

Science Can “Naturally” Improve on Nature

A few years ago, there was a disaster. In March 2011, a nuclear power plant in Fukushima, Japan became out of order and had been leaking radioactive matters. Too much exposition to radioactivity cause diseases to human beings. Actually, not only humans but also animals and plants, all of the earth are affected.^[1] Meanwhile in Korea, the level of fine particles in the air is very high these days. Experts say that the cause of the air pollution is mostly factories in Korea and in China.^[2] Many people wear a mask when they go outside.^[3]

More than that, there are problems such as water and air pollution, too much plastic waste, global warming. Above examples seem like that the science and technology never improve on nature. Rather, they seem to prove that science deteriorate the environment. Before discussing the science improving on nature, we should first check the word “nature”. Nature would refer the environment around us. For example, stone, tree, grass, and animals are in nature. Then, it is natural to think the meaning of improving on these things.

It is easy to think that improving nature means enhancing nature. Any artificial implement of environment cannot be an improvement. For example, the technology of gene modification improved in these days. Life science scientists can modify genes of an organism to make it stronger, surviving more. Some will call an improvement, but that is definitely not an improvement of nature. If one organism is stronger than the others, they will not be easy to survive than the one with modification. The intention may be innocent but the result is a damage to the ecosystem, and consequently, nature.

Then, reducing harmful human effects on nature is an improvement on nature. Reducing pollution and planting trees are the example of improvement on nature. They minimize the human effect of harming nature. Thus, improving on nature means preserving nature. Here are three examples of science protecting the Earth.

First, science removes wastes and pollutions. For example, scientists deal with plastic wastes. People use so many plastic products because they are mostly useful and inexpensive. Consequently, too much plastic wastes are generated. Many animals are suffering from plastic waste. Even in the pacific ocean, a land is formed of plastic.^[4] The biggest problem is that plastic is so stable that it does not decompose easily. So scientists made biodegradable plastics which is decomposable by a bacteria. Another example is a sewage disposal plant. Also, in the factory and houses, sewage comes out every day. Sewage disposal plant cleans water with the process of deposition, decomposition, and sterilization, etc. After that, the water is released to the river and the sea. If the dirty water is not cleaned, every organism will soon die because the pollution of the freshwater causes a deprivation of water. Finally, there is Carbon Capture and Storage technology. When organic things burn, they emit carbon dioxide. They are emitted mostly from the factories. However, carbon dioxide is one of the causes of the global warming. This technology makes people collect carbon dioxide. The collected carbon dioxide can be used where people need them. By these technologies that are

made from the scientists' research, the wastes and pollutions in nature are reduced.

Second, science reduces paper use, reducing human effect on nature. People make paper with trees. Trees are important because it consists of nature. Trees are a lung of the Earth because it converts carbon dioxide into oxygen. In addition, less tree means less place for animals, disrupting an ecosystem. As science and technology developed, scientists invented computers and smartphones. Now, newspapers, paper mails, and paper books are replaced with internet news, text messages, and e-books. As a result, paper is used less than before.

Third, scientists are studying renewable energy, which will prevent future pollutions. Fossil energy makes many carbon dioxides, with some air pollutants. This makes global warming faster. Nuclear energy is clean but dangerous considering the case of Fukushima. People cannot remove power plants because electricity is necessary. A solar power station and a wind power plant are well known to people. A solar power station converts solar light or heat into energy and a wind power plant uses the wind into energy. A tidal power plant and a geothermal power plant are comparably unknown to people. A tidal power plant uses an energy of a tide, which is generated by the gravity between the Earth and the Moon. A geothermal power plant converts heats from the land to electricity. These power plants are called sustainable energy and will not make any pollutions.

In conclusion, there are problems deteriorating nature, but science can improve on nature. A plastic waste, water pollution, and carbon dioxide are being removed. Trees are saved. Fossil fuels will be replaced with the sustainable energies. All of these can be done with the eco-friendly technology made by the scientists' hard work.

People harm nature because they do not consider nature 'that' important. We often think that we can use environment endlessly, and the damaged environment will heal itself, giving benefits always as usual. Sadly, it will not. It has its threshold, and if the limit exceeds, then what we have done cannot be undone. We must always remind this old saying, which emphasizes us to preserve the environment:

“We do not inherit the earth from our ancestors; we borrow it from our children.”

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Discuss how modern technology is improving on nature.

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It is easy to imagine two conflicting associations, one to carry out development even if it sacrifices the natural environment, and the other to protect nature. Likewise, it seems evolving science and technology, and retaining the natural environment are somewhat incompatible. It may true that technologies adversely affect nature in some aspects. However, modern technology actually improves on nature in that it affords measurements of the environment, leads the public to harm nature less, and suggests the idea that enhances nature.

Modern technology improves on nature by providing objective measurements to show how our environment is. These measurements are important because they give the quantitative data, instead of inaccurate information relying on feelings. Generally, people do not perceive harm in two ways – They do not have enough knowledge, or they do know but do not care about it as they are too used to it. For both cases, measurements can help people to discern the harm and save nature. For example, in old times, people do not concern much about water pollution, not only because they do not need to since the pollution was not that serious, but also because there was no way to realize the severity. Today, however, there are many ways to assess the water quality. We can do this simply by estimating COD, chemical oxygen demand, or BOD, biochemical oxygen demand, the amounts that indicate the condition of the water.¹ From these, we can easily check the quality of water. For another example, fine dust is a serious problem nowadays. Fine particulate matters, particles with their diameter less than $10\mu\text{m}$, bring about fine dust pollution, which triggers respiratory diseases and cardiovascular diseases as we inhale the air.² In the beginning, people did not recognize the gravity of fine dust pollution, but then, after it is possible to measure the concentration of the fine dust, its numerical value is put on the weather forecast. This arouses people's attention and now people try to care more about the environment.

Some people may counter that this is a false causal relationship because it is more probable that people made the measurements after they realize the seriousness, and so the measurements themselves do not actually keep people from severe contamination. Nonetheless, the measurements are not created after most people notice the significance. Some experts perceive the danger and set up a certain standard. Base on this, people make proper measurements to inform the public and change their behavior.

Moreover, modern technologies make people follow the methods that harm nature less. Most anthropogenic activities that damage natural environment are substituted due to enhanced technologies. Previously, it was inevitable to destroy the nature when new technologies or products came out, because there was no way to test them sufficiently before the use. For instance, people did not realize the harm of DDT, Dichlorodiphenyltrichloroethane, and it was a popular pesticide until 1972, the time when it was banned due to its fatal effects on human and nature. DDT was widely used without adequate research, since it was cheap and effective.³ On the other hand, now it is capable of testing such products before getting them out, as technologies are advanced enough to examine chemicals. Communications technology also allows us to share the knowledge from experts in all over the world. What's more, when testing new technologies or products, people had to do hands-by-hands, consuming a lot of resources. Now, however, simulation programs enable to test them using almost

¹ "Water quality - Wikipedia." https://en.wikipedia.org/wiki/Water_quality. Retrieved 19 May. 2017

² "Fine dust and public health concern - KoreanLII." 21 April. 2017, http://www.koreanlii.or.kr/w/index.php/Fine_dust_pollution. Retrieved 19 May. 2017

³ "What is DDT? - National Pesticide Information Center - Oregon State" <http://npic.orst.edu/factsheets/ddtgen.pdf>. Retrieved 19 May. 2017

no substantive resources. In the past, people chose to destroy nature rather than preserve it, because it was more profitable. Nevertheless, thanks to highly developed simulation technique and calculation with computers, we do not need to impair nature relentlessly to test new products or use them before knowing side effects.

In addition, the modern technologies provide the actual products or idea to improve on nature. Many technologies are established to boost the nature, and eco-friendly products are the examples. People can easily find the eco-friendly products in the markets – bags or notes with recycled paper, rechargeable batteries, reusable water bottles, and LED bulbs.⁴ Also, electric cars, although they are not that common yet, show new technologies are becoming more and more environment-friendly. Furthermore, some modern technologies such as a remote control technique save endangered animals and plant species. A remote control photography and video facilitate closer look at wildlife without bothering their natural habitats. A new technology of a remote monitoring of wildlife sounds allows us to listen to the sounds of various species in the forest without disturbing the natural environment. A gene sequencing, as well as a remote control technique is one of the modern technologies that rescue endangered species.⁵ In these ways, endangered species are saved from the danger of extinction.

In conclusion, modern technology improves on nature through diverse ways, including offering measurements, guiding people to protect nature, and proposing the methods to improve on natural environment. The primary purpose of the science and technology is to enhance the betterment of the society. It is obvious that pleasant environment is one of the most important features of our lives. This is why we cannot help trying to improve on nature, and no one welcomes a technology that destroys the place where we are living on. Still, a technology does not developed from nothing. People have to realize a problem and try to think over how to fix it. Therefore, the awareness of people is important to improve on nature and our lives. Thereby, lots of technologies will be continuously developed to improve on nature now and forever.

⁴ "25 Green Eco-Friendly Products - Conserve Energy Future." <http://www.conserve-energy-future.com/25-green-eco-friendly-products.php>. Retrieved 20 May. 2017

⁵ "12 Innovative Ways Technology is Saving Endangered Species." 15 June. 2012, <https://www.treehugger.com/gadgets/ways-technology-saving-endangered-species.html>. Retrieved 21 May. 2017

The development of modern technologies such as physics, chemistry, biology, and computer science have had a great impact on medicine and have enabled people to provide effective and excellent medical services. But some problems are still not solved. One of the problems of the modern healthcare system is that the division of labor is so severe that one person can't do everything. If there are three doctors, one has to take a CT or MRI picture, another has to make a diagnosis, and the other has to do an operation. The most difficult part of this process is to determine the cause of the disease through accurate diagnosis. However, since a disease can have a variety of causes, it is almost impossible for highly specialized medical industry to have a complete understanding of the disease with only a few doctors.[1] That's why it takes a great deal of time to diagnose diseases like some cancers. To solve these problems, computer science has recently started to diagnose diseases by cooperating with medical industry.

In recent years, many high-tech companies, such as Google, Apple, and IBM, have been employing basic scientists and physicians. Especially, it was a big issue for Google to attract the heart specialist Jessica Mega, a promising professor at Harvard Medical School.[2] The main reason why these companies that have grown up on the basis of engineering is seeking doctors is to combine engineering and medicine. For these high-tech companies, scientific and medical knowledge is at the heart of any business that needs to be done in earnest, especially in cancer diagnostics. A year ago, Google's AlphaGo became the strongest player in Go game, winning tons of experts. The background of AlphaGo is deep learning, an algorithm that checks many cases and learns by itself to give the best answer to each situation. Learning thousands of Go games in a short time, AlphaGo had always been able to made the best choice in Go game. Surprisingly, this mechanism can be applied similarly in medicine when we give the best answer for disease diagnosis.

It is the interest of many companies and the medical community to integrate artificial intelligence programs to health care service. Let's look at Google's recent traces as the most famous example. Google is working with healthcare professionals to develop tools to improve the availability and accuracy of healthcare services. And it succeeded in diagnosing diabetic cancer and related eye disease (diabetic retinopathy) by using deep learning technology. Patients with diabetic retinopathy, a very complicated disease, suffer from a lack of expertise and 45% of them become blinded before they are diagnosed.[3] There are two main reasons for this: first, since the disease test is a highly complex task, skilled professionals who are trained and experienced are necessary. Second, even if this test procedure is done, physicians have to deal with a lot of data within a limited time because if time is late, patients are likely to be blind before the result even comes

out. Surprisingly, the accuracy and speed of diagnosis of this artificial intelligence that Google created is much higher than people. Therefore, using diagnostic machine that uses deep learning algorithm makes it possible to handle much more data than people in a very short time, and many patients can get better health care efficiently.

Let's take a closer look at current medical problems and the advantage of deep running in connection to the healthcare industry. The diagnosis of fetal diseases, such as cancer, starts with a doctor analyzing the photographs taken by CT or MRI. So the most relevant medical field in this regard is radiology, which takes pictures of a body and interprets them. The process of analyzing the pictures taken in the hospital is called 'medical imaging'.^[1] Currently, one of the major problems is that even if you take a picture, the result of the analysis differs from doctor to doctor. For example, I went to various orthopedic clinics because my waist was bad, but seeing the same spine picture of mine, some doctors judged there was a disc and others said there was no any disc. Also, the same doctor may make two different diagnoses when there's a time interval between two tests. So I couldn't exactly know what to believe. This kind of situation is very stressful for the patient and it is why many specialists in radiology are needed. But what if the computer does this analysis? If the artificial intelligence can analyze the medical images and interpret them, like AlphaGo which analyzes thousands of existing Go games and finds the best number, physicians can get a much more accurate and rapid test result, followed by precise surgery and prescription.

Another famous example of using artificial intelligence includes the IBM company. For the first time in December 2016, Korea introduced an artificial intelligence cancer diagnosis solution, IBM Watson. Watson is a clinical decision support system that assists physicians in the medical decision-making process. It has learned a vast amount of clinical data, including more than 200 medical journals and textbooks. Watson entered some university hospitals such as Gachon Daegil University, Pusan National University, and Konyang University Hospital and helped doctors make decision. With Watson, doctors analyze medical images or genetic information, diagnose cancers, and even determine whether a patient is eligible for health coverage. Watson especially exerts its strength when it comes to evidence-based medicine. Evidence-based medicine means health care should be based on the best medical evidence available for patient care. Watson provides strong reference to strengthen the physician's cognitive abilities. Based on a vast amount of learning, it has fast analytical power and insight, and helps to prevent doctors from becoming prejudiced. Many physicians in Korea now have come to recognize the performance of Watson.^[4]

Of course, some people may say that it will take a long time for the system to be commercialized for everyone, or question the accuracy of the diagnosis. It is true in some ways. Above all, it's necessary to secure the accuracy of the diagnosis. India's Manipal Hospital has

surveyed 1,000 cancer patient cases for the past three years, and found that the doctor and Watson's judgments were consistent only with 80%, which means there is a 20% instability. Moreover, no definitive clinical study has been done about how accurate Watson is. One of important features of the deep learning algorithm is that it uses a lot of data, but the lack of data such as medical images is one of the barriers that must be overcome now. So many companies are maintaining partnerships with hospitals, trying to store and analyze data. Although it seems to need more investment and effort now, scholars say the technology will completely be commercialized within 20 years at the latest.[4],[5]

The advantage of using deep-learning diagnostics is that it is not biased when diagnosing, but uses the knowledge of all areas to make an integrated conclusion. Although doctors are studying hard to read large volumes of books and papers, one person can not study all fields of medical science. This is why some doctors spend a lot of time thinking about the exact cause of disease even though the skill to treat the disease is sufficient. If an AI which has learned more than 200 medical books and many medical cases comes up with a rough answer on the cause of the disease, the doctor will make a more definitive diagnosis based on it. This allows doctors to correct their mistakes and prejudices at the same time the speed of diagnosis is dramatically increased.[5] In particular, these AI programs shine in the case of certain diseases that are suffering from labor shortages like diabetic retinopathy mentioned above. Therefore, if advancing computer science cooperates with the healthcare industry, we can clearly develop current nature of medicine that is time and effort consuming.

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“Earth provides enough to satisfy every man’s needs, but not every man’s greed.” A well-known proverb from Mahatma Gandhi, a leader of Indian independence movement, decently seems to show some insight on necessity of care for the nature and the environment. As technology advanced throughout history, especially in the 19th and the 20th centuries, our everyday lives of humanity have become much more convenient than ever. On the other hand, excessive consumption of natural energy and exploitation of resources have also led to devastation of the natural environment around the globe which still is an ongoing problem in our contemporary society. However, realization of this issue by scientists has thankfully triggered numerous research on development of conservative technologies for nature, including development of renewable energy, utilization of carbon sink, and enhancement of biodiversity, as some major achievements.

One of the most important modern technologies which can improve our natural environment is the development of renewable energy. Unlike the limited underground resources such as coal or petroleum, this energy is accumulated from renewable and reusable resources that are naturally restored continuously. Resources are mainly composed of wind, tides, sunlight, geothermal heat, and a multitude of other various kinds of recyclable energy. Renewable energy is often known to provide service in four major domains which are generation of electricity, heating and cooling of water and air, energy delivery in transportation, and rural energy provision. Such technologies can be of great importance in terms of prevention of global warming since they are highly effective in cutting down on greenhouse gas emissions, most typically carbon dioxide. For wind power, the energy obtainable from the wind turbine is proportional to the cube of the wind velocity, so that if the wind speed rises, power output will also increase (EWEA, 2007). Water, for usage in hydroelectric energy, is approximately 800 times much denser than gas, so that even a slow water stream can yield significant amount of power. Classic methods involve constructing hydroelectric dams or reservoirs in large scales as well as power plants beside rivers (IRENA, 2012). Photovoltaic systems, commonly known as solar power plants, convert sunlight into direct electrical current by exploiting photoelectric effect (Department of Energy, 2011). Geothermal energy is defined as high thermal energy which is generated or reserved underneath the ground. In geothermal power plants, the temperature difference between the earth’s core and the surface stimulates a constant conduction of heat (Dye, 2012). According to statistics, nearly all estimates of greenhouse gas emissions from the wind turbines range

from 0.02 to 0.04 pounds of carbon dioxide per 1 kilowatt-hour. It is also measured as 0.01 to 0.03, 0.06, 0.08 to 0.2, and 0.2 for small riverside plants, large hydroelectric reservoirs, solar power plants, and geothermal systems, respectively. Compared to the amount from electricity generated by coal which ranges from 1.4 to 3.6 pounds, the reduction rate of carbon dioxide is quite efficient (Edenhofer et al. 2011).

In addition to renewable energy, utilization of carbon sink for practically reducing carbon dioxide in the earth's atmosphere is another cutting-edge technology that is still under development. Carbon sink is basically a type of reservoir, either natural or artificial, which collects or stores some chemical compounds that contain carbon. Such chemical compound is usually carbon dioxide, and removing process of this gas is called carbon sequestration. While conventional agricultural methods often cause loss of carbon compounds from soils, regenerative agricultural practices can effectively prevent carbon loss and eventually ameliorate the soil to play important roles as a carbon sink. The Rodale Institute, an agricultural institute in the U.S., claims that if this method is conducted on 3.6 billion acres of tillable ground on the earth, sequestration of carbon dioxide currently emitted is possible for about 40% (LaSalle, 2008). To be more precise, soil that is managed organically helps conversion of carbon dioxide into an asset of food production from an unfavorable greenhouse gas, which ultimately mitigates further global warming (Rodale Institute, 2013). In industrial areas, carbon dioxide capturing techniques are carried out by absorbing carbon dioxide onto diverse solvents mainly composed of amine-based substances. Moreover, utilization of hydroxides for direct carbon capture from the air and serpentinite deposits exploited as a mineral sequestration method are under further investigations (Sustainability Matters, 2010). On a similar basis, ocean fertilization, which entails nutrient nourishment such as incorporating phosphorus, urea, and iron to induce food production of marine ecosystem, is another efficient technique for atmospheric carbon dioxide removal (Matear & Elliot, 2004). When the integration of carbon and inorganic substances for production of organic matter is processed by phytoplankton through photosynthesis, production rate is usually determined by the accessibility of iron or nitrogen. Due to this fact, addition of iron into the ocean promotes increase in phytoplankton growth, and after this considerable bloom the phytoplankton will die away taking carbon dioxide from the atmosphere to the seabed. Not only does this facilitate carbon capture, but it also helps support marine biodiversity and fisheries production as well (Mission, 1999).

Along with renewable energy and carbon sinks, enhancement of biodiversity by employing gene banks is a notable biological technology for nature. Generally, a gene bank is a specialized biorepository which is designed for preserving genetic materials, or 'genes'. Preservation is typically possible for multicellular organisms such as plants or animals and can be done through collection of some tissues or gene fragments. To be more specific, conventional methods involve freezing detached grafts or storage in seed banks for plants and freezing reproductive cells for animals until usage.

When it comes to conservation of agricultural biodiversity, gene banks are essential as a means of maintenance of genetic resources for preserving important crop species and their wild relatives. Gene banks are mainly comprised of four major types, which are seed bank, tissue bank, cryobank, and field gene bank, respectively. As its name implies, dried seeds are stored at extremely low temperatures in seed banks (Drori, 2009), and seedless plants including buds or meristematic cells are preserved in tissue banks. Likewise, cryobanks are also designed for such preservations as well as animal species, but the only difference is that it utilizes liquid nitrogen to apply deep-freezing method. This is known to be beneficial especially for crossbreeding of plants and protecting endangered species since long term storage is favorable (CGIAR, 2012). In a different concept, field gene bank refers to artificial ecosystem created by planting various plants on a certain land mass. Botanical studies such as comparison among different species of plants and preserving germ plasma of crops are adequate for this method. Most importantly, not only does enhancing biodiversity around the globe assists in ecological services, which eventually takes part in modulating water supply and chemical reactions in the atmosphere (Cardinale, 2012), but it also provides crucial support in human health. For instance, the accessibility of medicinal materials critically depends on biodiversity (Mendelsohn & Balick, 1995). Statistics shows that in the U.S. market, drugs derived from microbes, animals, and plants constitute up to 50% of the total pharmaceuticals while the percentage of this type of medicine used in fundamental healthcare for the world population is estimated to be 80% (Chivian, 2008). Hence, the significance of biodiversity itself can never be emphasized enough.

Despite the fact that such contemporary technological advances regarding sustainable development and natural conservation still have some limitations in terms of practical efficiency, extensive research into these fields of technology will eventually improve on producing cost-effective energy and further prevent secondary pollution. Last but not least, governmental support is pivotal in reinforcing this nature-friendly technology either by expanding financial investment in research or legalization of initiating environmental policies. Fortunately, international organizations are taking specific actions concerning this issue. Since the selfishness of humans has apparently resulted in negative consequences on our own living environment, it will not be too hasty to conclude that efforts for restoring nature is the best strategy for prosperity of humans and other forms of life on the earth.

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