Sustainability and Existential Risks with Special Reference to Climate Change - An Overview

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Abstract. The initial part of this paper provides an overview on conceptual framework of sustainability and sustainable development in balancing the needs for development and environmental conservation. The concept is based on structural and functional diversity relationship of natural ecosystem functioning and environmental filters that determine its services sustainably. Subsequently, the paper deals with a brief historical perspective of eco-development initiated by the United Nations and other relevant agencies that lead to the promulgation of the “17-Sustainable Development Goals (SDGs)” in 2016. On the existential risks and potential future risks of humanity with special reference to the current and future potential impact of global climate change as consequence of energy transition from fossil fuel to renewable are also discussed. The paper ends with the way forward with an enlightenment optimism rather than romantic declinism in achieving the goal of Paris climate agreement.

1. Introduction
In recent years, greater attention has been paid to the need to study and monitor the impact of climate change on global ecosystem. It is regarded as one of our Earth’s existential and potential future risks due to the warming effect as a consequence of greenhouse phenomenon. Though it is considered as part and parcel of the natural climate variability, however, it is a multifaceted linkages between energy utilization and its transition over decades and coupled with the unsustainable used of natural resources. The latter as a consequence of failure in understanding the concept of sustainability and theoretical framework of natural ecosystem services. Hence, there has been a lot of global initiatives taken place including research and development in the areas of climate science, modeling, mitigation and adaptation in reducing global warming impact. The objective of this paper is to highlight some of those initiatives and research findings discovered by climate scientists and modelers hence provide recommendations to the policy maker aim at limiting temperature rises to less than two – or $1.5^\circ$ C above pre-industrial levels before end of the century.

2. Result and Discussion
2.1. Sustainability and Sustainable Development
According to Hezri (2016) human development and environmental protection used to be considered mutually exclusive, resulting in the tension between the need for development and to preserve ecological integrity [1]. The word sustainability simply means meeting our current needs while not compromising our ability to meet our future needs. The term became widely used in environmental context since 1987, after it appeared in a United Nation report by former Norwegian Prime Minister who defines sustainable development as “meeting the need of the present without compromising the
“ability of future generations to meet their own needs” [2]. Dovers (1997) and Robinson (2004) maintains that sustainability is a system state that perpetuates itself endlessly, whereas sustainable development is a process towards that state which is achievable through strategies, law and other environmental policy instruments [3], [4]. Essentially the framework of sustainability and sustainable development is a multi-dimensional bridging concept that links the environment and development [1] and promotes the optimal resource allocation [5].

The Cocoyoc Seminar on Patterns of Resource Use, Environment and Development Strategies in 1974 endorses the term ‘sustainable development’ for the first time [6], [7], and eco-development concept was formally introduced by International Union for Conservation of Nature and Natural Resources (IUCN) as mooted earlier by Maurice Strong of United Nation Environment Programme (UNEP) in the 1970s [8]. Another landmark of theoretical framework which is related to sustainability and sustainable development concepts is the principle of ecosystem services based on an ecosystem approach as clearly mentioned in the 12 Principles of ecosystem approach (UNEP/CBD/5/23, 2000) namely, 1, 5, 6, 7, 10 and 11, and Millennium Ecosystem Assessment (9 and 10). With the official launching of transformative plan of action “17 Sustainable Development Goals (SDGs)” in 2016 marked the latest effort of the United Nation to address urgent global challenges that need to be implemented over the next 15 years. Among the goals which are closely related to global climate change are goals number 7, 8, 13, 14, and 15, respectively.

The interconnectivity between these goals are very much in line with what has been described by Diaz, et al (2007) and Ojima et al (2007) earlier [11], [12]. Impacts of anthropogenic activities on changes of atmospheric composition, terrestrial, marine and other related ecosystems in relation to climate change have been well documented (Mooney and Canadell, 2001) and Steffen et al. (2004) [13], [14]. Pielke et al. (2007) outline such changes include the increases in concentrations of greenhouse gases; changes in global and regional climate; habitat destruction and land cover change; increases in the amount of reactive nitrogen compounds in the biosphere; increases in species extinction rates; and increases in the number and the impacts of exotic and invasive species [15]. These environmental changes directly or indirectly affect the ecosystem processes and consequently provide impacts on ecosystem services, including water resources and food production systems [11]. Constanza et al, (1987) estimated natural ecosystem provides fundamental services such as clean air to breath and potable water besides others amounted to US33 trillion annually [16].

2.2. Existential Risks and Climate Change

Ord (2020) defines existential risks as the risks that threaten the destruction of humanity’s long term potential [17]. It covers all risks; notably, natural and anthropogenic, known and unknown near future and far future. Under the anthropogenic risks include climate change, nuclear weapon and other environmental degradation. Earlier, Diamond (2019) explores what lies ahead for the world with special reference to existential and potential future risks [18]. At least four sets of problems with potential for the worldwide harm: explosion of nuclear weapons, global climate change, global resource depletion, and global inequalities of living standards, besides other candidates such as emerging infectious disease, an asteroid collision, and mass biological extinction. On a similar note, Bostrom (2018), Ord (2020) and Wallace-Wells, (2020) anticipated that over the coming centuries anthropogenic climate change will take a high toll on both humanity and natural environment as it poses a risk of an unrecoverable collapse of civilization or even the complete extinction of humanity [17], [19], [20].

Yergin (2020) pointed out that the subject of global climate change has been studied and discussed over the last four decades [21]. But the mobilization of public opinion on climate is more recent due to the events around the world such as forest fire, drought, torrential rainfalls, coastal flooding, heat waves, melting ice, and hurricanes. Such unusual phenomena become a great motivator for the energy transition initiative aims at limiting temperature rises to less than two – or 1.5°C above pre-industrial levels. Over the years Intergovernmental Panel on Climate Change, known as IPCC under the auspices of the United Nations played a significant role in shaping the global discussion on climate change. It is a self-governing network of scientists and researchers that produced periodically its reports not only limited to science of climate change but also highlighting further on the seriousness of its impact based
on climate models and other related studies. Among the most significant report was published in 1990, highlighting that the earth was warming and that warming was “broadly consistent with the predictions of climate models” as to largely “man-made greenhouse warming” and also were broadly consistent with “natural climate variability”. By 2014 in its fifth report IPCC confirmed that “human influence on climate system is clear” and “emission of greenhouse gases are the highest in history”. The report set the stage for what was to unfold in the Paris Climate Conference – United Nation COP 21 a year later on November 30, 2015 attended by 195 countries representatives, joined at various times by 150 leaders of the countries.

On causation chain of global climate change, Diamond (2019) shows a strong correlation between human population and its impact of the individual [18]. Accordingly, warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia”. Rotman (2019) highlighted that data scientists and climate scientists have worked together to create far more detailed and localised maps of impacts of climate change [22]. The data subsequently be plugged into increasingly sophisticated climate models to see what happens as the planet continues to warm over the coming hundreds of years in terms of health, human behavior, and economic activities.

It has been estimated that without the greenhouse gases in our atmosphere, the earth would be about 33°C colder. These gases act like a blanket: trapping some of the heat, keeping the earth warm due to greenhouse gas phenomenon as described by Miller and Spoolman (2012), Diamond (2019), Ord (2020) and Yergin (2020)[17], [18], [21], [23]. Currently the concentration of carbon dioxide in our atmosphere has risen from about 280 ppm prior to Industrial Revolution to 412 ppm in 2019 [24], [25]. Similar trends were observed in methane CH$_4$ and nitrous oxide N$_2$O [26]. Over the last decades the Earth’s climate has warmed by about 1º C, sea levels have risen by 23 centimeters [27] and the ocean has become more acidic by 0.1 pH [28]. It is anticipated that if the emission of the greenhouse gases continues, the Earth average temperature will rise to at least 1.5ºC above the pre-industrial level by end of 21st century, and perhaps to 4ºC above the level or more [29]. Recent estimate by the IPCC under high emissions scenario, permafrost melting would contribute about 0.3ºC of additional warming by 2100 [30].

Copernicus Climate Change Service/ECMWF (after Financial Times Weekend, October 10/11, 2020) reported that global average temperature in September 2020 which was 0.63°C warmer than the 1981 – 2010 average, making it the warmest September on record [31]. While the latest observation by Polar Portal: Danish Meteorology Institute, GUES, DTU Space, Nature Climate Change (after Financial Times Weekend, September 12/13, 2020) on Greenland’s changing ice mass shows the anomaly between cumulative ice mass changes from August 31 to August 31 the previous year, compared with the period 1981 – 2010, in which the temperatures at the summit of its ice cap in 2019 causing it to melt for only the second time this decade [32]. While in summer 2020 ice melt was less extensive than the previous year, although the ice sheet continues to lose mass over time. It has been estimated that ice loss from Greenland has pushed global sea levels by 10.8 mm between 1992 and 2018. Another observation was on the Arctic sea ice at second-lowest level since records began, with the sea ice in the Arctic shrunk below 4m square kilometers in September, making the second time the sea ice has crossed below that threshold since satellite record began. According to US National Snow and Ice Data Centre (after Financial Times Weekends, September 26/27, 2020) warm temperature and unusual summer heatwave in Siberia contributed to making this the second-lowest sea ice minimum during the 42-year record [33]. It is expected that as the planet warms, the Arctic Sea ice is to undergo its first ice-free summer before the year 2050. Accordingly, with unusually high temperature during the six month period from May to October this year (after Financial Times Weekend, November 14/15, 2020) has led to 2020 being one of the warmest year in National Oceanic and Atmospheric Administration’s 141-year record.

These remarkable trends as noted by Wallace-Wells (2020) will result more frequent and more severe heat waves, more floods in wet regions, more droughts in dry regions, heavier storms and more severe hurricanes, lower crop yields in warm regions, more species extinction, and an average of rise in sea level of between 0.7 and 1.2 meters from both the melting of land ice and the expansion of seawater [20]. Since 1870, sea level has already risen almost eight inches, and the rate of rise appears
to be accelerating. Consequently, low lying areas would be flooded, island nations would disappear beneath the waves, large stretches of farmland would no longer be arable and millions of people would be displaced. It has been estimated the average sea level rise expected during this century are 3 feet, but there have past rises by up to 70 feet. Such situation is amplified by storm and tides that would be enough to undermine livability of some areas, as well as damaging estuaries that serve as “nurseries” for ocean fish and other related marine life. According to Baker (2020) these coastal habitats such as mangroves and salt marshes are extraordinary carbon sinks, sequestering as much as CO$_2$ per acre as 16 acres of pristine Amazonian rain forest [34].

Aside from International Panel for Climate Change reports [26], [28], [32], Lichfield (2019) [35] highlights some of the impact of global climate change and details are discussed elsewhere including Pinker, (2018); Scranton, (2019); Diamond (2019); Ord (2020); Yergin (2020) [17] [18] [21] [29] [36]. Studies on vulnerability, mitigation [25], [37] and adaptation [38], [39], [40], [41], [42] much of the effort have been devoted by the researchers and modelers. Earlier, Nicholas Stern in his book *The Economics of Climate Change* (2006) pointed out that one of the biggest dangers of climate change would be mass migration [43]. It is anticipated that West Africa, the Nile Basin, and Central Asia would be the most affected. Details on the migration prediction pattern in Mexico, Bangladesh and Ethiopia provided by modelers are highlighted by Cosier (2019) [44].

Another important phenomenon is called coral bleaching. Buck (2019) noted that with the increase of 1°C of ocean warming it can breakdown coral-algae symbiotic relationship [42]. Under stressed warming condition, coral will expel the algae, and after repeated or prolonged episodes of such bleaching, they can die from heat stress, starve without the algae feeding them, or become more susceptible to disease. An increase in acidity of seawater as CO$_2$ produced get dissolved and stored into the ocean it will dissolve the skeleton of coral either directly or indirectly destroying the coral reef ecosystem. These coral ecosystems play a major role as breeding ground or nursery for marine life including ocean’s fish, besides protecting tropical and sub-tropical sea-coast ecosystems. Currently, the world’s coral reefs are contracting by 1% or 2% per year, invariably, they will mostly be gone by the end of the century and consequently there will be a big declines in tropical coastal safety and protein availability from seafood resources [42].

The complication in understanding of global warming is clearly spelt out by Diamond (2019) such as rivaling the average warming trend, big time lags between causes and effects, and also there are potential big non-linear amplifiers that could make the world heat up much faster than a current conservative projections that assume linear relations between causes and effects [18]. Those amplifiers include permafrost and sea ice melting, and the possible collapse of the Antarctic and Greenland ice sheets that indirectly resulting in sea level rise.

2.3. Way Forward

Pinker (2018) expresses his optimism on the whole scenario of global climate change issues with the following: *we cannot be complacently optimistic about climate change, but we can be conditionally optimistic. We have some practicable ways to prevent the harms and we have means to learn more. Problems are solvable. That does not mean that they will solve themselves, but it does mean that we can solve them if we sustain the benevolent forces of modernity that have allowed us to solve problems so far, including societal prosperity, wisely regulated markets, international governance, and investment in science and technology* [29]. This philosophical approach has to be “grounded in enlightenment optimism rather than romantic declinism”. Case in point, Amazon (Bezos, 2021) provides one of the finest examples if not a role model in meeting the goal of Paris Agreement through their climate pledge signatory initiative programmes signed in September 2019 [45]. The programmes include measure and report their emissions on a regular basis, implementing decarbonisation strategies, and with any remaining emissions they cannot eliminate with real change, they agree to do offsets that are credible.

While Wallace-Wells (2020) [20] proposes economic instruments such carbon tax and political apparatus be utilized to aggressively phased out dirty energy through energy transition as described by Yergin, (2020) [21]; a new approach to agricultural practices including biotechnology through digitizing DNA sequence information (Piore, 2019) [38] and physiological adaptation; and public
investment in green energy and carbon capture through research innovations and technological development besides improve our current understanding of the permafrost and methane clathrate feedbacks (Ord, 2020) [17] for vulnerability, adaptation and mitigation measures [22] [46] [47] as recommended and adopted by IPCC(2019) [48] and SDGs’ framework endorsed in 2016.

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