

THE ROLE OF FERTILIZERS IN NUTRITION SECURITY

Three examples of micronutrient fertilization

Billions of people, mostly in developing countries, suffer from micronutrient malnutrition, sometimes referred to as “hidden hunger”. The nutrient deficiencies most commonly associated with human health problems on a global scale are iron, zinc and iodine, but selenium and fluorine deficiencies are also widespread.

Micro-enriched fertilization is considered one of the most promising ways to fight malnutrition in soils, livestock and people. The three case studies below highlight the importance of micronutrient supplementation in Turkey, Finland and China.

Micronutrient deficiencies in crops

Micronutrient deficiencies are widespread. Globally, 50 per cent of cereal soils are deficient in zinc and 30 per cent of cultivated soils are deficient in iron. These are only the most severe deficiencies. Moreover, the steady growth of crop yields in recent decades (particularly as a result of the Green Revolution) have compounded the problem by progressively depleting soil micronutrient pools. This trend will continue unless appropriate steps are taken. In many places the amount of micronutrients supplied to crops is low compared to their uptake. Thus, there is an urgent need to look at micronutrient balances.



© iStockphoto

Micronutrient deficiencies have negative agronomic impacts. They can:

- affect yields, either directly or indirectly;
- lead to less efficient use of other essential plant nutrients;
- trigger nitrogen losses to the environment;
- result in lower water use efficiency;
- weaken the capacity of crops to withstand difficult conditions;
- contain undesirable element (such as cadmium) with higher risks of non-nutritive trace elements being present in edible parts;
- affect crop quality.

Using zinc-containing fertilizer to boost yields and protect public health in Turkey

Zinc is an essential micronutrient required by crops and people. Almost half the world's cereal crops are deficient in zinc. Zinc deficiency is the fifth leading risk factor for disease in the developing world. Research has shown that in regions with zinc-deficient soils there are often poor crop yields, as well as widespread zinc deficiency in humans. This has been the case in the Central Anatolia region of Turkey. In 1993 a research project found that, through zinc fertilization, yields could be increased six- to eight-fold and child nutrition could be improved dramatically.



Zn deficiency in wheat in Turkey

Through a partnership between Çukurova University, the state and the private company TOROS Agri Industry Group, zinc was added to fertilizers. While this product was initially made available at the same cost, the results were so convincing that Turkish farmers significantly increased their use of the zinc-fortified fertilizer (1 per cent zinc) within a few years despite subsequent repricing to reflect the added value of the content.

Today, nearly ten years after the zinc deficiency problem was identified, the total amount of zinc-containing compound fertilizers produced and applied in Turkey has reached a record level of 300,000 tonnes per year. It is estimated that the

economic benefits associated with the application of zinc-containing fertilizers on zinc-deficient soils in Turkey are around US\$ 100 million per year. Zinc deficiency in children has been dramatically reduced.

Such an approach could easily be replicated around the world in the many other zinc-deficient countries. One-third of the world population is at risk of zinc deficiency, which affects physical growth, the functioning of the immune system, reproductive health and neurobehavioural development, among other symptoms. Preventive zinc supplements are important in reducing infant morbidity from diarrhoea and pneumonia. Zinc fertilization is now recognized as a promising strategy to address zinc deficiencies in humans.

Improving Finland's selenium-poor soils with micro-enriched fertilizers

Selenium is one of the micronutrients that is essential to sustain human and animal health. However, selenium deficiency is one of the most common micronutrient deficiencies. Low levels of selenium (Se) are associated with a higher risk of cardiovascular disease and cancer in humans. This micronutrient is mainly provided by plant foods (such as cereals), meat and dairy products. The selenium content of food depends on selenium concentrations in the soils where plants are grown or animals are raised.

Soils in Finland are especially poor in selenium. Selenium deficiency has been shown to be a possible public health risk. The Finnish Ministry of Agriculture and Forestry decided in 1984 to implement selenium supplementation through the use of fertilizers to increase very low concentrations of selenium in the food chain. The National Public Health Institute has monitored blood selenium levels in adults since the 1970s. Before selenium supplementation with fertilizers, the intake of selenium was very low and average blood selenium levels in Finland were among the lowest in the world.

The effects of this approach have been monitored, and the amount of selenium added to fertilizers has been adjusted twice on the basis of research results. In 1990 the programme had been so successful at raising selenium levels in plants and humans that higher applications ceased. **Today, the amount of selenium added to fertilizers is 10 milligrams per kilogram.**

Since selenium supplementation with fertilizers began, selenium levels in foods have clearly risen, consequently raising blood selenium levels. As a result, consumption of selenium is adequate and selenium levels in children and adults are satisfactory.

Finland's experience with selenium fertilization is unique in the world. It demonstrates the safety, effectiveness and cost-efficiency of this practice for raising selenium levels in a population. Such a policy should be replicated in other countries where micronutrient deficiencies in soil are targeted. For example, in New Zealand and some mountainous regions of China the amounts of selenium in soils have also been found to be scarce.

Fighting iodine deficiencies in China through fertilizer and irrigation

Iodine is a micronutrient that is essential to sustain human and animal health. Nevertheless, iodine deficiency is one of the most common micronutrient deficiencies. Iodine deficiencies can cause a wide range of physiological abnormalities (iodine deficiency disorders), mainly related to defective mental development and brain damage.

The iodine content of food depends on that of the soils in which crops are grown. The most common source of iodine in the Western diet is iodized salt. However, in certain countries iodization of salt is inefficient due to infrastructure or cultural problems. Moreover, iodized salt does not address the root cause of iodine deficiencies. Globally it is estimated that 2.2 billion people are at a risk of iodine deficiency. Those at risk are often the poorest populations, living on subsistence agriculture and in an environment that is unable to provide the correct mineral balance.

In Xinjiang Province, northwest China, the soil is particularly poor in iodine with an associated high infant mortality rate. In 1997 the Xinjiang Uiger Autonomous Region Health Bureau, with the support of the Thrasher Foundation, the Joseph P. Kennedy, Jr. Foundation, Kiwanis International and UNICEF, launched an expanded **Iodine Dripping Project (XIDP)**. This project aimed at supplying the irrigation system with iodine using an iodine fertilizer dripping technique called "fertigation". With this technique, iodine from the treated water is absorbed by the soil and progresses through plants and animals that eat the iodine-rich plants. At the top of the food chain, people eat the iodine-rich produce and therefore increase their iodine levels.

This iodine fertilizer dripping project has shown unprecedented results. Not only did iodine levels in women and children rise, **halving infant mortality and improving children's intelligence quotient, but local livestock production also increased by 40 per cent in the first year.** The increase in livestock production contributed to an annual 5 per cent growth in average family income.

The iodine dripping project in Xinjiang has also demonstrated that **a single dripping can provide iodine for at least six years.**



In China's Xinjiang province, women picking up wheat

The promise of micro-enriched fertilization

Micronutrient supplementation through fertilizers in Turkey, Finland and China demonstrates the importance of fertilizers as an effective agricultural tool that can be used to improve the nutritional health of people throughout the world. Micronutrient supplementation through fertilization and fertigation is a means of alleviating malnutrition in some countries, provided there is economic, social and environmental monitoring of impacts.

Economists estimate very high returns on micronutrient deficiency elimination in terms of health, social and economic development. Food biofortification using plant breeding (genetic biofortification) and/or micronutrient fertilizers (agronomic biofortification) can contribute to reaching this goal.

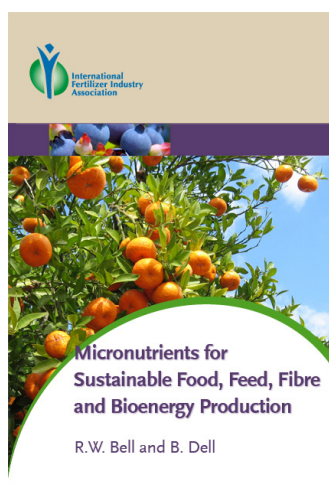
A report by the World Bank and the Asian Development Bank stated that eliminating micronutrient deficiencies could:

- improve GDP by more than 5 per cent;
- enhance the intellectual capacity of populations by more than 10 per cent;
- enhance worker productivity by 30 to 70 per cent;
- reduce maternal deaths by up to 50 per cent.

The contribution of the fertilizer industry

In contrast to food security, nutrition security has traditionally been viewed as the realm of health professionals. Yet the nutrition challenge cannot be solved solely by the health sector: the entire agri-food chain has a vital role to play. Producing more nutritious food and feed, or “farming for health”, should be a central objective. This means increasing micronutrient content. The compelling market development opportunities present a strong business case for the fertilizer industry to make an important contribution to human well-being by offering micronutrient products.

IFA recently launched an initiative aimed at assessing the linkages between fertilizer applications and human health, with the ultimate objective of developing practical fertilizer recommendations that combine crop productivity, environmental protection and human health objectives. IFA also works in close partnership with the HarvestPlus Biofortification Challenge Program.



See also: Bell, R. W. and Dell, B. (2008). Micronutrients for sustainable food, feed, fibre and bioenergy production. International Fertilizer Industry Association (IFA), Paris, France.

To order copies: www.fertilizer.org/ifa/Home-Page/LIBRARY/Our-selection/Fertilizer-use.html

Feeding the Earth represents a series of issue briefs produced by the International Fertilizer Industry Association to provide current information on the role of fertilizers in sustainable agriculture and food production.

International Fertilizer Industry Association (IFA) - 28 rue Marbeuf, 75008 Paris, France

For further information contact: Morgane Danielou, Director Information and Communications Service

Tel: +33 1 53 93 05 00 - Fax: +33 1 53 93 05 45/47 - mdanielou@fertilizer.org - www.fertilizer.org