Nestlé

Creating Shared Value

Nutrition | Water | Rural Development

Natural Capital

- Soil & Soil Health -

Nestlé's mission is to respond to the needs of consumers by offering safe, nutritious and healthy foods and beverages.

As the world's leading Nutrition, Health and Wellness company we purchase nearly 1% of the world's agricultural output. Along with other companies in the agri-food sector, we depend on functioning ecosystems and a healthy environment probably more than most other businesses.

Soil, and in particular soil health, play a vital role in the production of food and ensuring food security in the long-term. Yet unsustainable agricultural practices are a major contributor to the degradation of agricultural soils in the form of erosion, loss of organic matter, nutrient depletion, contamination, compaction, and increased salinity.

Soil and soil health

Soils form in response to natural processes from parental material. Factors like topography, climate and natural vegetation influence the development of particular soil types. Soils are made of four basic components; mineral solids, water, air and organic matter. Mineral solids consist of stones, sand, silt, and clay. Water, essential for all life on earth, transports nutrients in the soil and plants. Air provides oxygen to organisms living in the soil and to plant roots. It is constantly exchanged between the sub-soil and above-soil environment. Finally, organic material originates from vegetation and living organisms.

Soils are complex, multifunctional systems that alter over time through natural or manmade processes, for example, soil cultivation, drainage, irrigation, and addition of plant nutrients. Although often seen as lifeless, soils are living, dynamic environments that provide habitat for many different organisms. Soils with high agricultural productivity usually have a high biological activity. 'Soil health' is the term that describes the soil's capability to support the production of food and non-food crops in sufficient quantity and quality to meet human needs.

Understanding soil and soil health in a cocoa plantation in Cote d'Ivoire.

Soil used for agricultural purposes belong to the 'agro-ecosystem', which is part of the more comprehensive conventional ecosystem.

Importance of soil health

Soils provide us with a range of so-called 'environmental goods and services' - ecosystem services that are essential to sustaining life on earth (Figure 1). Processes include nutrient cycles, the biological control of pest and diseases, the regulation of water flow and quality, and influence on the gaseous composition of the atmosphere. This means that soil processes can have an impact on the global climate.

In short, the main services that soils provide can be summarised as follows:

- Transformation of carbon: Soil organisms decompose plant residues and waste from animals. Thereby, residues and waste are used as source of feed. Favourable conditions allow organisms to develop and synthesise new carbon structures, including soil organic matter – a very important component of soil. Soil organic matter improves nearly all soil properties - including moisture retention, soil structure, drainage, nutrient storage - and therefore plays a vital role in many functions of soil. The ability of soil to store carbon is important in reducing the amount of carbon dioxide (CO_2) in the atmosphere, thereby regulating our climate.
- Nutrient cycling: most nutrients, essential for plant growth, are related to organic matter. In particular the availability of nitrogen, the most important plant nutrient, directly depends on the amount of soil organic matter and the biological activity of the soil (i.e. the ability of the soil to break down and mineralise organic matter).
- Soil structure: Soil particles are aggregated or released, forming structures and pore networks. These provide habitats for organisms, allow water to penetrate and infiltrate, and offer plants favourable rooting

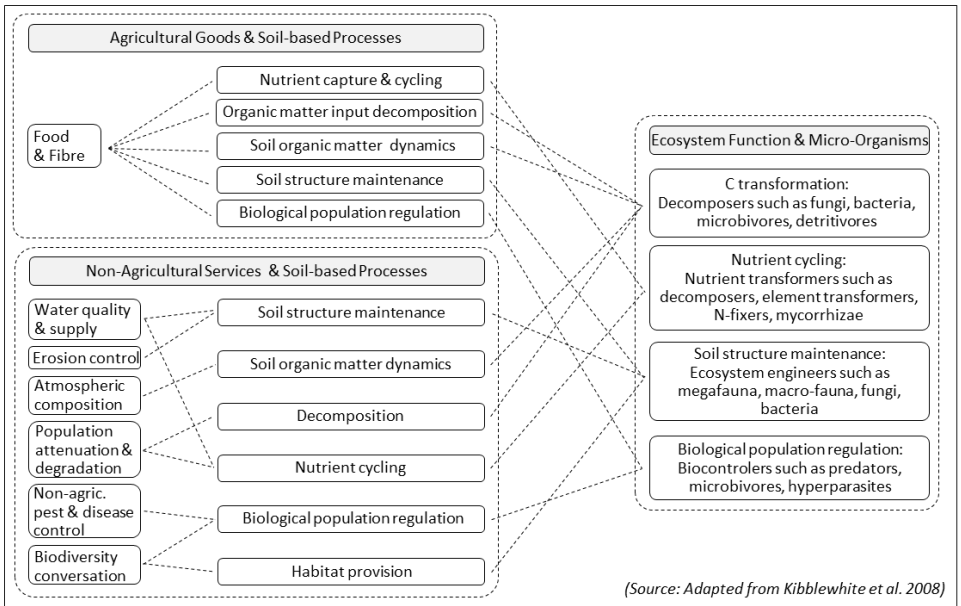


Figure 1: Ecosystem services that society might expect from soils.

environments.

- Natural regulation: Pests, and diseases of plants and animals (including humans) are regulated through biological processes in soils.

Table 1: Nutrients and their functional properties in plants.

Nutrient	Function in Plants	Nutrient	Function in Plants
Nitrogen (N)	Chlorophyll and protein formation	Chlorine (Cl)	Oxygen production, cell osmotic pressure, tissue hydration
Phosphorus (P)	Growth, cell division, root lengthening seed and fruit development, and early ripening	Copper (Cu)	Chlorophyll formation, enzymes
Potassium (K)	Enzymes functioning, photosynthesis, nutrient and water cycles in plant, pest, diseases, and frost and drought tolerance	Iron (Fe)	Chlorophyll, carbohydrate production, catalyst for chemical reactions within plant cells
Calcium (Ca)	Cell walls and membranes	Manganese (Mn)	Chlorophyll, regulates several key enzymes
Magnesium (Mg)	Central component of chlorophyll	Molybdenum (Mb)	Enzyme systems, reduction of nitrate and synthesis of proteins
Sulfur (S)	Amino acids i.e. protein production	Zinc (Zn)	Enzymes systems, protein synthesis, seed production
Boron (B)	Cell growth and pollen formation		*(Source: Adapted from Roy et al. 2006)*

Soil organisms play a crucial role in sustaining above processes. Decomposers such as fungi and bacteria are involved in carbon transformation. Nutrient transformers, for example decomposer, N-fixer, mycorrhizae, engage in nutrient cycling. Ecosystem engineers, including macro-fauna, bacteria and fungi, support maintenance of soil structure. And finally, bio-controllers such as predators, and microbivores act as natural regulation agents over microorganism populations.

Recycling of organic waste through composting (e.g. coffee pulp) in Thailand.

Factors influencing soil health

Soil health is basically controlled by four key factors:

- Soil type: The particular soil type (a function of parental material, topography and environmental factors) and past land management by humans, set particular frame conditions for soil health.
- Soil organisms: Several ecosystem services, such as organic matter decomposition, nutrient transformation, ecosystem engineering and biological population regulation, are provided by soil organisms.
- Carbon: The energy used for any biological transformation process is derived from carbon coming from net primary production. The quality and quantity of carbon is indicative of soil health (i.e. determines biological activity and nutrient cycling).
- Nutrients: Processes in the soil system are strongly regulated by nutrient addition.

Nutrients and crop growth

Nutrients added to a soil system affect soil health and influence crop growth, crop quality, and ultimately feed and food quality for animals and humans, respectively.
There are 16 elements essential for the development of the full genetic potential of a crop (Table 1). The first three elements - carbon, hydrogen and oxygen - are obtained from air and water. The other 13 elements are taken up by plants from the soil. Nutrients required in larger amounts are called macronutrients (i.e. nitrogen, potassium, calcium, magnesium, phosphorus, and sulphur), those required in smaller amounts are referred to as micronutrients (i.e. chlorine, iron, boron, manganese, zinc, copper, molybdenum, and nickel). The availability of these nutrients varies depending on soil types and soil health status.

Nutrients can be added to plants in the form of organic or synthetic fertilisers (Figure 2). Organic fertilisers originate from primary production such as crop residues, mulches, or waste including farmyard manures and the organic fraction of municipal solid waste. Nutrients contained in organic fertilisers are slowly released. Conversely, nutrients in synthetic fertilisers are more easily available for plant growth. Synthetic fertilisers are produced industrially by physical and chemical processes and the use of large amounts of energy.

Integrated soil fertility management

Discussing fertiliser recommendations with a cocoa farmer in Ecuador.

Today it is generally agreed that sustainable crop production can be best achieved by making use of both organic and synthetic fertilisers. Good agricultural practices help farmers to develop nutrient balances for their fields and farms in order to make the best use of both fertiliser sources. An important guiding principle is to replace nutrients exported through the crops harvested. Organic fertilisers are recommended to be applied as a basal application, due to slow nutrient release characteristics. Synthetic fertilisers are then used to complement and synchronise nutrient supply with crop nutrient demand.

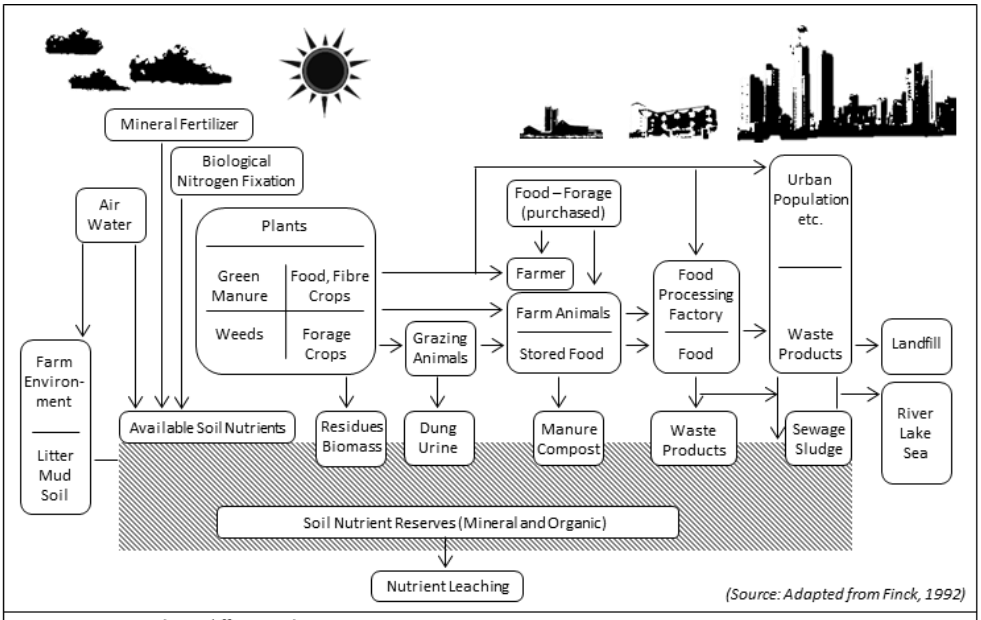
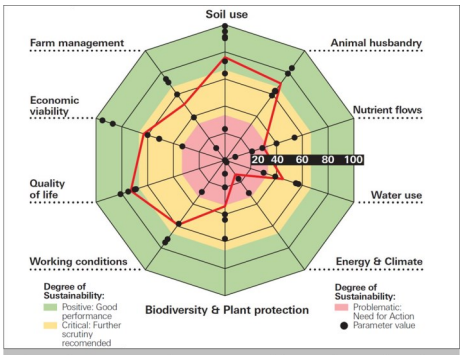


Figure 2: Nutrient cycling at different scales.

While farmers in developed countries receive formal training in farming and have the possibility to consult an agricultural advisor to prepare a nutrient balance for their fields/farm, many farmers in developing and emerging economies often lack basic knowledge in soil fertility management. On top of that, over the past few decades advisory services in these countries have been seriously neglected or have been discontinued. Furthermore, farmers in developing and emerging economies usually don't have the financial means to invest into integrated soil fertility management with the consequence that soils continue to degrade, and future harvests are jeopardised.

Nestlé's actions

In 2002 Nestlé started its *Sustainable Agricultural Initiative Nestlé* (SAIN). As a corporate-wide, action-oriented initiative, SAIN contributes to the production and supply of safe, high quality raw materials for Nestlé brands. It includes the whole value chain, from farm input suppliers (for example chemicals, fertilisers, seeds, animal feed) to farmers, primary processors and traders. SAIN promotes more sustainable, agricultural practices that reduce environmental impacts and favour the development of lean, efficient supply chains. It makes use of the guiding principle "Remove the worst, promote the best, improve the rest". Communication and dialogue are important elements of the initiative.



The tool Response-Inducing Sustainability Evaluation (RISE) is used to visualise areas for improvement at farm level. *(Source: www.hafl.bfh.ch/rise)*

Scientific evidence and our own experience concerning the degradation of natural resources - namely soil and soil health - led us to complement our Policy on Environmental Sustainability in 2012 with a specific commitment on Natural Capital, recognising that the long-term success of our company is built upon the products and services provided by nature.

Soil, an essential element of natural capital, is intrinsically linked to everything around us and performs many ecosystem services we depend on. A smarter use of soil, and soil health, should be guided by not wasting, not polluting and not destroying. Through SAIN, we promote integrated soil fertility management as a way of helping to effectively raise crop yields and quality while strengthening rural and community development.

As such we make use of the tool 'Response-Inducing Sustainability Evaluation' (RISE) to sensitise and train our own employees, and farmers, in holistic farm sustainability assessment.

We have integrated soil and soil health in different initiatives including the Nescafé Plan, the Nespresso AAA Program, and the Cocoa Plan and in other direct sourcing operations. In collaboration with our partners, we provide guidance and training to farmers on integrated soil fertility management.

We advocate for and support policy dialogues to promote good agricultural practices and to protect natural resources on the Sustainable Agriculture Initiative (SAI) Platform, the main food and drink industry initiative supporting the development of sustainable agriculture worldwide, as well as in international fora such as the United Nations Global Compact and the World Economic Forum.

More information, including the Nestlé Commitment on Natural Capital, and details on how to contact us, is available at: www.nestle.com/csv

References:

Finck, A. (1992). Fertilizers and fertilization. Introduction and practical guide to crop fertilization. 2nd edition (German). Verlag Chemie, Weinheim, New York.

Gugino, B.K., Idowu, O.J., Schindelbeck, R.R., van Es, H.M., Wolfe, D.W., Moebius-Clune, B.N., Thies, J.E. and Abawi, G.S. (2009). Cornell Soil Health Assessment Training Manual, Edition 2.0, Cornell University, Geneva, NY.

Kibblewhite, M. G., Ritz, K., Swift M. J. (2008). Soil health in agricultural systems. Phil. Trans. R. Soc. B, 363, 685–701.

Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-Being: Biodiversity Synthesis. World Resources Institute, Washington, DC.

Roy, R.N., Finck, A., Blair, G.J., Tandon, H.L.S. (2006). Plant nutrition for food security - A guide for integrated nutrient management. Food and Agriculture Organization of the United Nations, Rome, Italy.