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To cite this article: N Umamah *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **485** 012085

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Identification of Biotechnology Urgency in the Environmental Knowledge Course

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Abstract. The development of Biotechnology has the benefit of health, agriculture, environment, industry, and so on. Biotechnology provides solutions to environmental problems, hunger, agricultural damage, and other problems that affect the quality of natural resources and human resources. This paper will review the research conducted on the urgency of Biotechnology in the subject of environmental knowledge. This work takes the form of a survey involving 18 lecturers at the University. Data for this study were collected using a questionnaire. The results showed that 45% strongly agreed; 50% agreed, and 5% did not agree to have interested in Biotechnology. Biotechnology has an urgency on the research theme of Higher Education with a percentage of 45% agreed and 55% strongly agreed. Biotechnology has a necessity for the subjects of environmental knowledge with a rate of 28% strongly agreed and 72% agreed. Environmentally topics in every department in the University are ecological education, environmental physics, geography for conservation and rehabilitation of land, humans and the environment, and environmental knowledge. The environmental content of courses in higher education is put on environmental damage and its prevention, biodiversity, renewable energy, and environmental education subjects

1. Introduction

Biotechnology has become one of the technologies to face challenges that appear in humans. Biotechnology act in the application of bioscience and technology which involves practical applications in living organisms, manufacture and environmental management [1]. Biotechnology is a branch of biology that focuses on the application of bioscience and technology to fulfill the needs of human life. Biotechnology involves various fields of science such as chemistry, physics and mathematics in order to support the development of biotechnology science. More than 250 health biotechnology centers from around the world are producing vaccines. Around 13.3 million farmers from all over the world utilize agricultural science to increase their crop. Around 50 biorefiners produce biofuels and various renewed materials to reduce the effects of greenhouse gases [2].

Biotechnology is an engineering technique applied towards living organism using modern technology to improve and develop an organism that is beneficial for human. Biotechnology development has been growing rapidly in last few years and giving much benefit for humanity. The increasing number of human population demands the fulfillment of human needs in food, health, and a decent living environment. Biotechnology has played a major role in increasing the quantity and quality of food through agriculture, including superior varieties that have their own speciality. Biotechnology is all technological applications in applied technology and biosciences whose application towards living organisms or their sub-cellular components. Biotechnology defined as a technology that use a biological system that can be applied in manufacture and service industries. In its application, biotechnology utilizes: yeast, molds, bacteria, algae, plant cells or animal cells bred for industrial processes [3]; [4].

This science emerged when humans began to have difficulties to solve various problems in various fields of life. The number of Indonesia's population is one of the threat. The threat comes from the needs of every individual's life [5]. Fulfillment of these needs will continue to be pursued by everyone. The examples of these problems are the large number of environmental pollutions, susceptible agricultural crops and food crises, epidemics, and even decreasing number of species on earth. The existence of these problems makes biotechnology act as a new breakthrough to solve the problem. Over time, biotechnology is now increasingly explored because it has been supported by advanced technology



that supports exploration. Exploration covers various organisms from the cellular level (bacteria) to high level organisms (animals, plants) to be utilized in various fields of life.

There are several branches of biotechnology which include industrial biotechnology, environmental biotechnology, and health biotechnology. Industrial biotechnology utilizes techniques from molecular biology to reduce the impact caused by the textile industry, the paper industry and the chemical industry. Environmental biotechnology is a branch of biotechnology that focuses on managing waste and preventing pollution. Handling on the environmental problems can be done by applying bioremediation, one of which is by utilize waste-degrading bacteria. The application of health biotechnology to humans is applied by develop various therapeutic proteins that can be used as a drug for humans. The discovery of biotechnology was extended to the mechanism of gene therapy and DNA fingerprint [5].

Basically biotechnology is also classified as Green biotechnology based on agriculture, red biotechnology is applied in the medical field, blue biotechnology focuses on marine biotechnology and white biotechnology is an industrial biotechnology that uses genetic engineering techniques to produce products that are beneficial to humans [6]. There are two terms to distinguish biotechnology, namely non-gene biotechnology and gene biotechnology. Non-gen biotechnology means that in its application it involves the whole cell, tissue and whole individuals for example tissue culture in plants, hybrid seed production, fermentation, hybrid antibody and immunochemical. Whereas gene biotechnology in its application uses genetic material by transferring genes through genetic engineering [7]. Biotechnology provides a variety of diagnoses, treatments and resistance to a disease by producing several drugs and recombinant vaccines [8]. Modern biotechnology begins with the discovery of genetic engineering through DNA recombinant techniques. The discovery of recombinant DNA techniques is the result of molecular biology research carried out for decades.

Another example is health biotechnology. The development of recombinant proteins is one of health biotechnology products. Recombinant protein has many benefits for humans for medicinal purposes, not only in humans but also in animals. Brucellosis occurs due to *Brucella* bacterial infection which can be transmitted from animals to humans either directly or by consuming the meat or milk of infected animals. *Brucella* has unique ability of virulence mechanism to avoid detection and activation of the immune system in its host [9]. The development of recombinant protein expected to be able to increase immunogenicity both in humans and in livestock. Besides the examples above, there are still many biotechnology-based vaccine developments.

Urgency of Biotechnology

The benefits of biotechnology for human life are that it can improve welfare and improve life including its application to overcome the scarcity of energy resources, reduce environmental pollution and fight hunger. Biotechnology can be used to increase livestock production through production technologies such as embryo transfer, artificial insemination and genetic engineering such as GMOs, gene identification and improved feed quality efficiency such as rumen microbial manipulation. The development of technology has a major influence on the science of biotechnology that can bring up modern biotechnology. Modern biotechnology has the same principles as conventional biotechnology, but utilize living things at the molecular level [5]. Modern food biotechnology contributes to the advancement of food products result from the advancement of plant breeding. This form of genetic engineering has been implemented by some farmers by crossing plants and animals with the aim of increasing an attribute to be propagated and creating new varieties with desirable traits [8]

The benefits of biotechnology are not limited to increase the value and taste of a material. The role of biotechnology in agriculture is in the formation of superior seeds and the manufacture of bioherbicide products. Superior seeds are formed by genetically manipulating plant so that the plant can survive in certain conditions such as dry resistance, pest resistance, acid resistance, etc. so it can increase the productivity of plants (foodstuffs). Biotechnology can solve pepticide by using microbes to make bioherbicides. Bioherbicide is the result of fermentation of material by microbes that can be used in controlling weeds, so it is environmentally friendly [10]

Agricultural problems are also threats to human survival. It is caused by lack of land and agricultural output that inversely proportional compared to high community needs. Solution of this problem is to change agricultural systems that exist in Indonesia. Developing biotechnology-based agriculture is an important new model to solve agricultural and land problems. Changing conventional

farming systems to biotechnology-based can overcome problems and encourage production from various sectors.

Rice is an Indonesian's staple food. Rice crop land decreased and its pest has become a threat in agriculture. The role of biotechnology is to create rice varieties that are resistant to Tungro pests. Tungro is caused by infections and viruses whose vectors are green leafhoppers. GMO rice is carried out through genetic engineering by applying the concept of pathogen derived resistance (PDR) or transferring genes from viruses to plants [11]

The application of biotechnology has an important role in sector of agriculture and health.

Biotechnology can help humans cure diseases caused by various other organisms such as fungi and bacteria. A study applies Polymerase Chain Reaction (PCR) technique to analyze Mycobacterium tuberculosis that causes Tuberculosis which is taken from pleural fluid. Early detected pleural fluid can help the effectiveness of the treatment [12].

Utilization of biotechnology in food can increase agricultural production through GMO crops using genetic engineering technology, tissue culture and recombinant DNA. Plants with superior properties contain more nutrients than ordinary plants, and are also more resistant to pests and environmental stresses. One of biotechnology in food sector, New Plant Breeding Technique (NPBT) produce superior plant varieties using genome editing techniques that are difficult to obtain through traditional breeding [13]

Biotechnology in the pharmaceutical industry demonstrated by the discovery of cloning techniques that enable one to get cancer treatment using monoclonal antibodies. Given antibody will specifically weaken the target cell without affecting other cells, so it can increase Indonesia's life expectancy [14]. Biotechnology allows faster production of insulin in large quantities compared to conventional methods. Insulin production is currently using bacteria that have been inserted with insulin coding genes and specifically treated so as to accelerate production. Biotechnology is also able to minimize pollution caused by industrial waste or crude oil spills by utilizing microbial decomposers.

Through the use of biotechnology in various ways it is possible to improve the quality and competitiveness of Indonesian products and resulting a big impact on the economy. The high production of GMO crops will reduce the price of basic needs and indirectly will improve the welfare of the community.

Biotechnology in the health sector plays a role in making hormones and vaccines for the treatment and prevention of a disease. Making insulin is the first application of biotechnology in the health field. The hormone insulin is used for the treatment of diabetes mellitus, initially the hormone is collected from the pancreas of pigs and cows. Utilization of biotechnology in the manufacture of vaccines in the health sector triggered by the emergence of endemic diseases that can cause death such as dengue. Utilization of other health biotechnology is through the production of compounds that are important to the body such as the amino acid L-lysine, L-Glutamate, L-Threonin and other essential compounds that are important for the body. The compound was produced using the bacterial agents *Escherichia coli* and *Corynebacterium glutamicum* [15].

The development of increasingly advanced technology with the world's population increasing every year becomes a complex problem related to the emergence of new diseases and drug resistance. Biotechnology is able to produce antibiotics to kill various dangerous diseases. *Rhizobacterium Bacillus subtilis* forming the endospore (a model system for Gram-positive organisms) capable of producing more than two dozen antibiotics with various structures. Active-microbial compounds produced include dominant peptides as well as some non-peptide compounds such as polybetide, aminosugar, and phospho-lipids [16]. The development of biological systems has also contributed greatly to the emergence of various kinds of drugs and chemicals. Biotechnology can produce drugs that are cheaper and more effective. An example is the manufacture of the hormone insulin derived from the bacterium *Escherichia coli* as biopharmaceuticals. *Escherichia coli* is the most preferred microorganism to express heterologous protein for therapeutic use, because about 30% of the approved therapeutic protein is currently being produced using it. Because of its rapid growth, high product yields, cost effectiveness, and easy scale-up process. *E. coli* is a number of expressions of choice in the biotechnology industry for large-scale protein production, specifically non-glycosylated proteins, for therapeutic use [16].

Biotechnology approaches are widely used to overcome health problems, such as diabetes. The nano-biotechnology approach dealing with diabetes seems to give hope to diabetic patients, with the nano-biotechnology approach blood glucose levels can be monitored by making nanosensors to monitor

blood glucose dynamics, while also being able to visualize and measure beta cells [17]. Diabetes management can also be done by providing external insulin for type 1 diabetes mellitus. External insulin is obtained by culturing myeloma cells and pancreatic cells so that they become hybridoma cells, later hybridoma cells are cultured on minimal α medium for several days [18].

Biotechnology provides important benefits in various fields of life such as the existence of plant cell culture techniques that offer sustainable production systems to overcome food crises [19]. Biotechnology also develops molecular markers for authentication and provides identity for several herbal plants through DNA barcoding techniques [20]. Biotechnology in the industrial field is exemplified by the production of biometallurgy that utilizes microbes. This is done to overcome some raw materials that are predicted to run out in the future [21]. Detection of a disease and pathogen in plants can also be carried out to determine the causative agent of the disease and to know the impact caused by the disease agent, so that preventive efforts can be made in overcoming the problem [22]. For example, efforts to detect pathogens and microbiome analysis in wheat using portable DNA sequencers. This method is considered effective for detecting fungal pathogens in wheat plants [14]. The benefits of biotechnology in the environmental field are handling cases of heavy metal pollution carried out by biosorption utilizing various biological natural materials (bacteria, yeast, and algae). Utilization of biotechnology is able to overcome environmental problems from pollution to biodiversity conservation if managed properly. The lower the level of water, soil and air pollution due to good waste treatment, the better the quality of human life.

In addition, biotechnology is now extended to the handling of marine problems. Sea is the largest ecosystem of the earth with the highest diversity. The latest development in biotechnology is the existence of aquaculture techniques using algae and seaweed which are being explored to replace fossil fuels in the oceans. This is a substitute material for producing renewable petroleum (biofuels). In addition, both of them can be used as biomass to provide nutrients for other organisms as well as biosensors for marine pollution [23].

Biotechnology will continue to develop for the benefit of humanity. Biotechnology expected to be able to solve problems both now and in the future. Also in the application process requires a variety of considerations including the costs involved and risks that may arise. It is expected that these risks can be minimized in order to avoid losses and other negative impacts both for humans and the environment.

Biotechnology can also help preserve the environment by helping to digest waste by using microorganisms. Liquid waste from factories can be degraded in vitro by using certain bacteria. The bacteria cultured purely in the laboratory and can be reproduced. Biodegradation can be used as decomposers with decreased levels of BOD and fat degradation. The application of biotechnology in this period can be found in the preservation of the environment from pollution. Biotechnology can help reduce environmental pollution. For example, decomposition of petroleum which is spilled into the sea by bacteria, and decomposition of substances that are toxic (poisons) in rivers or the sea by using new types of bacteria. China as a country that has a large population contributes 27.8% of waste production and pollutes of the sea. The existence of biotechnology expected to reduce waste by using microbes as biodegradable to handle plastic waste [24].

Another environmental problem that can be handled with biotechnology approach is water pollution through bioremediation. Bioremediation can be carried out using certain organisms such as microbes that have been modified. *Lactobacillus* sp. and *Bifidobacterium* sp. is an example of bacteria that can clean up the aquatic environment by reducing and changing pathogenic microbes and other chemical components in the waters. *Bacillus subtilis* A1 is one of the few bacteria that is considered fast and efficient because it can degrade crude oil that contaminates waters with biosurfactant content produced in the form of lipopeptides with 7 days degradation period.[25].

Biotechnology is a technology that is needed in the future and provides many benefits so that many industries take advantage of this. Biotechnology enables industries to create new or better products, have greater speed, efficiency and flexibility. Biotechnology needs to be carefully regulated so that maximum benefits are received with the least risk. This is the basis of the urgency to study Biotechnology.

Biotechnology in University of Jember

Biotechnology in agriculture provides many benefits. An example we can take is the development of dry sugarcane which is chaired by Prof. Bambang Sugiharto University of Jember. This

test is carried out with several tests namely environmental safety test, food safety test, and feed safety test. This variety attracts the largest sugar producer in Africa, Illovo Sugar Africa. This dry sugarcane variety can grow well in Africa which generally has dry land conditions. The existence of this variety can help Africa in meeting the needs of sugar in the country.

2. Methods

This study aims to identify the awareness of educators in the tertiary environment of the urgency of biotechnology. This research uses a quantitative descriptive research design involving 18 educators in the university. This study aims to explain the phenomena that exist by using numbers to describe the characteristics of individuals or groups. This study assesses the nature of the conditions that appear. The purpose of this study is limited to describe the characteristics of something. The number of question items used is as many as 5 questions.

3. Results and Discussion

The following will explain the results obtained from the study. Please refer to the table below to obtain the results of the study.

Table 1. Interpretation of the results of the questionnaire

No	Item	Strongly Disagree	Disagree	Doubt	Agree	Strongly agree
1	Urgency of Biotechnology knowledge within the University of Jember	0	1	0	9	8
2	Biotechnology is in accordance with the leading research theme of the University of Jember	0	0	0	10	8
3	Biotechnology has urgency in environmentally charged subjects	0	0	0	13	5

Based on the data above shows that 5% of respondents answered disagree; 50% agreed and 45% answered agreed that Biotechnology has urgency if implemented in the University of Jember environment. This is related to the status of the University of Jember which states that it is the center of biotechnology research in Indonesia in the ranking of universities. The second item on the suitability of Biotechnology to the Jember University's flagship research theme shows that 45% of respondents answered strongly agree and 55% agreed to the statement. Biotechnology research is in accordance with the main research theme of the Jember University's flagship at number three. The leading research themes of Jember University include:

- 1) Development of people's coffee towards an organic system in order to improve community welfare;
- 2) Development of fermented people's cocoa in order to improve national welfare;
- 3) Development of sugarcane biotechnology as a source of carbon and renewable energy;
- 4) Cassava-based agro-industry for equitable development and national food security;
- 5) Assembling superior rice varieties based on local genetic resources;
- 6) Using, Pandalungan, and Tengger cultures for productivity and welfare of the community;
- 7) Advanced Technology for Supporting Agriculture and Health Industries;
- 8) Maritime technology innovation and development to improve the welfare of the maritime community;
- 9) Sustainability of natural resource management in the East Java horseshoe area.

The third item on the urgency of biotechnology in environmentally charged subjects shows that 72% agree and 28% strongly agree with the above statement. Environmental content is a reflection in realizing the university's vision and mission. The fourth item is the question of what are the names of environmentally friendly subjects from different departments and faculties. The courses include (1)

environmental education; (2) environmental physics; (3) geography of conservation and land rehabilitation; (4) humans and the environment; (5) environmental knowledge. This shows that university students have environmental based content. The last question is on the subject whether the environmental content should be placed on the courses being taught ?. Based on these questions the respondent answered that there were several subjects including (1) environmental damage and the impact of environmental pollution; (2) biodiversity; (3) renewable energy; (4) school environment; (5) environmental education.

4. Conclusions

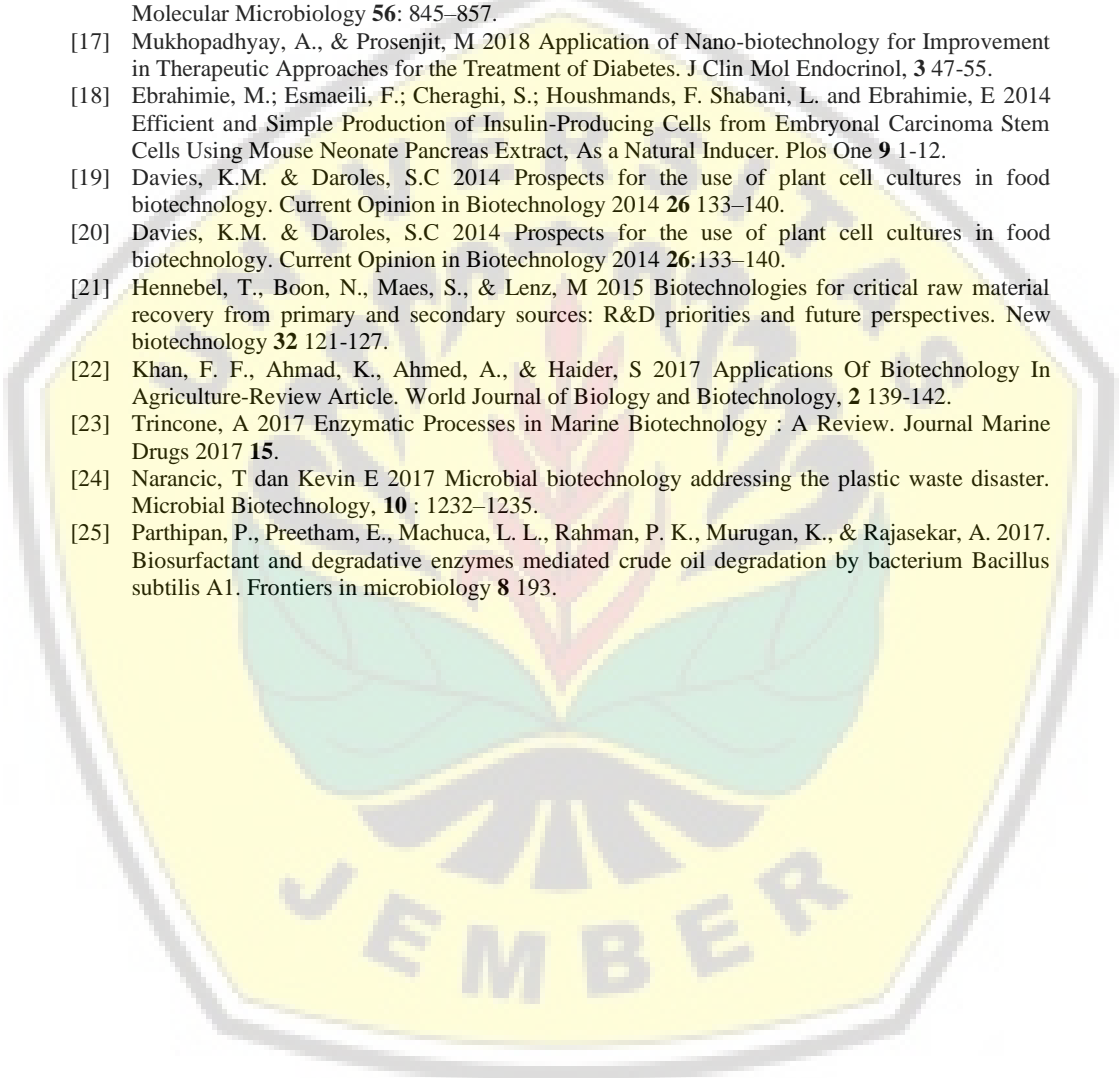
The role of biotechnology in environmental control is also the focus of researchers and some industry players in the era of the industrial revolution as it is now. Biotechnology can answer environmental problems related to the environment. Bioremediation is an attempt to restore or restore the original polluted environment to its original condition. Bioremediation uses microorganisms to reduce or even eliminate harmful waste components from the environment. The implementation of biotechnology development at Jember University is demonstrated by the application of biotechnology in environmental subjects.

Acknowledgments

Thank you to the research and community service institution at the University of Jember.

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