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Effect of Pollution on Sustainable Development and Pollution Control Technologies

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ABSTRACT: At the global scale sustainability and environmental management involves managing the oceans, freshwater systems, land and atmosphere, according to sustainability principles.^{[1][2]}

Land use change is fundamental to the operations of the biosphere because alterations in the relative proportions of land dedicated to urbanisation, agriculture, forest, woodland, grassland and pasture have a marked effect on the global water, carbon and nitrogen biogeochemical cycles.^[3] Management of the Earth's atmosphere involves assessment of all aspects of the carbon cycle to identify opportunities to address human-induced climate change and this has become a major focus of scientific research because of the potential catastrophic effects on biodiversity and human communities. Ocean circulation patterns have a strong influence on climate and weather and, in turn, the food supply of both humans and other organisms.

KEYWORDS-sustainable, pollution, control, technology, development

I. INTRODUCTION

In March 2009, at a meeting of the Copenhagen Climate Council, 2,500 climate experts from 80 countries issued a keynote statement that there is now "no excuse" for failing to act on global warming and without strong carbon reduction targets "abrupt or irreversible" shifts in climate may occur that "will be very difficult for contemporary societies to cope with".^{[4][5]} Management of the global atmosphere now involves assessment of all aspects of the carbon cycle to identify opportunities to address human-induced climate change and this has become a major focus of scientific research because of the potential catastrophic effects on biodiversity and human communities.^[1,2,3]

Other human impacts on the atmosphere include the air pollution in cities, the pollutants including toxic chemicals like nitrogen oxides, sulphur oxides, volatile organic compounds and airborne particulate matter that produce photochemical smog and acid rain, and the chlorofluorocarbons that degrade the ozone layer. Anthropogenic particulates such as sulfate aerosols in the atmosphere reduce the direct irradiance and reflectance (albedo) of the Earth's surface. Known as global dimming the decrease is estimated to have been about 4% between 1960 and 1990 although the trend has subsequently reversed. Global dimming may have disturbed the global water cycle by reducing evaporation and rainfall in some areas. It also creates a cooling effect and this may have partially masked the effect of greenhouse gases on global warming.^[6]

Oceans

Ocean circulation patterns have a strong influence on climate and weather and, in turn, the food supply of both humans and other organisms. Scientists have warned of the possibility, under the influence of climate change, of a sudden alteration in circulation patterns of ocean currents that could drastically alter the climate in some regions of the globe.^[7] Major human environmental impacts occur in the more habitable regions of the ocean fringes – the estuaries, coastline and bays. Eight point five of the world's population – about 600 million people – live in low-lying areas vulnerable to sea level rise. Trends of concern that require management include: over-fishing (beyond sustainable levels);^[8] coral bleaching due to ocean warming, and ocean acidification due to increasing levels of dissolved carbon dioxide;^[9] and sea level rise due to climate change. Because of their vastness oceans also act as a convenient dumping ground for human waste.^[10] Remedial strategies include: more careful waste management, statutory control of overfishing by adoption of sustainable fishing practices and the use of environmentally sensitive

and sustainable aquaculture and fish farming, reduction of fossil fuel emissions and restoration of coastal and other marine habitats.^[11]

Freshwater

Water covers 71% of the Earth's surface. Of this, 97.5% is the salty water of the oceans and only 2.5% freshwater, most of which is locked up in the Antarctic ice sheet. The remaining freshwater is found in lakes, rivers, wetlands, the soil, aquifers and atmosphere. All life depends on the solar-powered global water cycle, the evaporation from oceans and land to form water vapour that later condenses from clouds as rain, which then becomes the renewable part of the freshwater supply.^[12] Awareness of the global importance of preserving water for ecosystem services has only recently emerged as: during the 20th century, more than half the world's wetlands have been lost along with their valuable environmental services. Biodiversity-rich freshwater ecosystems are currently declining faster than marine or land ecosystems^[13] making them the world's most vulnerable habitats.^[14] Increasing urbanization pollutes clean water supplies and much of the world still does not have access to clean, safe water.^[12] In the industrial world demand management has slowed absolute usage rates but increasingly water is being transported over vast distances from water-rich natural areas to population-dense urban areas and energy-hungry desalination is becoming more widely used. Greater emphasis is now being placed on the improved management of blue (harvestable) and green (soil water available for plant use) water, and this applies at all scales of water management.^[13]

Land

Loss of biodiversity originates largely from the habitat loss and fragmentation produced by artificial land development, forestry and agriculture as natural capital is progressively converted to man-made capital. Land-use change is fundamental to the operations of the biosphere because alterations in the relative proportions of land dedicated [4,5,6] to urbanisation, agriculture, forest, woodland, grassland and pasture have a marked effect on the global water, carbon and nitrogen biogeochemical cycles and this can negatively impact both natural and human systems.^[3] At the local human scale major sustainability benefits accrue from the pursuit of green cities and sustainable parks and gardens.^{[15][16]}

Forests

Since the Neolithic Revolution, human consumption has reduced the world's forest cover by about 47%. Present-day forests occupy about a quarter of the world's ice-free land with about half of these occurring in the tropics.^[17] In temperate and boreal regions forest area is gradually increasing (with the exception of Siberia), but deforestation in the tropics is of major concern.^[18]

Forests moderate the local climate and the global water cycle through their light reflectance (albedo) and evapotranspiration. They also conserve biodiversity, protect water quality, preserve soil and soil quality, provide fuel and pharmaceuticals, and purify the air. These free ecosystem services are not given a market value under most current economic systems, and so forest conservation has little appeal when compared with the economic benefits of logging and clearance which, through soil degradation and organic decomposition returns carbon dioxide to the atmosphere.^[19] The United Nations Food and Agriculture Organization (FAO) estimates that about 90% of the carbon stored in land vegetation is locked up in trees and that they sequester about 50% more carbon than is present in the atmosphere. Changes in land use currently contribute about 20% of total global carbon emissions (heavily logged Indonesia and Brazil are a major source of emissions).^[19] Climate change can be mitigated by sequestering carbon in reforestation schemes, plantations and timber products. Also wood biomass can be utilized as a renewable carbon-neutral fuel. The FAO has suggested that, over the period 2005–2050, effective use of tree planting could absorb about 10–20% of man-made emissions – so monitoring the condition of the world's forests must be part of a global strategy to mitigate emissions and protect ecosystem services.^[20] However, climate change may preempt this FAO scenario as a study by the International Union of Forest Research Organizations in 2009 concluded that the stress of a 2.5 °C (36.5 °F) temperature rise above pre-industrial levels could result in the release of vast amounts of carbon^[21] so the potential of forests to act as carbon "sinks" is "at risk of being lost entirely".^[22]

Cultivated land

Feeding more than seven billion human bodies takes a heavy toll on the Earth's resources. This begins with the appropriation of about 38% of the Earth's land surface^[23] and about 20% of its net primary productivity.^[24] Added to this are the resource-hungry activities of industrial agribusiness – everything from the crop need for irrigation water, synthetic fertilizers and pesticides to the resource costs of food packaging, transport (now a major part of global trade) and retail. Food is essential to life. But the list of environmental costs of food production is a long one: topsoil depletion, erosion and conversion to desert from constant tillage of annual crops;

overgrazing; salinization; sodification; waterlogging; high levels of fossil fuel use; reliance on inorganic fertilisers and synthetic organic pesticides; reductions in genetic diversity by the mass use of monocultures; water resource depletion; pollution of waterbodies by run-off and groundwater contamination; social problems including the decline of family farms and weakening of rural communities[7,8,9]

All of these environmental problems associated with industrial agriculture and agribusiness are now being addressed through such movements as sustainable agriculture, organic farming and more sustainable business practices.^[26]

Extinctions

Although biodiversity loss can be monitored simply as loss of species, effective conservation demands the protection of species within their natural habitats and ecosystems. Following human migration and population growth, species extinctions have progressively increased to a rate unprecedented since the Cretaceous–Paleogene extinction event.^[citation needed] Known as the Holocene extinction event this current human-induced extinction of species ranks as one of the world's six mass extinction events. Some scientific estimates indicate that up to half of presently existing species may become extinct by 2100.^{[27][28]} Current extinction rates are 100 to 1000 times their prehuman levels with more than 10% birds and mammals threatened, about 8% of plants, 5% of fish and more than 20% of freshwater species.^[29]

The 2008 IUCN Red List warns that long-term droughts and extreme weather put additional stress on key habitats and, for example, lists 1,226 bird species as threatened with extinction, which is one eighth of all bird species.^{[30][31]} The Red List Index also identifies 44 tree species in Central Asia as under threat of extinction due to over-exploitation and human development and threatening the region's forests which are home to more than 300 wild ancestors of modern domesticated fruit and nut cultivars[10,11,12]

Biological invasions

In many parts of the industrial world land clearing for agriculture has diminished and here the greatest threat to biodiversity, after climate change, has become the destructive effect of invasive species.^[33] Increasingly efficient global transport has facilitated the spread of organisms across the planet. The potential danger of this aspect of globalization is starkly illustrated through the spread of human diseases like HIV AIDS, mad cow disease, bird flu and swine flu, but invasive plants and animals are also having a devastating impact on native biodiversity. Non-indigenous organisms can quickly occupy disturbed land and natural areas where, in the absence of their natural predators, they are able to thrive.^[34] At the global scale this issue is being addressed through the Global Invasive Species Information Network but there is improved international biosecurity legislation to minimise the transmission of pathogens and invasive organisms. Also, through CITES legislation there is control the trade in rare and threatened species. Increasingly at the local level public awareness programs are alerting communities, gardeners, the nursery industry, collectors, and the pet and aquarium industries, to the harmful effects of potentially invasive species.^[35]

Resistance to change

The environmental sustainability problem has proven difficult to solve. The modern environmental movement has attempted to solve the problem in a large variety of ways. But little progress has been made, as shown by severe ecological footprint overshoot and lack of sufficient progress on the climate change problem. Something within the human system in preventing change to a sustainable mode of behavior. That system trait is systemic change resistance. Change resistance is also known as organizational resistance, barriers to change, or policy resistance[9,10]

II. DISCUSSION

Sustainable development has been on the agenda since the late 1980s and over that time much progress has been made in moving towards a world that is more sustainable. However, with population growth and issues surrounding climate change the challenges of sustainable development continue and its needs must be met with new initiatives.

What is Sustainable Development?

First, what exactly is meant by the phrase 'sustainable development'? In simple terms sustainable development is a guiding principle that focuses on sustaining natural resources and the world's eco systems in line with human development.



Sustainable Development Goals (SDGS)

A key aspect of sustainable development is ensuring that the development needs of future generations are met. For example, introducing sustainable energy initiatives so that fossil fuel use is reduced which helps keep current resources whilst reducing carbon emissions.

At the turn of the millennium the United Nations introduced the eight Millennium Development Goals (MDGs). This was a set of goals that focused on a range of sustainable development aspects. After 2016 this set of principles have been succeeded by a new set of goals, called the 17 Sustainable Development Goals (SDGS)

Environmental sustainability implies meeting our current needs without jeopardizing the right and the ability of future generations to meet theirs. Opportunities should be identified and taken to reduce the production of wastes and the use of toxic materials, to prevent soil, water, and air pollution and to conserve and reuse resources, as feasible. Environmental pollution with its health impacts is a key issue for sustainable environment (United Nations General Assembly 1987). Sustainability and sustainable development focuses on balancing that fine line between competing needs, our need to move forward technologically and economically, and the needs to protect the environments in which we and others live. Sustainability is not just about the environment (Kates et al. 2005); it's also about our health as a society in ensuring that no people or areas of life suffer as a result of environmental legislation, and it's also about examining the longer term effects of the actions humanity takes and asking questions about how it may be improved (World Commission on Environment and Development 1987). Sustainability has become a wide-ranging term that can be applied to almost every facet of life on Earth, from local to a global scale and over various time periods. Long-lived and healthy wetlands and forests are examples of sustainable biological systems. Invisible chemical cycles redistribute water, oxygen, nitrogen, and carbon through the world's living and non-living systems and have sustained life since the beginning of time. As the earth's human population has increased, natural ecosystems have declined and a change in the balance of natural cycles has had a negative impact on both humans and other living systems (Hawken 2007).

Pollution prevention reduces the amount of pollution generated by a process (industry, agriculture, or consumers). Pollution-control strategies, in general, seek to manage a pollutant after it is emitted and reduce its impact upon the environment; the pollution prevention approach, however, seeks to increase the efficiency of a process (Sherman et al. 2016), hence reducing the amount of pollution generated at its source. Although there is wide agreement that source reduction is the preferred strategy, some professionals also use the term pollution prevention to include pollution reduction.

With increasing human population, pollution has become a great concern. Pollution from human activities is a problem that does not have to be inevitable. With a comprehensive pollution prevention program, most pollution can be reduced, reused, or prevented. Reducing and managing pollution may decrease its health impacts (Thiel et al. 2015).[10,11]

Pollution prevention however is a key issue to sustainability. Pollution results from waste. The best way to deal with pollution is to prevent it from being created in the first place. This means finding new efficiencies, doing things smarter, and valuing every resource. Understanding how waste is produced and how it can be minimized, or even prevented, is the first step to reduce waste and protect our environment; in that way, pollution prevention is an essential component of sustainability.

Fundamental ideas of preventing pollution rather than fixing problems are essential for efficient, economically viable manufacturing, providing services, and addressing many environmental problems (Jorgenson and Wilcoxon 1990).

With new business tools, new materials, and new approaches, it is expected to innovate methods to reduce waste.

Prevention is the first priority within an environmental management hierarchy that includes prevention, recycling, treatment, and disposal or release. Pollution prevention, however, requires a cultural change, one which encourages more anticipation and internalizing of real environmental costs by those who may generate pollution (United States Environmental Protection Agency n.d.).

Our responsibility is to utilize our knowledge to take actions that are protective of human health and the environment.

All of the publications retained in this journal issue deal with methods and techniques suggested to maintain sustainable environment with its various components through pollution prevention and treatment. They were selected from the presentations in the International Conference in Integrated Management of Environment (ICIME) congress that has been conceived as a special platform to exchange knowledge among researchers from the Euro-Mediterranean region. The main idea was to share the different approaches to counteract the negative impacts of pollutants on the environment and human health: recent achievements of researchers acting within the region for remediation, protection,



and smart management of pollution problems. It is the duty of the region scientist to find solutions for the negative impacts of pollutants resulting from our activities. The ICIME conference was held in Sousse, Tunisia, from 25 to 28 September 2016 to serve this purpose. More than 250 participants attended this event to share new findings and discuss the potential applications of such new processes that can be turned out to viable technique for sustainable development. A good and transparent work of selection has been undertaken to choose researches to inclusion in this special issue. The intense and fruitful exchange between the attending researchers showed their common concern to address the problem of waste and remediation together. Few problems may be specific to a given region, but similarity in the diagnosis as well as the remediation approaches demonstrated that the scientific community is in charge of bringing solutions for sustainable environmental protection. So, we are really grateful for researchers who attended this edition of ICIME; congratulations to the authors with published papers. We are thankful for all authors who actively contribute to the success of the meeting, hoping that there will be other occasions to meet and exchange ideas and new scientific findings. Doctor Philippe Garages, editor-in-chief of the Environmental Sciences and Pollution Research, and the editorial team are acknowledged for their endless help during the review process of this special issue.

Special Issue is intended to improve our understanding of the current research and achievements in the broad field of sustainable environment and pollution prevention management. It includes, but is not limited to:

- Environmental assessment
- Soil, water, and air pollution
- Pollution prevention and treatment
- Assessment of pollution impact on the environment and on health
- Sustainable environment[11,12]

III. RESULTS

Nowadays, environmental issues are a significant problem that are growing rapidly and have not been properly addressed. Unsolved problems resulting from environmental pollution indicate people's inability to manage local problems over external issues. Globally, the natural and built environments are under threat, due to climatic disturbances: sudden, destructive heavy rains and repetitive floods due to intense tropical storms. Environmental issues have become more widespread and intense due to increasing industrial and human impacts on the environment. There is a need for an effort to achieve the objective of increasing ecoefficiency in several sectors of the economy envisaged in the national sustainable development strategy. The term sustainability is a key element of the ecological balance. Sustainable development requires a consistent supply of fuels such as hydrogen which, in the long term, is both sustainable and readily available at an affordable price that can be used for every needy work without harming the social impact. For a long time, it has been recognized that resource depletion and environmental pollution are the byproducts of industrial production. Pollution and its direct and indirect negative effects on humans, and animals is one of the most important issues that researchers have been studying and searching for radical solutions. Therefore, the research sheds light on the definition of pollution, its causes and environmental effects, its most important types, especially radioactive, industrial and household waste, and their levels of risk. The research focuses on the issue of air pollution resulting from fumes, smoke, and gases emitted from cars, factories, volcanic eruptions, and others. It also absorbs the problem of soil and water pollution due to the failure to properly treat factory, household and other waste, and the use of chemical fertilizers and pesticides harmful to water, air and soil. The research addresses the topic of noise pollution, and its causes by limiting loud noises from radio, television, cars, airplanes, music, etc. Solid waste management (SWM) is one of the key responsibilities of city administrators and one of the effective proxies for good governance. Effective SWM mitigates adverse health and environmental impacts, conserves resources, and improves the livability of cities. However, unsustainable SWM practices, exacerbated by rapid urbanization and financial and institutional limitations, negatively impact public health and environmental sustainability. This review article assesses the human and environmental health impacts of SWM practices in the Global South cities that are the future of global urbanization. The study employs desktop research methodology based on in-depth analysis of secondary data and literature, including official documents and published articles. It finds that the commonplace SWM practices include mixing household and commercial garbage with hazardous waste during storage and handling. While waste storage is

largely in old or poorly managed facilities such as storage containers, the transportation system is often deficient and informal. The disposal methods are predominantly via uncontrolled dumping, open-air incinerators, and landfills. The negative impacts of such practices include air and water pollution, land degradation, emissions of methane and hazardous leachate, and climate change. These impacts impose significant environmental and public health costs on residents with marginalized social groups mostly affected.

The UN Sustainable Development Goals (SDGs) aim to address poverty, inequality, environmental degradation and promote sustainable development worldwide. These 17 interconnected goals recognise the interdependence between economic, social and environmental aspects of human wellbeing and highlight the urgent need for transformative actions.

Clean air can be a catalyst for driving progress on Agenda 2030. We won't be able to meet these ambitious goals and ensure no one is left behind if air pollution is not addressed.

Which SDGs can clean air accelerate?

Clean air has a significant positive impact on several goals, directly contributing to SDG 3 (Good Health and Well-Being), and SDG 7 (Affordable and Clean Energy), and indirectly contributing to SDG 2 (Zero Hunger), SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land).[12,13]

Air pollution can cause respiratory and cardiovascular diseases, which are major contributors to global mortality rates. Policies and action tackling air pollution have a direct positive impact on population health (SDG 3), further resulting in increased labour productivity and economic growth (SDG 8: Decent Work and Economic Growth) and better education (SDG 4).

Building sustainable cities and communities (SDG 11) relies on safe levels of particulate matter pollution, while achieving universal access to sustainable energy (SDG 7) implies shifting away from the dirty fuels that cause both outdoor and indoor (household) air pollution. Ozone, a potent air pollutant, significantly reduces crop yield, so clean air supports food security and improved nutrition (SDG 2).

The most vulnerable people and communities – children, women and the elderly – are usually those who suffer the most from air pollution, so policies and actions to improve air quality can also contribute to reducing inequalities (SDG 10: Reduced Inequalities; SDG 5: Gender Equality).

As both air pollution and climate change are mainly caused by burning fossil fuels, clean air action is also often climate action (SDG 13). Solutions to improving air quality—such as switching to affordable and cleaner energy, cooking and lowering transport emissions—will also address the climate emergency.

Reducing air pollution associated with responsible production and consumption is critical to achieving SDG 12, including reducing emissions from transportation, waste burning and industrial activities. Clean air can also support SDG 15, as air pollution can harm ecosystems and biodiversity, including plants, animals and microorganisms. Clean air will help protect these species and maintain healthy ecosystems.

Indicators related to air pollution

While there are three specific indicators for reducing air pollution in the formal system of SDG indicators, improving air quality supports the achievement of many more goals. Click on the below goals to see which indicators are directly and indirectly related to improved air quality.

Financing a catalyst for Agenda 2030

Smarter funding for projects that improve air quality can deliver enormous benefits globally in terms of human health, economic development and climate mitigation and adaptation. By investing in clean air projects, funders can more effectively utilise their resources, delivering smart interventions that cut across several SDGs simultaneously.

IV. CONCLUSION

Urban mobility is rapidly becoming one of the greatest challenges facing developed and developing countries alike. Transport is estimated to be responsible for nearly a quarter of global energy-related CO₂. There are also rising concerns about its impact on the quality of urban life, including social inequities, and about the effects of its pollution on health and buildings.[14]

Overall demand for transport activity (for both passenger and freight) is growing rapidly, and it is predicted to roughly double between 2005 and 2050. The global vehicle fleet is set to multiply three or four-fold in the next few decades, with most of this growth set to occur in developing countries. In 2050, two-thirds of the global vehicle fleet is expected to be in non-OECD countries. At the same time technological improvements such as fuel-efficient vehicles and alternative power sources have not developed rapidly enough to cope with the consequence of this growth.

There is a growing consensus on the need for more sustainable patterns of transport activities. This requires a fundamental shift in investment patterns, based on the principles of avoiding or reducing trips through integrated land-use and transport planning. Moreover it is necessary to shift to more environmentally friendly modes of transport and improving vehicles and fuels, which is seen as a priority to reduce urban air pollution and greenhouse gas emissions. In order to reduce volumes of traffic and emissions, regulations and standards, environmental friendly technologies and concepts for public transport and 'green cities' have to be implemented. UNEP supports governments and partners in implementing policies, technologies and investments that lead to low-carbon, green transport on the ground.

Share the Road is the UNEP-led initiative that advocates a systematic inclusion on non-motorized transport (NMT) infrastructure in urban road investments as a matter of policy. It combines the agendas for mitigating climate change, improving road safety and increasing accessibility to essential services by investing in NMT infrastructure.

The Global Initiative on Promoting Bus Rapid Transit and Promoting Sustainable Transport in Latin America aims to facilitate the shift from private motorization to public and non-motorized transport. Another initiative is The Partnership for Clean Fuels and Vehicles, which has been coordinating programmes that aim at reducing vehicular emissions in developing countries to improve urban air quality.

UNEP supports also the "Make Roads Safe - Campaign for Global Road Safety" which addresses politicians, international institutions, vehicle manufacturers and road planners. It aims to reduce road deaths and injuries with a focus on developing countries, poor communities and children.

Pollution of the air, water, soil and workplace is an important threat to human development. The UN Sustainable Development Goals (SDGs) have a strong focus on reducing environmental pollution (UN, 2015). Specifically, SDG 3.9 seeks to "substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination" by 2030. Many of the other goals are also related to pollution, including SDG 2.4 on improving soil quality, SDG 7 on clean energy, SDG 9.4 on clean technologies and industrial processes, SDG 11 on sustainable cities and communities, SDG 12 on responsible consumption and production, and SDGs 14 and 15 on conservation of water and land.

People do not intentionally seek to cause pollution, but disposing of waste products into the nearby environment is often the most convenient, and inexpensive, form of disposal. Thus, pollution is an example of indirect, or second-order, environmental consequences of human development efforts (50 Breakthroughs study, ITT, 2014). Throughout human history, people have modified their natural environment in many ways to increase their well-being. In addition to the desired and beneficial first-order environmental changes, these modifications increasingly cause detrimental second-order environmental changes that harm human development efforts[15]

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