With Inclusion and Equity, can the Sustainable Development Goals (SDGs) Flower within the Planetary Boundaries?

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ABSTRACT

The present state of planetary boundaries reflects on unsustainable consumption of natural resources, driven by population growth, economic development and lifestyle changes. It also reflects on economic transactions that do not reflect true cost of production. One collective human effort that responds to the social, economic, and environmental issues to ensure equality for all humans by way of sustainable development is the Sustainable Development Goals (SDGs); a set of 17 goals with 169 targets adopted by 193 countries at the General Assembly of the United Nations in 2015.

This paper presents a conceptualized model for vital socio-economic and natural resources and the governance requirements to achieve the SDGs within the planetary boundaries. It does this by identifying the foundational roles, capacities, and values provided by the Earth systems to enable diverse human activities to be planned and implemented. The model identifies challenges and barriers to equity, inclusion, and social justice and identifies innovations in restoration, policies and stable leadership to achieve sustainable development within safe and just planetary boundaries.

(Keywords: Sustainable Development Goals, SDGs, Planetary Boundaries, biodiversity, water resources, climate change, agriculture, environmental management, sustainability, inclusivity)

AUTHOR'S PREFACE

This paper is a summary of thought processes that have evolved over several years of observation and learning from people and situations around me. I was born and raised in India. In my early years, I grew up in my grandparents' home with aunts, uncles, and cousins, and a large garden with a few cows that provided milk, manure and fuel for the family. It was here that I learned my first lessons in the cyclical nature of things. Cow dung was used to fertilize the garden, to make dung cakes (some of which were used as fuel) and to 'firm-up' the floor in the yards. Household greywater nurtured the garden from where we harvested bananas, guavas, and other fruits. All family members had different roles and jobs to do that kept our family functioning.

Learning was a constant and teachers varied in their formal and informal sources of knowledge. My college educated parents, uncles, and aunts learned essentials of nutritional diversity and biodiversity, food processing and storage, and learned about the harvest times and methods to save seeds from elders. These elders did not have an extensive formal schooling but held deep knowledge from a lived experience and their take-aways from observing the land and the skies. A thrill runs my spine when I remember my great-grandfather, an ace self-taught mathematician and engineer who read the sky and the constellations at night and shared his predictions on seasons and arrival of rains, etc., as was the norm for people of his times.

It is also here I learned that irrespective of age, family status, position as the primary/secondary income earner, or level of formal education, a person's overall well-being is dependent upon their ability to share and to receive information from others in the family or in the community. For example, our family was dependent on a skilled caretaker for our cows, an expert on coconut trees (harvest and cleaning), and the connections we had in our neighborhood that allowed for sharing and bartering of goods/produce/skills. In reflection it seems to me that I learned early about symbiotic relationships in ecosystems and social systems by observing both the environment and the people around me. The lesson I learned was that it takes many parts to

make the whole, and to keep the system relatively stable.

These lessons were reiterated as I observed my father, an agriculture scientist, working with farmers and his students in the lab to land programs, sharing research-based solutions with the farmers. He brought back with him lessons and stories of people who worked with the land and who (to a child's imagination) came across as people who heard it speak. Watching my dad and his students work with farmers I learned that a great deal can be gleaned by listening, observing, and by including as many voices as possible in the conversations.

I noticed how women and men had different experiences to share with the crops they grew; and sometimes-different stories for the same crop. I also noticed how people who worked for institutions, organizations, and government bodies seemed to have diverse opinions on the same matters. Through these observations, I learned that it was possible to synchronize opinions with empathy-based inclusion which often resulted in arriving at feasible solutions that could work for the farmer and the community.

During my studies as a student of agriculture in my undergraduate and postgraduate degree programs, many of these childhood lessons were replayed. The universal lessons learned from our relationship with the land, and my fascination with botany, microbiology, soil chemistry, genetics, and physiology were fueled by lectures and field-based learning opportunities under the tutelage of inspiring teachers both in India and the United States. The intricate interconnectedness between economics and politics (of policy making) with biological, physical, chemical, and social sciences confounded me since these connections were not always acknowledged in decision-making processes. It continues to fascinate me with its complexity looped within its simplicity and impress me with its potential to usher change.

These observations fueled a profound leap and deeper affirmation with my doctoral research and my work experience as a consultant for United Nations agencies. My work with diverse communities in different countries and regions through United Nations agencies for biodiversity conservation, gender mainstreaming and land degradation, and my doctoral research to understand dependencies of urban areas on agriculture, infrastructure and sound policies for urban food and water security, and their vulnerability due to climate change gave me ample opportunities to reflect and hone my thinking on the interconnected world we live in.

The dependence of producers, consumers, and markets on natural capital was starkly clear. So were the interdependencies between producers, consumers, and the markets with institutions for laws and policies, with man-made infrastructures essential to transport, store, and resupply commodities, and the historical narratives of stakeholders which determined their participation and the benefits they received from development interventions. These relationships between economic, political, and social systems with the natural systems around us stand out as parts of a whorled floral structure to me. In this whorled structure each layer feeds into and supports the other resulting in a relatively stable structure - societies functioning with relative compatibility with the earth system.

I could see how the Sustainable Development Goals (SDGs), the overarching umbrella of goals that humanity is striving to achieve for continued survival of our species and others, rested heavily on aforementioned factors of identifying the contributions of the earth systems to the social, political and economic systems we are part of. Based on my work and research it was clear that bringing together experiences from our cultures, histories and identities as people living in conjunction with each other and the natural processes we are part of was critical to achieve these interconnected goals.

The model for sustainable development with inclusion and equity presented here is a result of observation and thoughts churned in through interactions with people too many to be listed here. I extend my gratitude to everyone who inspired this thought process which helped me arrive at this model on sustainability through inclusion and equity and to write this paper. I would like to acknowledge my sister Uma Havaligi who created the electronic version of this model based on my paper and pen sketch; my doctoral mentor Dr. Anthony Maranto, Vice President and Professor of Environmental Science, Akamai University; Nick Remple, Technical Advisor to United Nations Development Program for Community Based Adaptation; Dr. Kim Smith, Sociology professor at Portland Community College and Founder/Director of Greater Portland

Sustainability Education Network; and Dr. David Zandvliet, Associate Professor at Simon Fraser University, who reviewed this paper. All of these scholars have inspired this work through their commitment to sustainability education and research and being envoys of change. This research remains a work in progress, evolving from lessons learned (and unlearned) while exploring ways to acknowledge the foundational role of the Earth systems in human existence and to build human capacity to network with each other for continued partnership with the Earth.

INTRODUCTION

Nature, environment, and Earth systems form the basic building blocks of human civilization. The planetary boundaries framework conceptualized by Rockström, et al. (2009) assesses the anthropogenic impacts on the functions of the Earth systems to estimate a "safe operating space for humanity" considering the unprecedented degradation of the natural environment (Crutzen, 2002; Stern 2007).

Since the industrial revolution, human activities have dominated the biological, chemical, and geological processes on the Earth presenting serious challenges to its self-regulatory capacity and its resilience (Green, et al., 2017; Steffen, et al., 2015). The planet is experiencing rapid urbanization and a growing ecological footprint (Wackernagel and Rees, 1996; Kitzes, et al., 2008). Increased demand for food and water strain the ecosystems and challenge their ability to provide ecosystem services (Satterthwaite, et al., 2010).

Both urbanization and agriculture are engaged in excessive use of natural resources, contributing to global climate change, biodiversity loss (McDonald, et al., 2008), and to variations in water cycles (Hoekstra and Chapagain, 2007 and 2008). Changes in water cycle have compounding adverse consequences on agriculture, energy production, transportation, human health, and to ecosystem functions (Gleick, 1993; FAO, 2011).

Scientific assessment by Rockström, et al. (2009) identified nine interdependent "planetary playing fields" where the boundaries of critical environmental parameters for the Earth systems lie. These boundaries include the physical circulation systems of the planet (the climate, stratosphere, ocean systems); global biogeochemical cycles (nitrogen, phosphorus, carbon, and water); biophysical features of Earth such as marine and terrestrial biodiversity; and land systems—all of which are essential for the planet's self-regulatory capacity and for its resilience.

Humankind has transgressed four of the nine planetary boundaries for climate change, biosphere integrity (which includes biodiversity), land-system change, and altered biogeochemical cycles (Rockström, et al., 2009; O' Neill, 2018; and Steffen, et al., 2015). Of these, climate change and biosphere integrity are the two "core boundaries", altering either "would significantly drive the earth system into a new state" (Steffen, et al., 2015).

The present state of planetary boundaries reflects on unsustainable consumption of natural resources, driven by population growth, economic development and lifestyle changes (Vitousek, et al., 1997; Dasgupta and Ehrlich, 2013; and Steffen, et al., 2015). It also reflects on economic transactions that do not reflect true cost of production (Costanza and Daly, 1994; Costanza, et al., 2014).

The situation also calls for all stakeholders in the Earth systems from scientists, policymakers, and others, to seek solutions to address this accelerating crisis (Mace, et al., 2014). It underlines the urgency for deliberate use of the planet's resources to ensure its continued habitability to all life forms (Rockström, et al., 2009; Whitmee, et al., 2015; O' Neill, et al., 2018).

Sustainable Development Goals

One collective human effort that responds to the social, economic and environmental issues to ensure equality for all humans by way of sustainable development is the Sustainable Development Goals (SDGs) (Griggs et al. 2013).

The SDGs are a set of 17 goals (Figure 1) with 169 targets adopted by 193 countries at the General Assembly of the United Nations in 2015.

The SDGs are characterized by (i) mutual dependency between the goals (Nilsson et al. 2016), (ii) their dependency on the natural, human, financial, physical (infrastructure) and social capital, and (iii) their reliance upon stable

Figure 1: Sustainable Development Goals.

biophysical processes of the planetary system which form the foundations of these capitals (Costanza and Daly, 1994; Puydarrieux and Mésenge, 2018). To be sustainable, development pathways must work within the renewing and recreating capacity of the Earth system/biosphere (Folke, et al., 2011).

The word 'sustain' traces its roots to the Old French word 'sostenir' which means 'give support to' and to the Latin word 'sustinere' which means 'to hold up; provide with means of support; to bear, undergo, endure'. Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" by the World Commission on Environment and Development.

Recognizing the embedded meaning in the word 'sustain' from Latin and Old French, sustainable development would mean 'development designed by humans that holds up, gives means of support to (the environment), and undergoes and enduring challenges to hold up (the functions of life systems) while development is being achieved'.

A recent assessment of 150 nations by O'Neill, et al. (2018) draws attention to the relationship between the environment and sustainable development. It frames the question on the capacity of humanity to make progress (develop) at a rate in which the environment can sustain the progress and, to retain its own functional capacities.

In this age of hyper-consumption underlined by social and economic inequities and growing urban boundaries (Hoornweg 2016), making progress toward sustainable development would require recognizing the interlinkages between human and planetary well-being and conceiving development that is inclusive and perceptive of social equity issues (Raworth, 2012 and 2017; O'Neill, et al., 2018).

Achieving the SDGs within planetary boundaries would require innovations, equitable partnerships and a willingness to reduce resource use at all levels, individual to communities, cities, corporates, to secure basic needs such as nutrition, sanitation, access to clean water for the well-being of all, including the well-being and the health of our planet (O'Neill, et al., 2018).

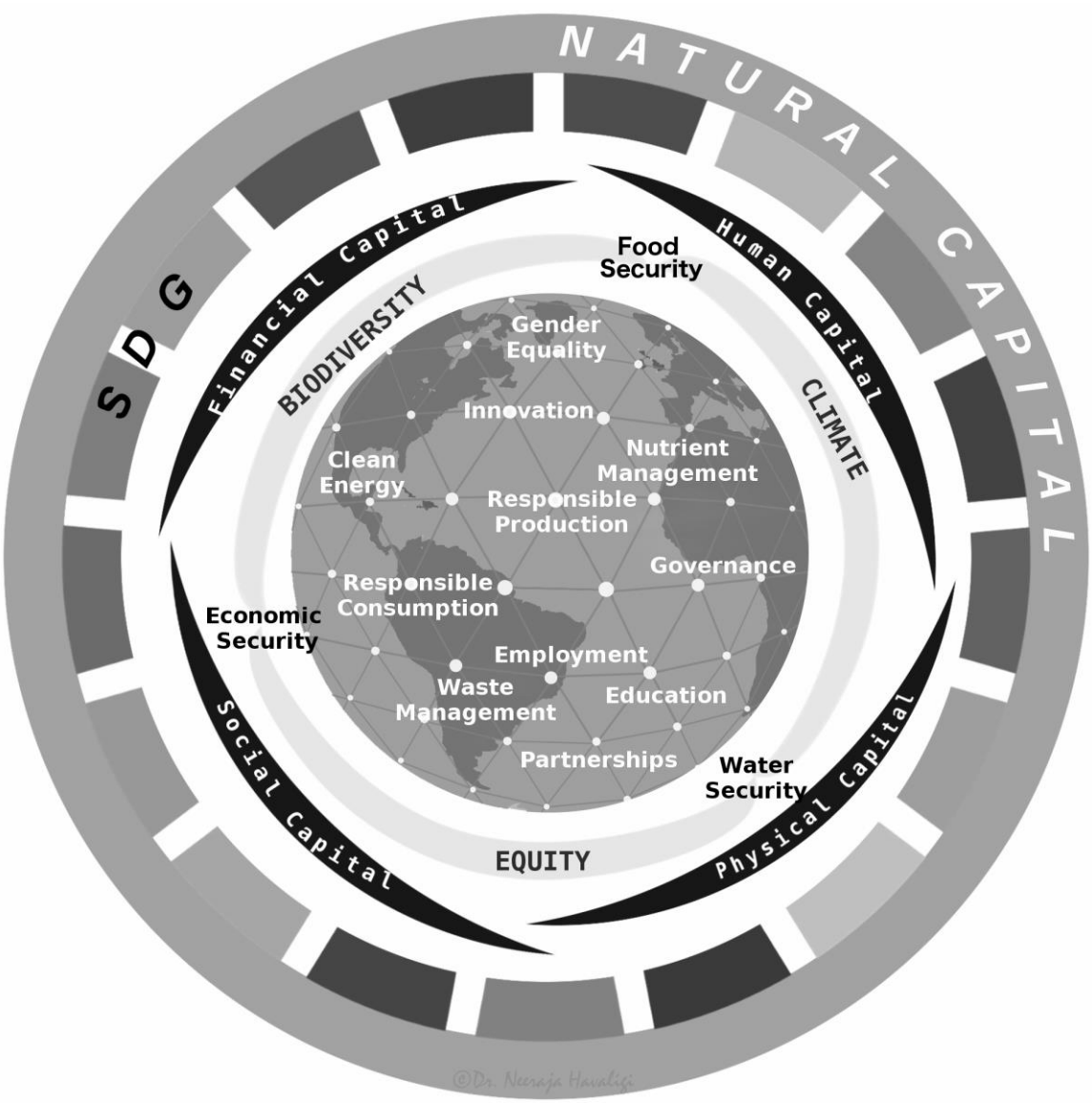

Figure 2: Inclusive and Equitable Sustainable Development within Planetary Boundaries©.
(Inclusive and Equitable Sustainable Development Model Copyright by Neeraja Havaligi, Illustrated by Uma Havaligi).

INCLUSIVE AND EQUITABLE SUSTAINABLE DEVELOPMENT MODEL

The Inclusive and Equitable Sustainable Development model (Figure 2) conceptualizes the vital socio-economic and natural resources, and governance requirements to achieve the SDGs within planetary boundaries. It does this by identifying the foundational roles, capacities and values provided by the Earth systems to enable diverse human activities to be planned and implemented. The model identifies challenges and barriers to equity, inclusion and social justice and identifies innovations in restoration, policies and stable leadership to achieve sustainable development within safe and just planetary boundaries.

This model draws inspiration from floral diagrams in botanical studies. Floral diagrams symbolize the different floral organs (bracteoles, bracts, calyx, corolla, androecium, and gynoecium), their

structural arrangements that enable different parts to function together as a flower. Flowers are marvels of evolution, perpetuation and resilience. They are nature's tools that interlink diverse species through partnerships and to pass on adaptive knowledge through seeds.

Seeds carry forward the lessons of adaptation experience to next generation. The floral whorls enable this process by ensuring pollination, fertilization and seed set, to perpetuate evolutionary experience through seeds. Based on the type of flower, the structures vary, each arrangement designed to maximize adaptation and for evolutionary success.

Floral diagrams represent placement of different parts of a flower intricately linked to support each other to form a flower. Like the parts of a flower that are inter linked to make a whole functioning flower, the Inclusive and Equitable Sustainable Development model depicts the inter dependencies between the Earth systems and life processes defined by diverse capitals (natural, social, financial, human and physical) and activities (socio-economic, innovations, consumption patterns and governance) that facilitate sustainable development.

The floral wheel of the Inclusive and Equitable Sustainable Development begins its movement with natural capital (representing the Earth system) in the outermost circle. Natural capital is the container of all systems that support life on the planet. Natural capital is the primary requirement to create and support other forms of capital and processes that result in diverse economic, social and other activities.

Planning interventions and designing activities to reach the SDG targets would require identifying their dependencies on available natural capital (site specific with a broader regional/global interconnected view) and equitable access of this resource along with equitable access to human, social, financial and physical capital to all in the community. Communities accrue food security, economic security and water security using these diverse forms of capital.

The stability of these securities within communities depends on appropriate use of biodiversity, with an understanding of the tenuous climate and ensuring equitable access of resources to all humans, fulfilling a critical need for 'just and safe space' described by Raworth (2012 and 2017). This relationship is depicted by their placement position within the floral wheel for the Inclusive and Equitable Sustainable Development model.

At the heart of this wheel are human activities that gather the energies from the outer rings to enable innovation, and to strive for gender equality, responsible consumption, responsible production, clean energy, nutrient management, waste management, education, employment, and governance, and to establish partnerships to work toward common goals. These activities speak to targets set for the 17 SDG's and they enable economic, social, natural and political processes on the ground.

In the inner whorl, biodiversity and climate can function and continue to provide for humanity when used equitably and within limits. When these three factors are working within their whorls/boundaries (notice their placement in the diagram), communities could be expected to experience a sense of wellness from having food security, water security and economic security. This security relies on the processes/ products/ results emanating from the activities depicted in the innermost circle.

The inclusive and equitable sustainable development tool is supple and adaptive, showing intricate relationships between factors within a whorl and between whorls, allowing for its application across in diverse communities and regions.

To get a realistic insight to this model, let us take a case of protected area where a team of planners, managers and other stakeholders are involved in safeguarding biodiversity, land and water use. This team is also sensitized to the socio-economic and cultural dependency of local communities on these resources to be included in plans to reach selected the SDG targets for their community.

- The natural capital in this case includes (and not restricted to) all sources of nourishment (food), sustenance (clean air and water) and maintenance (amicable climatic conditions).

- Social capital is the network between and within communities in that geographical area. Physical capital encompasses the buildings, equipment, and infrastructure, including access roads, irrigation canals, etc.

- Financial capital represents the money used in transactions.

- Human capital includes all the stakeholders with different levels of influence, demands, and access to resources.

These capitals have synergistic dependencies between each other. They are directly dependent on the natural capital enables the necessary conditions for resources such as biodiversity (for food and other life sustaining factors) to thrive, and regulates climate, thus supporting all potential activities emanating from use and conversation of these capitals through socio-economic-governance systems.

This model will help identify local and regional baseline capacities such as existing capacity for crop production and other productive activities within limits of available resources (land, water etc.); the threats and major challenges imposed on biodiversity, quality of water, soil health, etc.; research and development capacity integrating local knowledge and needs, education and health care systems that take an integrative approach to serve their communities, and more.

The model will also help identify needs such as lack of equitable access to land and other resources which could be a reason for its over exploitation, malnourishment in some communities within local population, and inequitable development in the community. The model will also point to presence of strong stable governance supporting informed policies and laws to guide locally appropriate development; identify major factors contributing to breaching boundaries. These factors could be economic, social and political structures including policies, stakeholder/investment interests that directly or indirectly support loss biodiversity and its knowledge within the community, promote unsustainable use of land and water resources, and deter inclusive equitable approaches to accessing resources and collective decision making.

Identifying these factors within the floral model will provide a visual representation of the influences these factors have on each other within the whorls, and their potential to influence other whorls. Analysis of trade-offs between the different factors within and between the whorls is imperative to identify interventions and to design opportunities for sustainability that remain within the planetary boundaries especially for water, biodiversity and climate change.

This inclusive and equitable approach can help gain momentum toward planning for appropriate SDG interventions through a more informed process, which can identify alternatives and innovations in creating practices, products, policies that help communities achieve their SDG targets using the planetary provisions available within their planetary boundaries.

Businesses, institutions and countries are expanding their horizon and measure progress with indicators that include well- being of the planet and people (Cassiers, 2009). This horizon has also gained momentum in integrating social equity (Wackernagel and Rees, 1997) as a factor to ensure 'safe and just operating space' (Raworth, 2012) for human development. Integrating social equity and environmental costs of economic activities within the planetary boundaries approach is critical, especially as we increase in population and strive to reach western standards of living.

The inclusive and equitable sustainable development also calls for collaborative approaches in governance, scientific assessments and sharing know-how of social–ecological innovation (Galaz, et al., 2012). Application of Principle 7 of "Common but Differentiated Responsibility (CBDR)" from the Rio Declaration to the SDGs will help different institutions and levels of administration to develop their own situation specific approach(s) to address local needs and targets (Kitzes, et al., 2008).

Identifying 1) policies that support multi-level institutional solutions, particularly those that hone the SDG goals to local resources and needs; and 2) lessons in sustainable production and consumption, effective partnerships for peace, equity, and development especially those influenced by governance structures and priorities (Galaz, et al., 2012; Heck 2018) can determine humanity's' ability to live within planetary boundaries.

The inclusive and equitable sustainable development model advances planning for sustainable development interventions through community-based action, through:

(i) clear insight of community needs, capacities

and its on-going challenges with focus on inclusion, equity and valuation of natural capital which contributes to pressure on planetary boundaries;

(ii) baseline information of threats to planetary boundaries in the geographic region based on GIS and other Earth system tools; and
(iii) insights to community based skills and knowledge, transfer of technology and identifying traditional modes of valuing and celebrating natural capital for locally relevant solutions.

Understanding and quantifying the interdependent links in the different whorls of the inclusive and equitable sustainable development tool is critical to determine the possible and appropriate SDG based solutions that can usher change and sustain it within the planetary boundaries.

CONCLUSION

The SDGs were envisioned as a partnership with the planet not only to create equal opportunities and access for improved living for all humans, but also to ensure peace and protect the planets health to support all life forms. The profound remark by Ban Ki-moon (the United Nations Secretary-General from 2007-2016) in his address at COP22[1] "We don't have plan B because there is no planet B" caught global attention as we set pace to the envisioned SDGs to take root in our communities. However, our current understanding of breaching planetary boundaries has positioned our pursuit of the SDGs in a profound predicament. It leads us to ponder on our ability to achieve and sustain the 17 SDGs by 2030 while not pushing the breaching boundaries by our actions.

Achieving the SDGs by 2030 will require a re-examination of business as usual approach on how we view and value natural capital; the Earth systems which define its existence; and how this value translates into equitable policies, governance directives and to every day actions.

Research indicates that equity is a powerful driver to partner with the planet (Steffen, et al., 2011) to create 'safe and just operating spaces' required to pave the path to achieve the SDGs for all humanity (UN, 2012; Griggs, 2013; Häyhä, et al., 2016). Planning for sustainable development within the breaching biodiversity and climate boundaries with safe and just operating space approach is urgent and inevitable (Lobell, et al., 2008; O'Neill, et al., 2018; Dearing, et al., 2014). The 'safe and just space' requires that consistent supplies of human and social capital be maintained along with the natural capital, an asset on which all the human activity and its well-being is contingent upon.

However, current times of hyper-consumption are marked by our active engagement in bankrupting the assets on which human well-being depends, with high dependency on fossil fuel driven growth and development based on land use change and displacement feeding inevitable social tensions and conflicts (Barnett and Adger, 2007; Gleick, et al., 2014). Factoring these significant forces which are gaining momentum in pushing the planetary boundaries is critical, in order to reach full potential of the SDGs in communities across the world.

Development interventions and policies that imbibe and reflect environmental costs on society and uphold equity may help reign in the breaching boundaries. The Inclusive and Equitable Sustainable Development model helps identify local and regional baseline needs, capacities, and other factors contributing to breaching boundaries both locally and regionally. This would be the first step toward planning for appropriate need and place based SDG interventions.

Critical learning that paves alternative paths to the inclusive SDGs comes from sharing lessons. Communities that have achieved the SDG goals with holistic partnerships and deliberate efforts in equity and inclusion and economy which values partnership with the earth offer leadership to the path ahead. Such lessons and experiences will help energize the collective efforts from all walks of life, to move toward a more equitable, inclusive and just state for all residents of the Earth system.

Kofi Annan (United Nations Secretary-General from 1997-2006) observed, "If tolerance, respect, and equity permeate family life, they will translate into values that shape societies and nations."[2]

[1] https://www.un.org/sustainabledevelopment/blog/2016/11/secretary-generals-remarks-to-the-press-at-cop22/

[2] https://digitallibrary.un.org/record/253927?ln=en

While this remark was made in context of emphasizing the roles that families play in turning human rights to reality, it is just as well relevant to achieving the SDG targets for 2030. Achieving the SDGs is nested in the premise that achieving sustainable development within the planetary boundaries is realistic only with equitable and inclusive participation of individuals, communities, states and countries across geographic boarders working together with a tangible knowledge of the economic, social and life-sustaining value of the planetary boundaries that have closely supported our development this far.

AUTHOR'S CLOSING REFLECTIONS

Our whorled world

Our world
is in whorls
Nature, its gifts
Water
Air
Soil
Minerals
Energy, together
pulsating through
all forms
living
non-living
and in between.

'Our' world
what we see,
the whorls
in flowers
in eddies
in leaves, vines,
tendrils and seeds
in hair
skin, scales
layers in a forest
and more.

We don't
always see
patterns' work,
they
touch, network
hold together
organs, organisms
systems.

We don't
always see
everyday patterns
our lives,
lifestyles,
choices available
unavailable,
determined by a past
a present,
by the knowledge
of the whole
and its parts.

Infrastructure,
education,
poverty,
hunger,
jobs,
peace,
energy,
all nestle
under the sun,
the atmosphere,
the resources,
all providers
for the living and nonliving forms
on earth.

The SDGs are ringed
whorled into
each other
each important
as the other.
For the present
and the future
whorled
inextricably to the sun
water,
land,
all species
and all the earth provides for.

The future
to secure
we must recognize
these upward, downward, sideways
connections,
our histories,
our treatment
of nature
of other(s)
and of each other.

We must identify
one ring holds the other,
One bract
supports the other
Doing so,
protects and
nurtures,
bringing forth
adapted seeds,
to inhabit
the earth
linking life
breath of the present to
the future.

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