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Sustainable Development in a Climate-changed World

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Abstract: Today, the rapidly developing global climate change is a major threat to our way of life. Responses to address climate change, both mitigation and adaptation, are linked to sustainable development. In this study, we first discuss the definition of sustainability, then four main areas impacted by climate change as well as the new goals of sustainable development are expounded. Finally, the relations between sustainable development and climate change are discussed.

Key words: Climate change, new goals, energy security, human health, sustainable development

INTRODUCTION

It is generally accepted that sustainable develop-ment calls for a convergence between the three pillars of economic development, social equity and environ-mental protection. Sustainable development is a visionary development paradigm and over the past 25 years governments, businesses and civil society have accepted sustainable development as a guiding principle, made progress on sustainable development metrics and improved business and Non-governmental Organization (NGO) participation in the sustainable development process. Yet the concept remains elusive and implementation has proven difficult. Unsustainable trends continue and sustainable development has not found the political entry points to make real progress. As a result, climate change has become the de facto proxy for implementation of the sustainable development agenda (Atkinson *et al*., 2007).

While sustainable development is intended to encompass three pillars, over the past 25 years it has often been compartmentalized as an environmental issue. Added to this and potentially more limiting for the sustainable development agenda, is the reigning orientation of development as purely economic growth. This has been the framework used by developed countries in attaining their unprecedented levels of wealth and major and rapidly developing countries are following the same course. The problem with such an approach is that natural resources are in imminent danger of being exhausted that threatens current biodiversity and natural environments (Malik and Elisabeth, 2011).

The recent financial crisis could mean some renewed receptivity for a new sustainable development paradigm. A new model could chart a development path that truly is concerned with equity, poverty alleviation, reducing resource use and integrating economic, environmental and social issues in decision making. The opportunity is ripe to move beyond incrementalism to real systemic change (Brundtland, 1987; Terry *et al*., 2007; IPCC, 2007).

BRUNDTLAND DEFINITION OF SUSTAINABILITY

A very commonly used definition of sustainability is implied in the following definition of sustainable development which is found in the landmark publication Our Common Future (or the Brundtland report) (Brundtland, 1987):

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

One should note two important things (Marco, 2006):

- The "future generations" (plural) implies "for a very long time" where long means long compared to a human lifetime
- The arithmetic of steady growth shows that steady growth of populations or of rates of resource consumption for modest periods of time leads to sizes of these quantities that become so large as to be impossible

The combination of these two observations leads us to the First Law of Sustainability (Marco, 2006):

- Population growth and/or growth in the rates of consumption of resources cannot be sustained

The First Law is based on arithmetic so it is not debatable.

The Brundtland definition of sustainability is appealing because it has both virtue and vagueness. It is virtuous to give the impression that one is thinking of the wellbeing of future generations, but the definition itself is vague; it gives no specifics or hints about the nature of a sustainable society or about how we must conduct our society in order to become sustainable. This vagueness of definition opens the door for people to use the term sustainability to mean anything they want it to mean. With the freedom supplied by the vagueness, anyone can become an expert on sustainability (Marco, 2006).

Unfortunately, the Brundtland definition contains a flaw. It focuses first on the needs of the present, which have nothing to do with sustainability and secondarily it mentions the needs of future generations which are vital for sustainability. This sets the stage for intergenerational conflict in which the present generation wins and future generations lose. We need to rephrase the Brundtland definition as follows (Marco, 2006):

- Sustainable development is development that does not compromise the ability of future generations to meet their own needs

MAIN AREAS IMPACTED BY CLIMATE CHANGE

Global warming and changes in climate will have severe and lasting impacts on national efforts to alleviate poverty and promote sustainable development. In the following we discuss four main areas, including energy, agriculture and food, human health and well-being and freshwater and forest ecosystems:

- **Energy security:** The classic conception of energy security addresses the relative availability, affordability and safety of energy fuels and services. On the other hand, according to the World Bank energy security is based on the three pillars of energy efficiency, diversification of supply and minimization of price volatility (World Bank, 2005)

However, consumer advocates and users tend to view energy security as reasonably priced energy services without disruption. Tackling climate change and improving energy security are two of the 21 century's greatest challenges. There are many types of GHG-reducing technologies available today, including high-efficiency transportation, high-efficiency fossil power, hydrogen power and fuels, renewable electricity and fuels, nuclear fission, carbon capture and sequestration, methane from energy and waste and demand-side management. Meeting the twin challenges of climate change and energy security will allow us to provide energy, maintain economic growth and preserve the natural environment (Brown and Sovacool, 2011):

- Agriculture and Food Security Agriculture is essentially a man-made adjunct to natural ecosystems and is weather and climate dependent. While agriculture is a significant contributor to greenhouse gas emissions, it is also a source of carbon storage in soils. New challenges are emerging in terms of how we interpret the impacts of warming, how farming systems adapt or are adapted to these changes and how near-term emissions mitigation requirements can take place in ways that are consistent with longer-term adaptation plans (Anita *et al*., 2010)

According to Food and Agricultural Organization, definition of the term food security is as follows:

- Food security is a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life

This definition is conventionally subdivided into three main components: Food availability, food access and food utilization. Availability refers to the physical presence of food; access refers to having the means to acquire food through production or purchase;and utilization refers to the appropriate nutritional content of the food and the ability of the body to use it effectively. Let us consider the relation between food availability and climate change. The food availability dimension of food security encompasses issues of global and regional food supply and asks the basic question: can we physically produce enough food to feed our population? Nevertheless, any discussion of the effect of climate change on the global food supply must take into account current realities and trends in global and regional supplies of food. Three particularly important characteristics of the global food supply are: (1) On an average per capita basis, the world today produces more than enough food to meet caloric requirements; (2) There are stark regional differences in the magnitude and source of agricultural productivity growth-differences that provide important insights into the challenge a changing climate might pose; (3) Food is now a truly global commodity and the movement of food across borders plays an increasingly important role in meeting regional food demand. So, climate change will have potentially large effects on both

agricultural yields and potential cropped area, with global trade acting as a potential buffer when countries trade and when climate shocks are not uniform across space (Lobell and Burke, 2009):

- **Human health and human well-being:** The long-term good health of populations depends on the continued stability and functioning of the biosphere's ecological and physical systems-life-support systems. Global climate change would affect human health via pathways of varying complexity, scale and directness and with different timing. Similarly, impacts would vary geographically as a function both of environment and topography and of the vulnerability of the local population. Impacts would be both positive and negative. This is no surprise since climatic change would disrupt or otherwise alter a large range of natural ecological and physical systems that are an integral part of Earth's life-support system. The more direct impacts on health include those due to changes in exposure to weather extremes (heat waves, winter cold); increases in other extreme weather events (floods, cyclones) and increased production of certain air pollutants and aeroallergens (spores and moulds). Climate change would affect the transmission of many infectious diseases (especially water) and regional food productivity (especially cereal grains). In the longer term and with considerable variation between populations as a function of geography and vulnerability, these indirect impacts are likely to have greater magnitude than the more direct (Epstein, 2005)

On the other hand, climate change is increasing the severity of disasters and adverse weather conditions worldwide, with particularly devastating effects on developing countries and on individuals with lower resources. Climate change is likely to impact mental health and psychosocial well-being via multiple pathways, leading to new challenges. Direct effects such as gradual environmental changes, higher tempera-tures and natural disasters, are likely to lead to more indirect consequences such as social and economic stressors, population displacement and conflict. Climate change is projected to magnify existing inequalities and to impact the most vulnerable, including those with low resources, individuals living in developing countries and specific populations such as women, children and those with pre-existing disabilities (McMichael *et al*., 2003; Weissbecker, 2011):

- **Freshwater ecosystems and forest ecosystems:** The main impacts of climate change on freshwater ecosystems result from changes in air temperature, precipitation and wind regimes. Freshwater systems respond by changes in their physical characteristics including stratification and mixing regimes of lake water columns, catchment hydrology or changes in ice-cover which, in turn, may induce chemical changes in habitats, e. g., alterations to oxygen concentration, nutrient cycling and, possibly, water color. Biological responses include changes in the phenology and species distribution of most organism groups. Links between changes in climate and freshwater ecological responses have already been reported (Martin *et al*., 2010)

Forests play a significant role in the climate system. Trees are large organisms that store carbon throughout their life and release it through decomposition. Since forests are important carbon sinks and sources, assessing forest carbon budgets has received much attention in recent years. There is a perception that humans must alter land use practices to reduce the rates of climate changes and alleviate any resulting negative social, economic and environmental impacts. Carbon losses or gains in forests may result through afforestation, reforestation or deforestation. Forest growth, structure and function are affected by the climate. Increasing temperatures will cause higher respiration rates while photosynthetic rates are reduced by dry conditions. The impact of climate on a forest ecosystem will vary depending upon what factors limit tree regeneration and growth.

Moreover, forest management is a key factor in mitigating the effects of climate change. There are a number of possible strategies, including: (1) Conservation and maintenance of carbon stocks which have accumulated in forests; (2) Increasing carbon stocks through afforestation; (3) Modification of the forest species composition and tree size distributions; (4) Promoting the planting of more resilient tree genotypes;and (5) Planting trees to provide shade, stabilize soils and alter hydrology to reduce the expected impacts of precipitation and temperature changes (Bravo *et al*., 2008).

REDEFINING SUSTAINABLE DEVELOPMENT

By interfering with the carbon, nitrogen, water and phosphorus cycles, human activity changes the atmosphere, oceans, water-ways, forests and ice sheets and diminishes biodiversity. Indeed, the effects of human behavior on the planet's ecosystems have become so significant in the last few centuries.

As the environmental consequences of human activity become increasingly apparent, so does humanity's responsibility to mitigate them. In 2012, at the United Nations Earth Summit in Rio de Janeiro, world leaders agreed to create a set of universal Sustainable Development Goals, which would change the playing field for future economic policy to safeguard our life-support system.

For almost three decades, sustainable development has been defined as development that meets the needs of the present, without compromising future generations' ability to meet their needs. Related policies have reflected the view that sustainable development rests on three equal pillars: the economy, society and the environment.

But this view is no longer tenable. As the United States Global Change Research Program's recently released draft report on climate change points out, some kinds of weather events have become more common and more intense, in recent years. In 2012 alone, Arctic sea-ice dipped to a new low, as an area larger than the US melted; unprecedented heat waves struck Australia and other areas; record floods hit China and Japan and the United Kingdom had its wettest year on record.

A new approach is needed. Rather than separate pillars of sustainable development, the economy must be seen as servicing society, which in turn thrives within a secure natural environment. Viewed this way, sustainable development should be redefined as "development that meets the needs of the present while safeguarding the Earth's life-support system, on which the welfare of current and future generations depends." After all, a healthy, thriving planet is a prerequisite for healthy, prosperous lives.

Very recently, David Griggs and his colleagues identified six universal goals for sustainable development as follows (Griggs *et al*., 2013):

- **Goal 1:** Thriving lives and livelihoods. End poverty and improve well-being through access to education, employment and information, better health and housing and reduced inequality while moving towards sustainable consumption and production
- **Goal 2:** Sustainable food security. End hunger and achieve long-term food security-including better nutrition-through sustainable systems of production, distribution and consumption
- **Goal 3:** Sustainable water security. Achieve universal access to clean water and basic sanitation and ensure efficient allocation through integrated water-resource management
- **Goal 4:** Universal clean energy. Improve universal, affordable access to clean energy that minimizes local pollution and health impacts and mitigates global warming
- **Goal 5:** Healthy and productive ecosystems. Sustain biodiversity and ecosystem services through better management, valuation, measurement, conservation and restoration
- **Goal 6:** Governance for sustainable societies. Transform governance and institutions at all levels to address the other five sustainable development goals

The next step is to define measurable targets, such as better lives for slum dwellers or reduced deforestation. Genuine progress in any of the six target areas will require a comprehensive approach, with policies that span the economic, social and environmental domains.

For example, eradicating poverty entails the provision of food, water, energy and access to gainful employment. But providing energy to all will require governments to discontinue subsidies for fossil fuels and unsustainable agriculture. And achieving food security is impossible without agricultural systems and practices that not only support farmers and produce enough food to meet people's nutritional needs, but that also preserve natural resources by, for example, preventing soil erosion and relying on more efficient nitrogen and phosphorus fertilizers.

SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

The IPCC (Atkinson *et al*., 2007) states that "It is no longer a question of whether climate change policy should be understood in the context of sustainable development goals; it is a question of how."

Sustainable development and climate change share strong complementary tendencies: they are multi-sectoral, they both require international cooperation to solve the problem and the problem is inter-woven through economic and technological development in increasingly complex networks.

Defining sustainable development is difficult and responses to climate change, if appropriately addressed, can help to concretely manifest sustainable development. While not all climate change actions are synonymous with sustainable approach, the broader long-term approach-on forestry, energy, technology and consumption patterns-would easily be incorporated in a sustainable development framework.

The climate change negotiations could benefit from a broadened discussion that is informed by the integrative thinking of sustainable development. For example, mitigation could be addressed within a broader discussion of energy and economic growth. Adaptation could benefit from a broader understanding of resilient development and measurement, reporting and verification (MRV) talks

could be addressed in the context of a broader appreciation of issues related to "transparency and accountability."

One of the results of climate change becoming the de facto proxy for sustainable development is that climate change has become home to other agendas. Many of the broader strategic development issues, such as poverty alienation and demographic challenges, need to be addressed for climate change to be effectively addressed. But the framework of the climate change negotiations are not the always the most appropriate forum for such broader strategic discussions.

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