THE CHEMIST AND ENVIRONMENTAL SUSTAINABILITY

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ABSTRACT
Sustainable development advocates environmental sustainability, which requires some roles of the chemist to achieve. This review paper captures these roles, including prevention and protection against environmental degradation and its monitoring, recycling of wastes, making packages from 100% renewable resources, production of agrochemicals for aforestation and biodiversity and food security, production of renewable energies, production and application of water treatment and sanitation chemicals, chemical control and recycling of automobile exhaust emissions. It recommends more serious measures at national and international levels to encourage the study of chemistry and to enhance the regulation of its practice.

INTRODUCTION
As an aftermath of the Brundtland Commission of 1987, the concept of development based on conquest and wrecking of the world for increased economic productivity has been replaced with the paradigm of development based on sustaining the environment for all generations of people. Depleting the planet in the name of economic development that seeks to maximize economic production, only to deny the future generations the resources bequeathed to the present generation as well as the future generations of the earth's inhabitants, is unacceptable[1].

Sustainable development is a mainstream recognition of a link between development and environment. It advocates meeting the economic, environmental, political, social, cultural and health needs of the present without compromising the ability of the future generations to meet their own needs. It seeks to minimize waste by maximizing recycling and discouraging the use of non-renewable resources, encourage sustainable use of finite renewable resources, discourage overtaxing the capacity of ecosystems to absorb or break down wastes, protect natural processes and climatic systems, including not overtaxing the capacity of global ecosystems to absorb or dilute wastes without adverse effects, and mobilize political and institutional structures within nations and internationally to support the achievement of these goals[2].

Before creation, the earth was void, empty, a formless mass cloaked in darkness. It would have remained most uneventful, dull and dumb to date, but for creation. Creation obviously involved lots of reactions of chemical elements. Hence, the Creator has been described as the First Chemist. He performed the first chemical reaction in creating light. Next, he reacted the chemical and biochemical elements (e.g. hydrogen, oxygen, etc.) to form water, land, vegetations and animals. He formed man from the dust. Thus, he set the pace and empowered the chemist with the knowledge and the skill to create one material substance from others. It has been said that the power of creation belongs

to God, who gave to the chemist the next power to change matter from one form to another[3-5].

Chemistry has been defined as the branch of science studying the properties, composition and structure of matter, which comprises all things that have mass and occupy space, together with the associated chemical and/or physical changes and how such changes impact on the welfare of man and society. Chemistry is the study of everything. Indeed, what on earth is not chemistry? Chemistry is the heart of science, which is the foundation on which technology for national development is built. Remove science and technology, mankind will revert to the Stone Age[6].

Thus, the chemist plays vital and strategic roles in the health sector. He is actively involved at every stage of the search for drugs - biologically active substances of known or unknown structure, compounds which affect life processes. Both pharmacokinetics (absorption, distribution, biological transformation and excretion) and pharmacodynamics (biochemical and physiological effects and their mechanism of action) of drug are directly related to the chemistry of the drug. Chemistry is deployed in the isolation (extraction, phytochemical screening, separation and purification, and analysis) of drugs. Similarly, chemistry plays very crucial roles in effective agriculture for sustainable food production, processing and preservation. From the determination of the soil nutrient status through the production and choice and application of fertilizers and pesticides and preservatives to food processing and preservation, chemistry plays indispensable roles. Thus, chemistry addresses food and drug availability and affordability, thereby enhancing both the quality of life and life expectancy of a nation's citizenry. Chemistry is applied to natural resources to release the potential in the flora and fauna, converting them into raw materials and wealth for the welfare of the citizens[6].

A chemist is a graduate of chemistry or chemistry-related discipline from a recognized university or polytechnic. He was trained in the area of chemical handling, usage and management. He practices in the industry, government ministry or agency, school, etc.[7]

This paper is a review of the relevance of the chemist in achieving environmental sustainability. His key roles include the prevention of and protection against environmental degradation, recycling of waste matters and sewage, making packages from 100% renewable resources, production of agrochemicals and fertilizers for aforestation and biodiversity and food security, production of renewable energy to replace the fossil fuels and other non-renewable energies, production and application of water treatment and sanitation chemicals, chemical control and recycling of automobile exhaust emissions, and monitoring of environmental degradation. It recommends the encouragement of the study of chemistry and the enhancement of the regulation of its practice in order to maximize the services of the chemist in environmental sustainability.

THE ROLE OF THE CHEMIST IN ENVIRONMENTAL SUSTAINABILITY

The modern utilization of biomass (organic matter) involves the large-scale coppicing of rapidly growing trees (such as various types of willow), the harvesting of rapidly growing trees eucalyptus), or the conversion of crops into fuels (e.g. sugarcane into ethanol)[8].

Geothermal energy projects may release carbon dioxide, hydrogen sulphide, and mercury. Tidal power projects, especially tidal barrages, may destroy or fundamentally change estuarine habitats. Emissions, notably sulphur, oxides of nitrogen, suspended particulate matter, and other noxious emissions, such as benzene and volatile organic compounds, having harmful local and regional effects, are a

problem with secondary forms of fossil fuels in particular[8].

Greenhouse effects arise from carbon "sequestration," the absorption of carbon dioxide that occurs when new tree or other plant growth follows modern biomass processing. Greenhouse gases are emitted into the atmosphere by the conversion and use of fossil fuels and by the burning of biomass. Some of this is absorbed in the oceans, and some on land, but the rest – for varying lengths of time – goes to increase the atmospheric concentration of these gases, which is widely believed to have a global warming effect. Increasing atmospheric concentrations of these gases resulting from human activity raise the mean temperature of the Earth's atmosphere, causing global mean sea level to rise, and having both widespread and localized climatic effects[8].

In general, coal emits the greatest quantity, weight for weight, carbon dioxide (the most significant individual greenhouse gas), followed by oil and natural gas. Coal, crude oil, natural gas, biomass, hydroelectric power, solar energy, wind energy, and heat all provide primary energy, which are recovered or gathered directly from natural resources. Primary energy usually, though not always, needs to be converted into secondary energy: electricity, petrol for cars, jet fuel for aeroplanes, paraffin and diesel oil for lighting and heating, charcoal, etc. Conversion requires plants and technologies: oil refineries, coal-fired or gas-fired electricity-generating stations, nuclear power stations, photovoltaic cells, etc. [8]

Distribution of the final form (electricity through the grid, petrol in delivery vehicle) follows, to be applied in an end-use technology (a cooker, a light bulb, a furnace, a car, an aircraft) to provide the energy service required (heating, lighting, mobility, etc.) The final transformation of energy by the end-use device to the energy service required is termed conversion to useful energy. Effective energy use is of practical, technical and policy concern, and could have a significant impact on world energy supply requirements. Various estimates place end-use efficiency as "exergy", at well under 10%, both in industrialised and other countries[8].

Environmental pollution (noxious and greenhouse gas emissions), global warming, ozone-depleting, deforestation and threat to and extinction of wildlife, and urban degradation are some of the manifestations of environmental degradation with disastrous consequences. The concept of 'environmental space' per person per country measures environmental degradation due to human activities. Environmental space is the sustainable rate at which we can use environmental resources without causing irreversible environmental damage, depriving the future generations of the earth's inhabitants of the resources they will need[8-10].

Massive pollution of the biosphere must be controlled in order to survive the crisis of environmental degradation and maintain the earth as a place for human habitation. The chemist is central to the basic techniques for pollution reduction, including precipitation, dispersion, treatment, cyclones, wet scrubbers, absorption, etc. To control air pollution by exhaust he introduces direct after-burner in the exhaust system, catalytic after-burners and exhaust cooling. He also controls the sulphur dioxide emitted by coal-fired plants by analyzing and selecting low-sulphur coal, desulphurising of coal and fuel-gas, stacking and dispersing sulphur dioxide, etc. [11]

The chemist is increasingly engaged in the research for recycling of waste matters and sewage, making packages from 100% renewable resources, production of agrochemicals and fertilizers for aforestation and biodiversity and food security, production of renewable energy to replace the fossil fuels and other non-renewable energies, production and application of water treatment and sanitation chemicals, environmental chemical control and recycling of automobile exhaust and other emissions of dangerous chemicals,

and monitoring of environmental degradation[12-23].

CONCLUSIONS AND RECOMMENDATIONS

The roles of the chemist in environmental sustainability are as crucial as they are diverse. This paper has attempted to review them, but not exhaustively, especially as new areas are being exploited by the day.

It is recommended that more serious measures should be taken at national and international levels to encourage the study of chemistry and to enhance the regulation of its practice in order to maximize the services of the chemist in environmental sustainability, which is a milestone in the new global paradigm of sustainable development.

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