of the challenges regarding the biotech sector and its technological developments.

Role of biotechnology in reducing carbon emission

For fighting climate change the most effective weapon that is often used is **biotechnology** or bioengineering. With the help of **biotechnology**, the process of farming can be made more energy efficient as it focuses more on biodegradable fertilizers. The threat due to climate is rising day by day and many have been working on making bio fuels not only for vehicles but also for aircraft. Ethanol, and biodiesel are the two best examples of bio fuel and it has been considered as the first generation of bio fuel. It has been purely developed by the modern **biotechnology**.

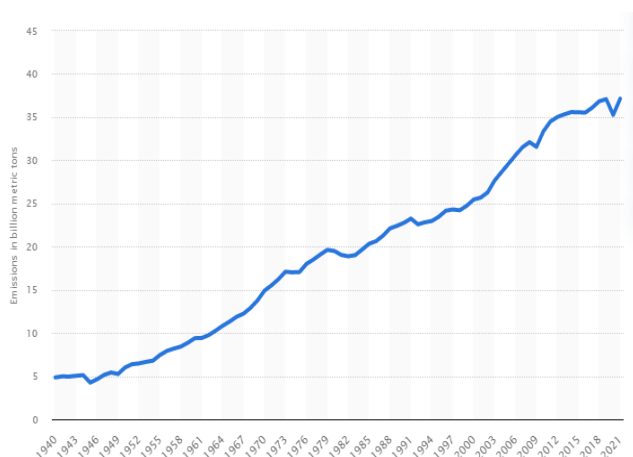


Figure 2: Annual carbon dioxide emission globally from the year 1940 to the year 2021

The given figure above has been providing a clear picture of how the carbon footprints have been increasing globally from the year 1940 to the year 2021. In the year 1940 the total carbon emission was 4.85 billion metric tonnes but this was the period of the Second World War [8]. After that a new industrial revolution had taken place all around the world and in that the role of power generation through fossil fuel was significant. Modern **biotechnology** at the same time started flourishing all around the world after the Second World War. Both the emerging and developed economies from all around the world had started exploiting fossil fuels and now in the year 2021 37.12 billion metric tonnes [8]. The importance of **biotechnology** can be understood with the help of the figure that pharmaceutical and pharmacy companies are the only that uses **biotechnology** specifically.

The world has understood the importance of **biotechnology** after the pandemic that was in the year 2020 and the pandemic is ongoing. **Biotechnology** prefers to use the biological in any operation and hence it helps reduce the usage of plastics. Bio fuels that have been discovered and a research has been ongoing can be used in modern vehicles to reduce the carbon emission. At the same time, bio fuels can also be used in making in generation of power and energy. It is basically environment friendly and also cost efficient but the technology needs further improvement [9]. The pollution

due to the aircraft results largely from the damaging of the ozone layer which is basically responsible for protecting the earth surface from the harmful ultraviolet rays. The SAF is a bio fuel that is used in the aircraft and with the help of this fuel it has been estimated that the greenhouse gas has been decreased significantly.

According to Statista, the year 2020 was the year which had witnessed the highest carbon emission by aircraft. The emission was around 936 billion metric tonnes of carbon emission yearly. In the year 2019 the total carbon emission by the aircraft globally was around 905 billion metric tonnes and it had kept rising if it would be studied right from the year 2004 [10]. In the year 2004 the total carbon emissions was around 627 billion metric tonnes but it had been severely affected during the year 2021 as it was around 547 billion metric tonnes [10]. If the figures are compared to other sources of pollution the aircraft gets the top spot. Therefore, it can be said that using **biotechnology** and making bio fuel it is possible to reduce carbon emission.

Use of biotechnology in addressing the environmental sustainability

The **biotechnology** can be addressed with help of **biotechnology** in **environmental** sustainability some of them will be discussed here in the upper section:-

Construction materials

Today the real estate industry has been a flourishing industry in the emerging countries which have large populations. Construction of the skyscraper and bridges has been successful due to the population boost. The chemicals that are used in the preparation of the concrete are the one of the polluters of the carbon globally and therefore it is significant to address the issue of the carbon emission due to construction material [11]. A start-up which is based in London named Biome had done a great job and used mushrooms for the development of the construction materials. A US based company named Bio mason uses similar tactics to create the cement and tiles with the help of microbes which have lower carbon footprints.

Cosmetics

Today most of the cosmetics industry uses chemicals which basically pollute the environment. To reduce these impacts on the environment the technology of **biotechnology** can be used and with this it can increase the sustainability in the environment [12]. Bio effect is a company based in Iceland and a US based cosmetic company named Bioscience has started using microbial fermentation and in this way they are making their business operation more and more environmentally friendly.

Clothing

The fashion industry operates in making and overall preparation of the final goods and for that a lot of non-biodegradable products are used. Thus with the help of **biotechnology** the textile waste and the process of washing

and other things can be made more and more environmentally friendly [13]. The best example is the AM Silk is a German silk garment company that uses bacterial fermentation for the production of spider silk fiber. Other examples are like the Pilli Company of France, Colorifix Company of the UK both are looking to use the microbes for the production of sustainable textile dyes.

Flavourings

Most of the flavouring that is used in the food items can be prepared with the help of plant extract. Today most of them are prepared with the petrochemical process. There are a large number of alternatives available in the market regarding the flavouring [14]. Some of the popular examples of the companies are Evolva which is Switzerland based company and it produces its most of products with the help of natural sweetener stevia along with the orange, vanilla, grapefruit and many more. Other companies which use *biotechnology* in flavouring are Phytowelt which is a German based company and Isobonis which is a Netherlands based company.

Cultivated meat

It is true that like the crops, meat can also be cultivated with the help of *biotechnology*. As it is known by everyone that meat is the biggest polluter and it needs to be reduced. For that the meat is cultivated in certain biological conditions in the labs that are sterile lab conditions, there are various examples [15]. In the year 2020 Singapore was the first country that had approved the commercialisation of the cultivated meat. Mosa meat is a Netherlands based company which used to make the beef burger and the meat that they use is cultivated. Similarly Super meat is an Israeli based company which works on poultry. All of this has been possible due to the biotechnological development and it has been possible due to the research and development.

Importance of biotechnology in the process of addressing the environmental issues and other domain of sciences

In daily life the importance of *biotechnology* has become the base of many other technologies that are based on developing the medicines and identifying the different organisms as well as microorganisms. There are many branches of science and engineering where *biotechnology* is being used. They are like microbiology, cell biology, neuro-endocrinology, and genetic engineering [16]. Along with all these disciplines, *biotechnology* has been exclusively used in the *environmental* sciences. If *environmental* science is studied thoroughly it would be found that it also had various branches but in this discussion a topic of *environmental* science is going to be addressed with the help of *biotechnology*. These days the world is witnessing the worst form of climate crisis and the rise of carbon emission and therefore it has become important to make use of *biotechnology* to make this situation more favorable for living beings. The domain of study where the technology of *biotechnology* is used is microbiology; it is a branch of

science which tries to understand the mechanism of life at the energy possible level of molecules [17]. The next domain is the cell biology; it is basically the branch of biology that deals exclusively with the relationship between the one cell and the other. Next branch is neuro-endocrinology, which is a branch of science that deals with the interconnection between the nervous system and endocrine system.

In modern *environmental* science *biotechnology* has been used to find out the particulate matter 2.5 that is present in air. Along with this the biosensors have been used to detect the extremely low level of protein, hormones, pollutants, gasses and other molecules. Problems like deforestation and air pollution can be tackled using the technology of *biotechnology*. Some of the recent developments in the field of *biotechnology* are DNA- profiling, DNA- cloning, genome analysis and stem cells and tissue engineering.

DISCUSSION

Biotechnology has become an important part of modern science, especially technology related to the living organism. The technology has been used in many areas like developing medicines, vaccines and other producers. It is due to the progress in modern *biotechnology* that farmers of today feel more confident about growing crops at record level. The fertilizer, fungicides and the pesticides which are developed biologically acting as a catalyst in the growth of agriculture. It has also benefited the modern treatment procedure like the discovery of the surgical process to cure the vulnerable disease. The technological development in the field of *biotechnology* is more centered on the developed nations of the world like the USA, UK and European countries. China is the only major country from Asia which has a decent bio-technological sector. The *environmental* concerns have been growing across the world and it has affected all of the nations across the world both the developed as well as the emerging economies. *Biotechnology* can be used to address these concerns and most of the developed nations have used this but still they are at the developmental stage and they need more years to fully utilize those sources. Fossil fuels and natural gas are the main reasons behind the carbon emission and global warming and a vast majority of them are done by vehicles as well as factories.

Situation is pretty much clear the problem is with the energy generation and for that many of the other source has been explored and among them the solar power, tidal power and hydro-electric power are some but in the *biotechnology* had developed a bio-fuel for all the commercial vehicles as well as the fuel of the aircraft. If the technology of bio-fuel becomes the daily norm of the people then it can be said that it will be a remarkable step towards green energy. There is another big concern which is often regarded by the experts and that issue is that the *biotechnology* research and development needs immense capital and there is a very high probability of failure of their research so persistence is also required. Because preparing bio-fuels or any other type of fuels which reduce the carbon emission will require immense

capital at least at the development stage. *Environmental* issues are growing day by day and therefore a constant and persistent effort is needed by all the nations globally. Carbon emission was never a big concern for the people before the Second World War as before the year 1940 the total global carbon emission was around 5 billion metric tons but in the year 2021 things have been changed [8]. From the year 1940 the industry started using the fossil as the crude petroleum was discovered and the carbon emission kept on increasing. Finally in the year the total annual carbon emission was around 35 billion metric tons [8]. Due to this with all other technologies the *biotechnology* is also explored to address this issue.

CONCLUSION

Climate crisis and increasing air pollution are the *environmental* issues that are currently addressed with the help of *biotechnology*. The particulate matter 2.5 is considered as the most dangerous particle that has been increasing the air which causes many health issues and it has been identified with the help of *biotechnology*. Increasing greenhouse gasses is another big concern for the modern day scientist as well as the common people. As due to the increasing greenhouse gasses the average temperature of the earth has been increasing which resulted in melting of the polar ice caps. If the polar ice caps keep on melting the sea will increase drastically therefore it has become the need of the hour for all around the world to make sure to slow down this process. For that purpose the biotechnological inventions will be remarkable like the bio-fuels for the vehicles as well as for the aircraft. Among all the sources of the carbon the share of the aircraft is significant hence it needed to be addressed and it should be provided with the bio-fuels. Technological advances are needed to provide assistance to the countries which are technologically weak nations as *biotechnology* needs immense capital expenditure. During the covid pandemic of the year 2020 it had become pretty evident as majority of the vaccine developing companies were from these developed nations. The situation of today regarding the climate has become vulnerable and for that to align with the innovation in the other sector innovation in *biotechnology* is equally important.

Biotechnology has been flourishing in many other domains of sciences like cell biology, microbiology, genetic engineering and many more along with the *environmental* sciences. In the future the research and innovation in this domain of technology is expected to rise hence it is the most effective technology to address the climate issue and other *environmental* issues.

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