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VIEWPOINT

Sustaining soil for advancing peace: World is one family

Rattan Lal

Vasudhaiva Kutumbakam from the ancient Hindu text the *Maha Upanishad* means "world is one family" (Sanskrit, from *vasudha*, the earth; *iva*, is, and *kutumbakam*, family). This phrase is more relevant now than ever before because humanity is at both political and environmental crossroads. The Sanskrit phrase also implies that peace must be universal rather than only in some parts of the globally "joint family." Global issues with several adverse impacts on human wellbeing and planetary processes include climate change, the COVID-19 pandemic, and conflicts leading to political unrest and refugees. Violent conflicts affecting a large number of people have global economic ramifications, and the gross domestic product and family income can be drastically reduced for even up to four years after the end of a conflict (De Groot et al. 2021). Because of numerous global conflicts, there were 79.5 million refugees worldwide by the end of 2019 (Augustinus and Tempra 2021) and 82.4 million refugees worldwide who were internally displaced (UNHCR 2021). The crisis in eastern Europe has created another 5.26 million refugees as of April 25, 2022, along with an estimated 7.7 million internally displaced persons. With eviction from land linked to violent conflicts, protecting people and their land rights, and addressing historical justices and political exclusion through judicious land governance, are critical to accomplishing peace and harmony (Augustinus and Tempra 2021). In the present era of degrading soils and warming climate, it is important to consider how can peace be climate-resilient and advanced simultaneously along with environmental sustainability (Brauch et al. 2019; Barnett 2019; Nicoson 2021), in which restoration and conservation of global soil resources can play a critical role.

Therefore, the objective of this article is to discuss how can peace be made resilient to climate change, soil degradation, drought and water scarcity, loss of biodiversity, low agronomic productivity, and poor nutritional quality. Simply put, the goal is to deliberate how peace can be achieved through sustainable management of soil and other natural resources while also restoring the environment and mitigating climate change. Soil and environmental degradation, leading to social conflicts and war, are related to the concept of economic growth (Lal 2015). An attempt is also made to assess the impact of military activity on soil quality, and necessity to heal both the land and people adversely impacted by war.

ROLE OF SUSTAINABLE SOIL MANAGEMENT AND AGRICULTURE IN UNIVERSAL PEACE

The present era is characterized by inequalities and wars both within and among nations, thereby creating a major challenge to achieving Sustainable Development Goals (SDGs) or the Agenda 2030 of the United Nations. Inequalities and wars of the modern era originate from dominant principles of acquisitiveness, self-centeredness, and short-sightedness (Berry 2017; Kuriakose 2021). Therefore, the movement on the peace-environment nexus should be a private rather than a public cause to be long-lasting and effective (Berry 2017). Rather than adopting the role of the guardians and stewards of the planet, humans have focused on the destructive and short-sighted approach to prosperity leading to inequities and wars. In this context, Wendell Berry advocates a "holistic approach to establishing sustainable societies" globally by "promoting a culture of agriculture, fostering prosperity," and advancing SDGs (Berry 2015; Kariakose 2021). The underlying philosophy is to safeguard natural harmony, achieve food and nutritional security, foster human wellbeing, protect/restore nature (Kuriakose 2021), and thus promote and sustain global peace by living in cooperation with nature. This concept is also supported by Diamond (2005), who in his book, *Collapse: How Societies Choose to Succeed or Fail*, documented that regions prone to soil degradation are also those that are susceptible to political unrest, civil strife, conflicts, and war. Thus, restoration and sustainable management of soil health is an essential prerequisite to living in harmony with nature and to achieving global peace in perpetuity.

Anthropogenic climate change must also be recognized as a threat to global peace and security. It is thus important to understand the climate-peace-nexus (Sharifi et al. 2021). Further, soil degradation and climate change are mutually reinforcing stressors, which strongly interact and undermine peace. Soil degradation is caused by land misuse and soil mismanagement and includes accelerated erosion, salinization, depletion of soil organic carbon (C) and plant-available nutrients, decline in soil structure, and loss of biodiversity. Decline in agronomic productivity and increase in risks of hunger and malnutrition are principal causes of civil strife, political unrest, and war (figure 1). Consequently, there is a growing interest in the emerging concepts of nature-positive agriculture, involving practices such as agroecology and regenerative agriculture as holistic approaches to natural resources management.

THE WAR–SOIL QUALITY NEXUS

Decline in soil quality can affect civil conflicts and vice versa. The scarcity theory indicates that lack of adequate renewable resources can lead to violent conflicts. Thus, there may be a link between population density, soil degradation/desertification, accelerated deforestation, and civil war (Theisen 2008). Inequality in access to

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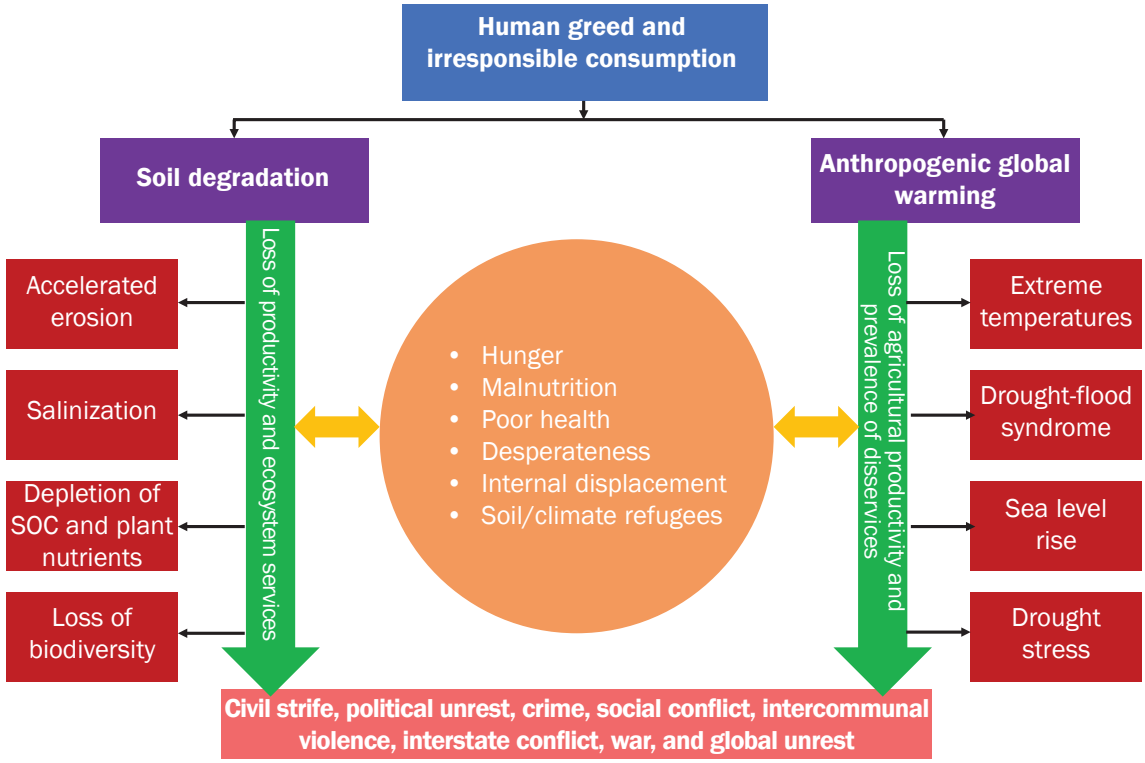
Figure 1
Stressors to peace caused by soil degradation and global warming.



fertile soils, coupled with an increase in prices of inputs (e.g., fertilizer) to restore soil quality, can aggravate the likelihood of conflicts because of adverse impacts on income and equality (Berman et al. 2019). However, poverty and dysfunctional institutions may be a major driving force to war and civil strife (Theisen 2008), and soil quality has a strong impact on income and equality.

Just like people, nature (e.g., soil, water, air, organisms) is also victimized and is a neglected casualty of war due to strong environmental impacts. Soil properties are adversely impacted by military activities through physical, chemical, and biological disturbances (Garten et al. 2003; Broomandi et al. 2020). Traffic by tracked vehicles increases soil compaction (Prosser et al. 2000), and battle tank disturbance degrades soil quality and adversely impacts invertebrates and vegetation (figure 2) (Althoff and Thien 2005). Military activities can lead to decline in total soil C, total nitrogen (N), microbial biomass C, and soil respiration (DeBusk et al. 2005). Soil carbon dioxide (CO_2) fluxes are strongly related to level of disturbance (Silveira et al. 2010). Even the foot traffic from military training can increase soil bulk density, decrease water infiltration rate, reduce above ground biomass and liter, and aggravate soil erosion hazard (Whitecotton et al. 2000). Military activities also increase concentration of mercury (Hg) (Gebka et al. 2016) and other contaminants in the soil (Broomandi et al. 2020). Therefore, nature and people both must be healed after the armed conflict.

SOIL MANAGEMENT AND RESTORATION

Land use and management, for diverse purposes including agriculture and others, must restore degraded soils, and regenerate deserted ecosystems for enhancing human wellbeing and strengthening nature conservancy. Violent conflicts and wars, even over a short period of time, adversely affect both people and the land (i.e., soil water, vegetation, biodiversity, and air). Therefore, people and the land ravaged by war must be healed (Lozano Moreno 2016). A war-affected territory is also a victim of the conflict and needs to be restored by an environmental and symbolic territory recovery. Land and nature also have rights (Boyd 2017; Lal 2019), which must be recognized and respected. Postmilitary soil is often compacted and contaminated with heavy metals and other compounds. Nebeská et al. (2018) studied the effects of growing a second generation *Miscanthus gigantus* in former military sites for phytoremediation of contaminants. Overall Miscanthus had a positive impact on soil health. Similar studies and restoration efforts are needed to recover conflict-affected lands and support those dependent on them.

There is an emerging "sustainability transition" research paradigm based on a rethinking of peace, security, and ecology. In the 21st century, there must be a long-term transformative change towards a low-C or circular economy, green infrastructure for transportation, urban planning, and agriculture. It is only with this new thinking that the threat of climate change, soil degradation, and food and environmental insecurity can be

effectively addressed via transition to sustainability (Brauch 2016). This long-term, transformative change can prevent violent conflicts related to climate change, resource scarcity, and soil degradation. Thus, there are strong linkages that need to be developed to address the issues of the Anthropocene related to sustainable development. Important linkages which need to be developed are in the context of (a) political-geoecology between the natural and social sciences, and (b) peace ecology between peace, security, development, and environmental studies (Brauch 2016). Therefore, the research focus must be directed toward a sustainability transition in the context of Anthropocene. In the present era of globalization, security and peace can only be universal rather than local or regional (Lal 2015), which has a relevance to global land use and soil management. Thus, a "Greener Revolution" can only be ushered in through a judicious soil and environmental (land use) governance (Lal 2015).

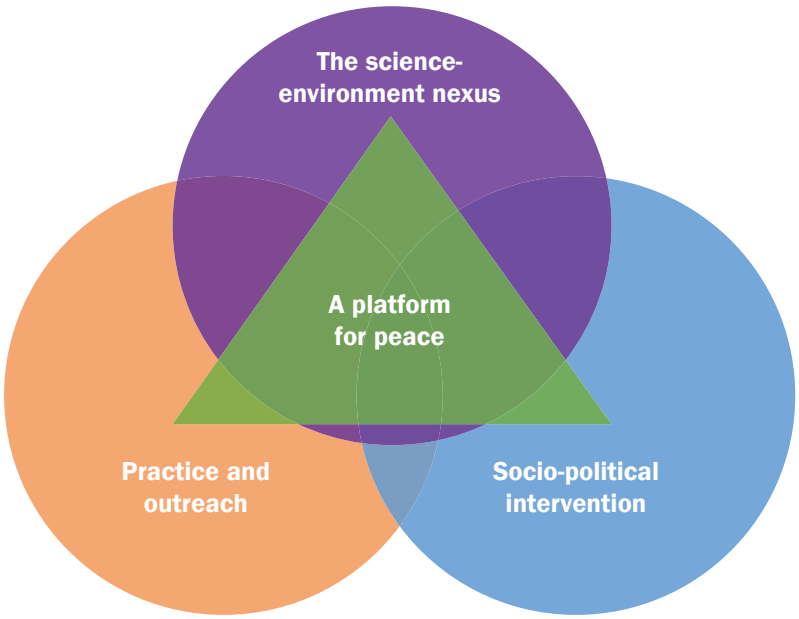
NATURE-POSITIVE AGRICULTURE

Agroecology is based on a conceptual model of tripartite intervention—"science-environment, practice, and sociopolitical intervention" (figure 3)—based on a socioecological dimension and sustainable development (Picón et al. 2019). Agroecology and regenerative agriculture are currently promoted as holistic approaches to sustainable management of natural resources. Regenerative agriculture, as a concept rather than one-size fits all practice (Lal 2019), is based on eco-innovation, powered by renewable energy, driven by circular economy and green infrastructure, and based on re-carbonization of the terrestrial biosphere (sequestration of C in soil and vegetation) as critical to sustainable development.

Therefore, the path to global peace and harmony lies in restoration, protection, and sustainable management of natural resources, which will yield improvement of soil quality and agronomic productivity. Indeed, there is a strong peace-sustainability nexus (Sharifi et al. 2021), and sustainable development is strongly related to global "peace with nature" in the Anthropocene (Brauch 2019). The economic causes of emissions of greenhouse gases must be addressed. Transition to non-C or renewable fuel sources would need a strong cooperation between individuals, families, local communities, states, nations, international government organizations, and nongovernment organizations and civil societies. It is also in this context that food security, access to healthy and nutritious food as a basic human

Figure 2
Military activities, including tracked vehicle traffic, increase soil compaction and negatively impact soil quality. US Department of Defense photo by Andres Chandler.

Figure 3
Sustainable soil and agriculture as a platform for peace and political stability have strong impacts on livelihood security, conflict prevention, social equity, and sustainable peace (Justino et al. 2020).



right, is intricately interconnected with global peace (Lal 2015). In addition to the absence of violence and war, access to food is also important to international peace and security (Fillol 2019). Food, as a common denominator for human wellbeing, is also a source of national pride and culture (Lander and Richards 2019) and indispensable to achieving universal peace.

CLIMATE CHANGE AND PEACE

Climate change is one of the important ramifications of the Anthropocene. However, whether the current and projected climate change would increase or decrease political violence and civil strife is a debatable issue. A study by Gartzke (2012) indicated that "global warming is associated with a reduction in interstate conflict." This conclusion is suspect because increased consumption of fossil fuel is related to changing patterns of politics and prosperity. In other words, economic development is related to both climate change and peace. Trends toward peace are related to increase in average income. Thus, in lower-income states, stagnating income caused by efforts to mitigate climate change could lead to fears of climate-induced violence or conflicts (Gartzke 2012). There is a need to build an alternate "framing of peace as a phenomenon that is resilient to climate change" (Barnett 2019). Barnett (2019) argues that climate-resilient peace may be realized by "layering knowledge about the conditions under which peace prevails through environmental change with that on environmental peace-building," and on the interactions between resilience and security.

DIET QUALITY AND HUMAN BEHAVIOR

The effects of diet quality on the human brain have not been widely studied. It is argued that diet quality, which depends on soil quality, may impact human behavior or mental health (Wiles et al. 2009). Nutrients in food, coming from a healthy soil, may have a strong effect on the structure and functions of the nervous system (Bourre 2004, 2006). Poor diet (deficient in micronutrients, protein, vitamins, etc.) may adversely affect brain functions. It is now hypothesized that a poor diet may be a changeable causal factor in antisocial behavior. Gesch (2013) tested the effects of diet quality on the behavior of young adult prisoners (18 to 21 years) in relation to essential nutrients. The data showed that those prisoners who received extra nutrients committed significantly fewer offenses than those receiving less nutrients. Furthermore, those receiving real supplements for at least two weeks committed 37% fewer of the most serious offenses (Gesch 2013). Thus, balanced and healthy diet may reduce and prevent a significant portion of violence and antisocial behavior. An important principle is not where one eats but what one eats. This study also confirms the importance of the "One Health Concept" that states that "health of soil, plants, animals, people, ecosystems and the planet is one and indivisible" (Kemper et al. 2018; Lal 2020).

EDUCATION AND OUTREACH

There is an urgent need for education as a tool to promote peace and to create awareness about the importance of sustainable management of natural resources as critical to living in harmony with nature and as a path to peace. Education objectives should include transforming the general public from audience to actors and strengthening awareness about the power of words, ideas, and feelings about peace (Bahajin 2018).

In the Anthropocene, educational curricula must focus on the environmental issues related to conflict and violence due to resource scarcity and access, patterns of consumption, and the function of the global economy (Amster 2014). These patterns lead to a positive feedback to climate change and soil degradation on the one hand and militarism and conflicts on the other. Therefore, peace educators should develop a pedagogy that addresses the basic issues leading to an effective engagement and a sense of hopefulness and optimism even in the face of mounting crises. Teachers at all levels must provide a classroom experience of aspirational goals of sustaining optimism even in the face of despair and helplessness (Amster 2014). There is a need for a curricula for the environmental-peace perspective that relates climate change and resource degradation to violent conflicts and political instability (Ide and Scheffran 2014).

ADVANCING PEACE AND JUSTICE FOR ALL

Humanity is currently engulfed and trapped into the tight grip of three Cs: conflict, Covid, and climate change. Therefore, now is the time that all of us must unite and face these challenges bravely, wisely, and prudently. As discussed, basic principles of soil science and conservation management can be useful in addressing the calamity of the three Cs that humanity is presently trapped in. Famine and starvation remain real threats to global peace. Thus, ensuring access to food for all may pave the way for improving the prospects for peace (Lander and Richards 2019). Food plays an important role in satisfying the basic human needs (Tansey 2013). Therefore, international peace and security does not mean simply the absence of war, it also includes diverse aspects, such as food security (Fillol 2019). Indeed, fair and sustainable food systems are critical to advancing global peace (Tansey 2013).

Mahatma Gandhi believed that "Mother Earth [*Terra Matre, Matre Bhumi*, soil] provides enough to satisfy every man's need, but not every man's greed." Therefore, sustainable peace may be achieved through peace with nature (Brauch 2019). There is an urgency to heal both land and the people adversely impacted by a war.

Furthermore, functioning soil has the power to prevent and repair the wounds. Now is the right time to heal the land to promote and sustain peace. To those who are suffering because of the conflict in some parts of the world, it is important to assure them, that they are not forgotten and are an integral part of the same human family, supported by shared natural resources: *Vasudhaiva Kutumbakam*.

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