Sulphur – an advantaged element® in more sustainable value chains

Sulphur is a naturally occurring element that supports more efficient use of the Earth's resources: It is a critical plant nutrient in agriculture, a key ingredient in sustainable urban development, and an essential input in efforts to slow the loss of productive farm land due to soil degradation. As industries, businesses and non-governmental organizations establish sustainability goals, sulphur—as an "advantaged element"—can deliver numerous benefits in a variety of areas.

Sulphur - An Advantaged Element®

Sulphur (S) is found in the Earth's crust and largely recovered through the refining or processing of oil, natural gas and coal. The process provides ready access to *sulphur — an advantaged element*® that offers solutions to a fundamental question: How can businesses and industries operate more sustainably?

Feeding the world

By 2050, growth in population and calorie consumption will double food demand. To achieve and sustain a level of food production assuring abundance of food to meet this growing population (food security), global agriculture must regularly replenish the soil with a balance of crop nutrients, including sulphur. While many government and non-governmental organizations advocate the application of fertilizers containing the most well-known nutrients—nitrogen (N), phosphorus (P) and potassium (K)—sulphur, which has become less abundant in soils, is also recognized for its importance to plant growth through balanced fertilization. This importance is supported by numerous research studies demonstrating major increases in per-hectare crop production and extremely favorable economic returns through sulphur fertilization for a variety of crops and in many regions around the globe.

Figure 1. Documented percentage crop yield increases from sulphur fertilizer application in India

Crop	Percent Yield Increase
Groundnut/Peanut	32
Mustard	30
Wheat	25
Soybean	25
Sunflower	20
Rice (Paddy)	17

Source: Tandon, HLS and Messick, DL. 2007. Practical Sulphur Guide (revised). The Sulphur Institute, Washington, DC.

In sulphur-deficient soils, judicious sulphur application is both an immediate and extremely cost-effective way to produce more food, feed and fiber, with gains typically realized within one growing season. For example:

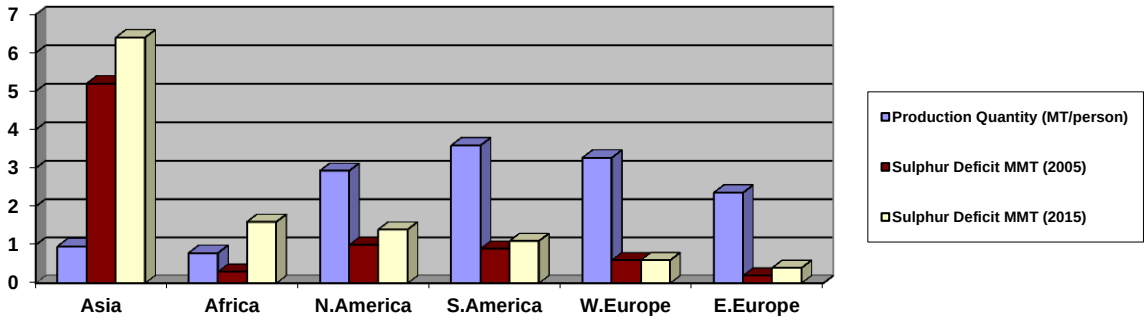
- In West Africa, sulphur fertilization increased per hectare yields of groundnut (peanuts), maize and other crops by 6 to 45 percent in multiple tests.[1]

- In India, where rice is a major food staple for over one billion people, research demonstrates an

- opportunity to increase per capita supply by 20 percent through sulphur fertilization. With India, university research has documented average economic returns for rice farmers at levels of US$37 for every US$1 invested in sulphur fertilizer at only 15 kg S/ha—a rate much less than inputs for nitrogen, phosphorus and potassium.[2]

- In the North American Corn Belt, where grains are grown for food, feed and fuel, university research demonstrated that sulphur fertilizer application increased corn yields by 11 percent per unit area.[3]

- In China, sulphur increased crop yields in 496 out of 570 research trials, with gains ranging from 7 to 30 percent per hectare.[4]



Per capita crop production is lowest in regions with a high sulphur deficit. In these regions, increased use of sulphur in fertilizer stands to increase agricultural production, boosting yields where food supply is a concern.

Rising population and dwindling food stocks demand the adoption of effective fertilizer policy and strategies around the world, including formal recognition by regulators and food security advocates of the benefits of applying sulphur to crops. Commitments from the fertilizer industry and farm advisors are needed to educate and train agricultural workers and to supply sulphur fertilizer where it is needed. The worldwide food industry can also play an essential role by raising sulphur awareness and encouraging balanced fertilization from their upstream supply channels. As developed nations push for higher agricultural productivity, developing nations strive for food independence, and food aid organizations shift from direct food assistance to fertilizer and other agricultural assistance, formal recognition of sulphur as a critical plant nutrient is essential.

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Making urban infrastructure more sustainable

Accelerated development of industrial and urban infrastructure will put greater demands on limited natural resources and drive specification and use of construction materials with lower environmental footprints. In this arena, sulphur-based technologies improve upon two essential building blocks in urban and industrial development: Portland cement and asphalt blacktop. Concrete is the most used synthetic material in the world, equivalent to twice the volume of all other building materials combined.[7] "The manufacture of conventional Portland cement is a very CO_2-intensive process for two reasons. First, CO_2 is removed during the manufacturing process when calcium carbonate (limestone) is converted to lime (CaO). Additional CO_2 is released when fuel is burned to produce the high temperature (1450° C) required for the manufacturing process. These CO_2 sources are avoided through the use of sulphur concrete. Molten sulphur replaces Portland cement as the binder that

"glues" together the other constituents of the final concrete product, which are largely sand and aggregates. The use of molten sulphur concrete also means that no water is required in the manufacture of concrete products."

Concrete binder made with sulphur is an eco-efficient alternative to conventional Portland cement for paving stones, sidewalks and building foundations. Sulphur binder is produced with no water and less heat than Portland cement, resulting in net energy savings, lower emissions of greenhouse gases, and a smaller environmental footprint overall. Sulphur-based concrete performs as well as cement-based concrete in a variety of applications—paving stones, drainage tiles, road barriers, rail tiles and marine defenses. Sulphur-based concrete can outperform conventional cement-based concrete, offering superior resistance to corrosion, improved durability and longer service life.

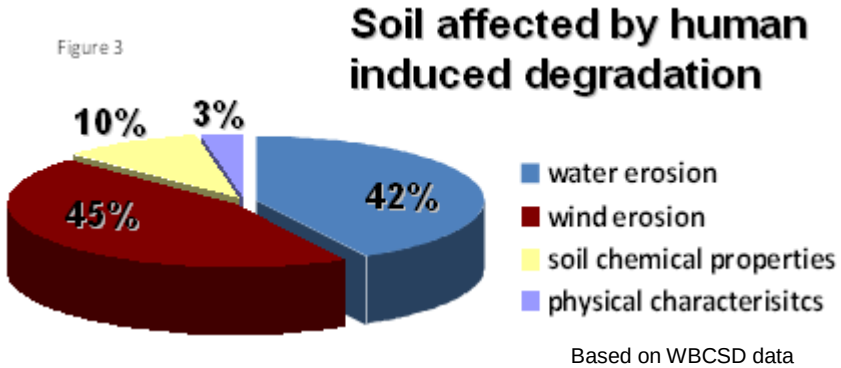
In road construction, sulphur technology can replace up to 30% of asphalt binder, a very energy-intensive input in blacktop roads, thus enhancing availability of this valuable resource for other areas. Sulphur asphalt roads enable the laying of roads at lower temperatures, reducing asphalt energy use and related emissions of CO_2 and of substances known to adversely affect urban air quality. Sulphur-enhanced roadways can also outperform conventional asphalt blacktops—they are less prone to rutting and last longer, reducing energy and funds expended on repairs. These benefits have been documented through extensive testing in the 1970s and are gaining renewed interest as stakeholders strive for more sustainable infrastructure options.

At current levels of resource efficiency, providers of conventional technologies for asphalt and concrete infrastructure will be challenged to supply the volume needed to accommodate projected population growth. To conserve energy, water, and other resources in urban and industrial development, regulators, and government agencies should establish eco-efficiency goals and specify solutions that include sulphur technologies for both concrete and asphalt.

Soil enhancement

Ongoing urbanization, industrialization and the need for more food production are placing increased pressure on the Earth's land mass. Meeting growing global demand for food will require strategies to slow the current rate of soil degradation and the associated loss in crop productivity. Sulphur can help society reclaim a portion of lands affected by soil degradation, a condition that reduces global agriculture's ability to produce an additional 20 million tons of grain each year.[9]

Figure 3



Based on WBCSD data

Areas affected by soil degradation are typically concentrated in arid regions: e.g. the western United States, Brazil, Asia and Africa. Soils in these regions often suffer from excessively high pH. Alkalinity deteriorates soil health and suppresses plant intake of essential elements, impeding plant growth to the point of no—or extremely low—appreciable yield.

Sulphur improves the plant root environment in alkaline, or high pH soils. With a more favorable environment, crop growth, and thus food production, stand to increase significantly. Our earlier discussion focused on sulphur as a plant food. In this case, we are talking about improving the environment for better plant growth.

Loss of land use is a setback that society cannot afford. Growers of high-value vegetable crops in the western United States are successfully amending soil pH and maintaining high crop productivity with the application of sulphur. This is a reclamation strategy that can work in other parts of the world. It should be recognized and adopted by governments, NGOs and other stakeholders in the development and execution of programs to stop the spread of soil degradation and restore land productivity.

For more information on how sulphur can help make business/value chains more sustainable, connect with us:

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Photos:
Time, CARE, TSI