**Digging Deeper: Soil Health as the Game Changer for Poverty Reduction**

*How does soil health contribute to the global goal of ending poverty?*

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## 1. Introduction

In his Nobel Prize acceptance lecture, economist Theodore Schultz (1979) remarked, "Most of the world's poor people earn their living from agriculture, so if we knew the economics of agriculture, we would know much of the economics of being poor". If agriculture, then, largely determines the fate of the world's poor, soil health has a fundamental role to play, given its impact on agriculture. In this paper, we lay out the deep relationships between soil health, agriculture, and poverty, and their implications for policy making. We focus on the United Nations Sustainable Development Goal 1 (SDG 1): No Poverty (United Nations, n.d.-a), which seeks to end poverty in all its forms everywhere. Extreme poverty is defined as surviving on less than $2.15 per person per day, at 2017 prices. We use the Intergovernmental Technical Panel's definition of soil health: ". . . the ability of the soil to sustain the productivity, diversity, and environmental services of terrestrial ecosystem" (FAO, 2020).

## 2. Why Focusing on SDG 1 Is Crucial

While the moral, economic, and political rationale for ending poverty requires no reexamination, it is critical to understand why, in the form of SDG 1, it continues to be a critical goal. Between 1990 and 2014, more than 1 billion people came out of poverty, thanks to economic growth and social protection initiatives (United Nations, n.d-b.). This change demonstrates that with the right policies and programs, similar progress can be made again in poverty reduction. Unfortunately, progress was slowed during the COVID-19 pandemic that began in 2020 (United Nations, n.d-b.). Baah et al., (2023) estimates that 659 million people (up from 648 million) live in poverty today. At the current slowed pace of poverty reduction, 575 million people, mostly from sub-Saharan Africa, will still be in poverty by 2030, and the world will have failed to meet the SDG 1 target. This potential outcome points to the fragility of progress in the face of economic crises and pandemics, highlighting the threat of people slipping back into poverty. The focus must shift to addressing the root causes of the persistence of poverty.

Further, there is growing recognition that SDG 1 is not an isolated target and poverty is multidimensional, influencing and being influenced by other development indicators related to food and nutrition security, healthcare, education, and more. Thus, focusing on SDG 1 is critical to achieving multiple SDG targets.

## 3. Soil Health: The Missing Piece of the Puzzle

Keeping in mind that poverty reduction is closely tied to the issues of equity and social justice, we turn to the question: what solutions exist that can promote resilient, sustained poverty reduction for the world? It is in this context that we examine the pathways between soil health and achieving SDG 1.

Scholars argue that soil health is, in fact, a holistic measure of soil condition as it pertains to multiple ecosystem services, and soil fertility is only one of multiple indicators that focus on the soil's ability to sustain crop production (Lehman et al., 2020). Today, the world has recognized that the health of ecosystems, such as soil, is intricately tied to human wealth, and the erstwhile trade-off between the two ceases to exist when natural resources are being depleted at a pace far higher than that at which they are restored. Thus, improving soil health is a goal in itself.

The link between soil health and poverty occurs through two pathways, as shown below.

### 3.1. Pathway 1: Soil Health to Agricultural Productivity

Here we examine the impact of improved soil health, specifically in terms of soil fertility, to explain the linkage with poverty. Soil fertility has been found to unequivocally affect crop productivity. Soil fertility impacts the mineral composition of plants, thereby improving their quantity. Integrated soil fertility management (ISFM) practices have been found to improve crop productivity by three to four times more than before, indicating how critical the role of minerals is. Further, soils with high levels of yield stability are also found to have higher levels of crop yield stability (Kihara et al., 2020). Soil fertility also affects the ability of crops to absorb nutrients. Therefore, efficiency of inputs such as fertilizers increases with higher levels of soil fertility (Berazneva and Güereña, 2019), potentially leading to a virtuous cycle between soil health and crop productivity. Higher levels of fertility do not just increase yields but also increase the impact of added fertilizers, further increasing productivity.

To support the validity of this relationship, assessments must be established to show that low soil fertility and poor soil health lead to lower yield. Research by Lipper (2001) shows that they do. For example, soils in tropical regions where the topsoil has been leeched exhibit some of the lowest yields. Alarmingly, the effectiveness of soil conservation methods as per this study is inversely related to the level of soil fertility; the greater the level of soil fertility loss, the harder it is for conservation measures to make a positive change. Thus, the soil fertility-crop productivity relationship can turn from a virtuous cycle as described above to a vicious cycle. Lipper's study shows that fertilizers and other agricultural inputs are complements, not substitutes, to soil fertility. Inputs cannot compensate in yield outcomes but only enhance them – if soil fertility is good.

### 3.2. Pathway 2: Agriculture to Poverty Reduction

The connection between agriculture and poverty is well documented. Agriculture-led growth has a more substantial impact on poverty reduction than growth in other sectors. In sub-Saharan Africa, investment in agriculture had a 4.25-times stronger impact on reducing poverty than investment in other sectors (Pingali, 2010). Furthermore, according to the World Bank (2007), agriculturally driven growth generates a larger welfare effect than non-agriculturally driven growth, especially for the poorest 20% of the population. A 2005 report commissioned by the Department for International Development (DFID) on the link between agriculture-led growth and poverty showed that across South Asia, sub-Saharan Africa, and Eastern Africa, agriculture-led growth was likely to significantly reduce poverty. The reason for such positive results is that 80% of the poor, even today, live in rural areas and are engaged in some form of agriculture, whether subsistence or commercial, temporary or permanent. Thus, agriculture sector-led growth directly benefits the poor, as opposed to waiting for a trickle-down effect from the growth of other sectors.

#### Establishing the Link Between Poverty and Soil Fertility

The impact of soil health on poverty through agricultural productivity is well established. Various studies have correlated soil health with poverty levels. For example, a 2019 study by the United Nations Convention to Combat Desertification (UNCCD) of 50 low- and lower middle-income countries shows that the top 20% of regions with degraded land also have the highest average rate of poverty, and a 5% rise in land degradation shows an increase in poverty by 1% in a regression analysis of 868 sampled locations. Additionally, Lal (2020) argues that soil health restoration can break the vicious cycle of land degradation affecting poverty and hunger, which in turn impacts the ability to invest in conserving soil health. Berazneva and Güereña (2019) state a crucial point: for poor farmers, soil is the only form of capital, albeit natural, that they have as they cannot afford physical capital or expensive agricultural inputs. Thus, a decline in this natural capital will lead to an aggravation of poverty. In sub-Saharan Africa, which is home to over 50% of the world's poor (Aguilar et al., 2024), farms are able to achieve only 20% of their attainable yield levels owing to lack of adequate inputs (Tittonell and Giller, 2013). Soil fertility thus has an outsized impact on how much these farmers can produce and earn, deciding poverty levels.

### 3.3. Soil Health: The Link to Future Poverty

Previous sections have outlined how soil health influences current poverty levels through agricultural productivity. However, a growing body of evidence shows that soil health – or lack of it – can impact future poverty as well, particularly through its effect on nutrition and human capital. Poor soil health impacts the nutrient composition of plants and thus the nutrient absorption of local populations, impacting malnutrition levels and leading to poor human capital outcomes. Studies from both the foothills of the Himalayas in the Terai region (Gautam and Bhattarai, 2007) and from countries in Africa (Ibia et al., 2023) show that areas whose soils contain excessive zinc, copper, and magnesium feature higher levels of malnutrition among children, not only harming their potential cognitive growth – leading to lower ability to take up gainful employment in the future – but also incurring health and caregiving expenses in their households. All these results set these children up for a future of lower income possibilities.

## 4. Conclusion

While the relationship between crop productivity and reduced poverty is clear, several caveats must be considered. The linkage between higher crop productivity and lower poverty levels can be threatened by poor terms of trade owing to low prices in the domestic or external markets for agricultural produce. Second, effective market linkages are critical to ensure farmers receive the full benefits of higher crop productivity through better prices and revenues. Third, as argued by Lal (2021), it is important to understand site-specific conditions to determine whether agricultural improvements can raise smallholder farm incomes and if so, how it can be achieved.

The full impact of soil health on crop productivity can be realized with the application of optimal levels of inputs such as fertilizers. Studies from Malawi showed maize production increased significantly with increased fertilizer subsidies (Ricker-Gilbert and Jayne, 2017), and in Kenya, One Acre Fund's work has seen a 50% increase in incomes for farmers who adopted better fertilizer application methods (IPA, n.d.). Our original questions centered on how soil health can support SDG 1 in ending poverty and what solutions are available to support this goal. This paper has shown why poverty remains persistent and why poverty eradication efforts are often fragile, and it has delineated pathways that lead from soil health to agricultural productivity, and productivity to poverty reduction. Our conclusions thus call for greater focus on policies that promote soil health and optimal application of agricultural inputs to fully realize the benefits of improved crop productivity (realizing its potential as a “game changer”) that can drive up a country’s growth in an equitable manner while reducing poverty.

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