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EDITORIAL

Bioengineering to tackle environmental challenges, climate changes and resource recovery

There is serious debate nowadays about climate change, environmental challenges, greenhouse gas emissions, rising temperature on earth, etc. The fact is that after industrial revolution and technology development in the last two centuries, we face a global improvement in the human health and also welfare. It resulted in increasing the global population to more than seven billion and also improving the lifestyle. For example, the number of the cars in the world which were ca 250 millions in 1970 were increased to more than a billion in 2010. The consequence is that we consume more resources such as oil, gas, water, minerals, forests and produce wastes and residuals in form of solid, liquid or gas, such as municipal wastes, wastewater or carbon dioxide.

The natural cycles and human activities were in balance, until the industrial revolution. It means we consumed resources and produced wastes, while other organisms in nature such as bacteria, fungi, algae, insects, plants and animals did the recycling and convert the wastes and residuals to the resources again (Figure 1(a)). However, the development of the technology in a linear economy resulted to improve, and still improving, human health, global population and also better welfare, which lead to an imbalanced natural cycles. It is because the other organisms and the nature in general cannot take care of the wastes and residuals that human produce and to recycle it back to the resources (Figure 1(b)). One example is CO_2, that its global production was ca 0.03 billion ton in 1800, while increased continuously to more than 36 billion tons in these years. It resulted in increasing CO_2 in the atmosphere with ca 2 ppm/year in the last 50 years. Although a large debate and global agreement since Kyoto protocol in the 1990s and several global meeting on climate change every year, we still face increasing CO_2 emission and rising CO_2 level in the atmosphere. Although the debates on other materials and greenhouse gases such as methane, minerals, municipal wastes, deforestation, are not in the same level, the trend is similar and accelerating. The question is how to face these challenges.

A solution to this global environmental challenge is to help natural processes and its organisms to accelerate their process and make the conversion of wastes and residuals (in gas, liquid or solid forms) to the resources faster and

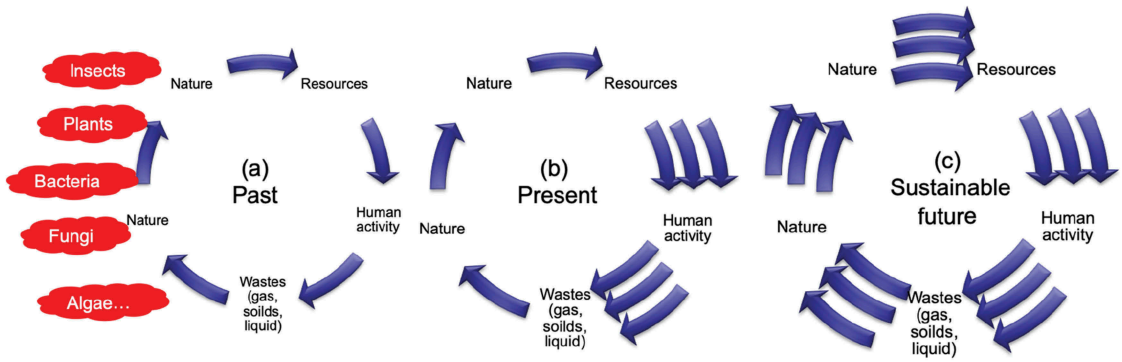

Figure 1. Natural cycles in nature between human and other organisms that were (a) in balance before, but (b) not in balance today, and (c) a scenario of sustainable balance in the future that keep economical and social growth, but being in balance by bioengineering of the natural processes of resource recovery by, e.g., faster bioengineered organisms.

develop a circular economy in order to make a new balance (Figure 1(c)). Bioengineering provides common tools for this process if properly adopted. While bioengineering is continuously providing a better understanding for human health and diseases to provide longer and healthier life, we should seriously consider all the means in the research and development in the world to understand the mechanism of action in organisms and facilitate their growth and conversion of our residuals to the resources. The bioengineering can be carried out not only in the genetic and metabolic level of the organisms, but also in the process level. It means if we cannot reduce the global production of, e.g., CO_2, why not focusing on faster conversion of this gas back to the resources, by, e.g., algae or other bioengineered organisms and plants. Another example is methane in the air that is the second greenhouse gas. There is a great potential to use bioengineering to capture it from the sources or even air and use it as a resource. This is the way to solve environmental challenges, where *Bioengineered* is contributing to the science and technology. The editors would like to thank all the authors in 2019 for their contributions toward the journal and welcome new submissions in 2020.

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