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For sustainable development, see the life in soil

The Edge, Malaysia

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Our food system — especially after the expansion of the barren green deserts of monoculture fostered by the Green Revolution — contributes to the climate change crisis. According to the United Nations, agriculture covers nearly 40% of the world's land and is responsible for 17% of global carbon dioxide emissions.

Many decarbonisation pathways exist in the agriculture sector. To find a sustainable systems solution, we need to look deeper. Our research in Cambridge in 2005 demonstrated that it is the quality of relationships that make things work. This requires acknowledging our relationship not simply "with" nature but "within" nature, and to work on understanding and honouring — and developing — the relationships within ecosystems, including human ecosystems.

Caring enables growth — caring is the action and growth is the result. This principle is brilliantly demonstrated in the work of Gawad Kalinga (GK) Enchanted Farm in the Philippines and Institut Bisnis dan Ekonomi Kerakyatan (IBEKA) in Indonesia. In the GK Enchanted Farm, communities are mobilised to transform barren and wasteland into fertile soil that produces food sustainably. This has empowered poverty-stricken Filipinos to be self-sustaining farmers and to live with dignity.

IBEKA is a non-profit organisation supporting rural electrification by installing small-scale renewable energy infrastructure (hydro or wind mini grids) and setting up village-based organisations to own and operate the systems. The revenues are channelled into a community fund directed at improving village infrastructure, healthcare and education. This initiative is significant in Indonesia because over a third of the Indonesian population do not have access to grid electricity. Empowering villages to become energy producers enables diversification of economic activities, a by-product of which is increased resilience of livelihood to various shocks.

Soil fertility

The 12th Malaysia Plan (12MP) identifies soil fertility as a health indicator of the ecosystem that must be closely monitored (page 309) and recommends more soil testing be done in collaboration with universities (page 266). The 12MP should have also pinpointed soil fertility as a lever for agriculture productivity and decarbonisation.

The excessive use of fertiliser seriously damages the microbiological ecosystem that is the soil's fertility. It is a vicious cycle that makes the agricultural system

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even more dependent on fertiliser and pesticide, the prices of which have been increasing. What is needed is a biological solution, based on a thorough understanding of the underlying microbiological ecosystem and working to regenerate it.

Science-based composting and other soil fertility-enriching practices will promote (rather than ravage) biodiversity in the soil and on farms, thus increasing agricultural productivity, which impacts food security and farmers' incomes. More than that, these good farming practices will also improve carbon sequestration, water efficiency, national health and reduce farmers' indebtedness and suicides.

SDG18: Life in soil

Despite its dirt-like appearance, soil is a living entity that is the ultimate basis of all human, plant and animal life. We need to preserve the health of the soil in the same way that we nurture the health of life below water (Sustainable Development Goal 14) and life on land (SDG15). Life in soil is largely microbial and should be designated by the UN as SDG18. Malaysia should propose this to promote healthy microbial populations in the soil.

Soil is not only the largest reservoir of microbial diversity on earth, but also the largest terrestrial water reservoir. Soil stores two-thirds of all fresh water, and with water as the medium, soil acts as a bioreactor that circulates the essential elements of living matter, recycles waste and purifies water. Water in the soil functions like blood in the human body.

Planet earth is facing a crisis of soil deterioration as a result of human abuses. Desertification and erosion have diminished the quality of soils' services, for example, producing food to feed the human population and sequestering carbon to regulate global temperature.

Before its restoration, the Loess Plateau in China was a good negative example of interlinkages among ecosystems. About 3,000 years ago, this fertile cradle of Ancient Chinese civilisation — a region about the size of France — had lush forests and running rivers, and fed a quarter of the Chinese population. However, intense pressure on the land over generations caused large-scale land erosion, soil degradation and desertification that condemned local communities to a desperate hand-to-mouth existence. The soil erosion and landslides also led to frequent downstream flooding and sedimentation in the mighty Yellow River. In the dry season, strong winds swept up the wind-blown soil from the Loess Plateau and choked China with dust storms.

In *Achieving Sustainability* (2021), Jim Platts points out that "vibrancy never occurs in only one part of an ecosystem. Either the whole ecosystem is vibrant or vibrancy is not there. 'Vibrancy' — is the flow of life ... what the Chinese would call '*qi*'."

Feeding the soil

Since soil is a living being, it needs to be fed. Microbes in the soil require carbon to build energy for development and nitrogen to build proteins.

Plantation crops continuously absorb soil nutrients to grow. Feeding the soil with chemical fertilisers — nitrogen (N), phosphorus (P) and potassium (K) — does not replenish all the lost nutrients. Soil in intensive agricultural systems loses carbon when plant material is removed from the land during harvest. Carbon starvation can happen to the soil when organic matter is not replenished. After a considerable period, organic matter in the soil breaks down, causing nutrients to be washed away by rain. Then, low soil fertility and low crop productivity set in.

Replenishing the organic matter with compost returns to the soil the nutrients (NPK and micronutrients) and organic material (carbon) taken away with harvest. As the nutrient content and quality of the soil improve, the growth of plant roots underground and crops above ground increases, leading to more carbon absorption from the atmosphere.

Apart from "understanding" soil in a scientific and technical sense (for example, understanding biological nitrogen fixation and microbial transformation of phosphorus, potassium and micronutrients), we need to build an intimate and loving relationship with it, that is, "understand it" in a relational sense (not an abstract academic sense) to get that shared vibrancy. When people who work with the soil and "live" with it, but do not see it as something to have a relationship with — that is, they don't love the soil — then there is a big problem.

Fertiliser production

Composting happens at ambient temperature and atmospheric pressure, thus it is far more efficient than the energy-hungry Haber-Bosch process, which converts hydrogen and nitrogen to ammonia at temperatures of about 500°C and at pressures up to 20 MPa (megapascal).

The Haber-Bosch process consumes about 1% of the world's total energy production and has only 50% energy efficiency. The carbon footprint of ammonia synthesis is accentuated by the use of natural gas to generate the hydrogen needed for making ammonia.

Between 75% and 90% of ammonia produced globally is directed to fertiliser production, which supports nearly half of global food production. Half of the nitrogen from synthetic fertilisers ends up polluting the environment. The Rockefeller Foundation reported that while Americans spent US$1.1 trillion on food (producing, processing, retailing and wholesaling) in 2019, the healthcare costs due to diet-related diseases, environmental pollution, climate change, biodiversity loss and economic costs associated with the food industry were at least three times that.

Mindset change and action

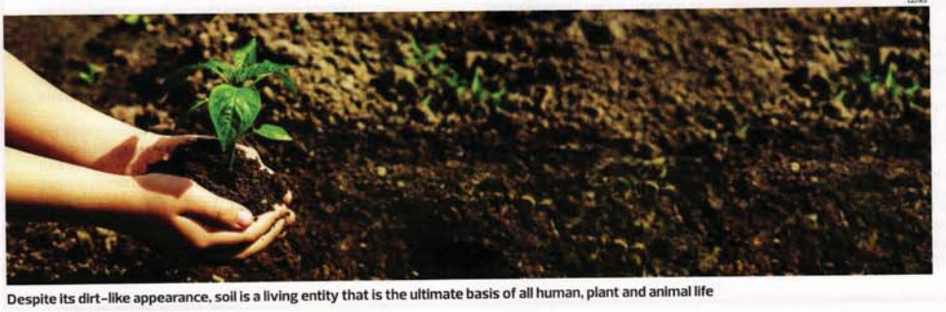
Instead of waiting for nitrogen fertiliser production to decarbonise with the emergence of green ammonia, farmers and policymakers can shift their mindset to treat soil as a living being and feed it appropriately so that the symbiotic relationships between microbes and plants can always be vibrant.

Land improvement, soil conservation, agriculture, agriculture loans and rehabilitation of land are under the state's care. Only with a change in mindset, will policymakers reduce fertiliser subsidies and increase funding to agriculture investments that nurture soil as a productive capital asset and develop good farming practice.

For plantation companies, they cannot transform their relationship with the soil everywhere at once. What they can usefully do is focus on the nurseries growing new seedlings and the planting out of new seedlings, in particular when replanting old plantations. A plantation company's soil fertility action plan will have the following strategic components:

1. Change the mindset and regenerate their attitude towards the soil and their relationship with it.
2. Develop the science and their understanding of the whole soil ecosystem.
3. Rejuvenate the soil and their plantations.
4. Level up their skills and managerial approach as a coherent, integrated strategic policy for the 2020s.

Rehabilitation of soil ecosystems at a massive scale is possible and makes financial sense. Not only will it improve employment, incomes and income resilience for ordinary people, it will also ensure that the diverse functions of soil will be fully available to future generations.



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SUMMARIES

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