Hans R. Herren

HOW TO NOURISH THE WORLD

rüffer & rub visionaries

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A world without hunger and misery

My vision of a sustainable food system for the world goes back a long way. I am a farmer's son. My father was estate manager for the Domaine des Barges in Switzerland's Lower Valais that was owned by the Burger und Söhne (Aargau) tobacco dynasty. The 40-hectare farm grew tobacco, potatoes and wheat.

I experienced intensive farming at first hand: it meant spraying highly poisonous insecticide to control the caterpillars of the diurnal and nocturnal moths that feasted on the tobacco leaves. It was the use of fungicides to control imported fungal diseases. They not only destroyed the pests but also eliminated beneficial insects such as bees. When I was growing up I found it quite normal, even though occasionally I also wondered whether so much poison was actually good for humans or the environment. At the time, we knew no different and it seemed as though chemicals were an essential ingredient of modern agriculture.

I spent two winters and a summer as a student at Valais Agricultural College in Châteauneuf learning what farmers needed to know about crops and fruit growing, vineyards and livestock management, i.e. that the use of agrochemicals guaranteed good harvests and a better life.

Having matriculated with a baccalaureate, I embarked in 1969 on an agronomy degree at the Swiss Federal Institute of Technology (ETH) in Zurich, with plant protection as my main subject and plant breeding as my subsidiary. At ETH plant protection almost exclusively, with one exception, meant the

use of chemical methods to control damaging insects, weeds and fungi.

It was the era of the "Green Revolution", the term used to describe the development that started in the 1960s of modern, high-performing and high-yielding crop varieties and their successful spread throughout developing countries. As a young ETH student I was seriously impressed by the higher yields that could be achieved with high-performing varieties and the massive application of agrochemicals. At the same time, however, I started to look critically at this type of agriculture and question it.

My doctoral supervisor, "the one exception", was Vittorio Delucchi, a professor of entomology. He was a pioneer in Switzerland for integrated and biological pest management, promoting the use of natural enemies and agronomic practices rather than synthetic insecticides to control pests. Entomologists had long known that you could control pests if you could find their natural enemies, i.e. the corresponding beneficial insects. However, it seemed too complicated and expensive for the conventional agricultural industry to find these beneficials, breed them in sufficiently large numbers for commercial use and to find a suitable way to release them into the fields—despite the fact that it had been known for a long time that the method worked.

Vittorio Delucchi gave me an introduction to the research group of Robert van den Bosch at the University of California in Berkeley, which at the time was the mecca for entomologists in the field of biological pest control. In 1979, whilst at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria, I had an opportunity to put into practice my knowledge of the biological control of the mealybug—a pest that devastated the cassava crops.[1]

I remained in Africa for 27 years working in the field of biological pest control. This experience and the knowledge I gained made me realize that fundamental changes were needed to agriculture—in fact to the entire global food system.

It is an ambitious aim: a world free from hunger and misery, where everyone enjoys the same right to live in freedom with one another and in harmony with nature. A world where the boundaries of Planet Earth are respected and violence and war are outlawed. Where the needs of future generations are at the very top of the political agenda; natural resources are regenerated and preserved on their behalf. A world where energy supplies are based 100% on renewable energy sources.

In this vision, the food system plays a crucial role.

One in nine people go to bed hungry. According to a report on food security published in 2015 by the FAO, the UN Food and Agricultural Organisation, 795 million people—just under 11% of the global population—are malnourished. Although the figure has fallen by 216 billion since the beginning of the 1990s,[2] it fails by some margin—more than half a billion—to achieve the goal set by the World Food Summit in 1996 to halve the absolute number of people without enough food between 1990 and 2015.

One in seven children under five years of age is underweight. Malnutrition contributes to the deaths of 3.1 million children under five each year—that is more than 45% of all deaths in this age group.[3] Africa, south of the Sahara, is the worst-affected region with 23% of the population currently malnourished; in the Caribbean it is slightly under 20%.[4]

Some two billion people are deficient in vitamins and essential minerals such as iodine and iron, even though they consume enough carbohydrates and protein. This is partly a result of reductions in food diversity; monoculture systems are used to grow essential foodstuffs, which means that certain highly nutritional plants are absent from local diets. Similarly, those living in rich countries are often malnourished because they eat high-calorie processed foods that are low in micronutrients.

Hunger is the greatest risk to global health. However, the reverse is also a problem: a total of 1.4 billion adults in the world are overweight and of these 500 million are obese.[5] Ex-

cess weight is a major cause of diabetes, high blood pressure, strokes and many cancers. In 1980, obesity was already affecting one-quarter of all adults and by 2008, that figure had risen to more than one-third; increasingly it is also affecting developing countries and overall, about 50% of the global population eats too little, too much or the wrong type of food.[6]

For many countries in the global South, hunger is a major obstacle to development. It is also a difficult one to overcome: If people have too little to eat, their productivity remains low and hungry children often miss school. It is also costly to treat the associated diseases. A study conducted in several African countries estimated that the cost of hunger in these countries is between 2% and 16% of Gross National Product.[7]

A food system that puts both too much and too little healthy food on the table cannot be a model for the future. The following sections look in more detail at the various issues and demonstrate why the aim of the World Food Summit—to eradicate hunger—has so far been impossible to achieve.

Waste

At present, farmers produce enough food to feed more than 14 billion people; that is twice current global requirements. Unfortunately, not all food ends up being eaten by consumers. According to a study published in early 2003 by the British Institution of Mechanical Engineers, 30–50% of food intended for human consumption is lost.[8] The main reason for this in developing countries is a lack of storage, processing and transport facilities.

The situation is different in industrialised countries. For example, in Switzerland domestic households account for 45% of the loss.[9] Special offers tempt shoppers to buy more than

they can consume. In addition, expiry dates are calculated in such a way that perfectly good food is often discarded.

Globally, about one-third of all food produced is currently not consumed. This causes not only a serious economic loss (US$ 940 billion per year) but also 8% of all greenhouse gas emissions. A study by Porter, Reay, Higgins and Bomberg from the University of Edinburgh found that the loss and waste of food accounted for 2.2 gigatonnes of CO_2 equivalents each year, which is 323 kg CO_2 per person and three times higher than 50 years ago.

Champions 12.3, a coalition of more than 36 business and government representatives as well as those from civil society, published a report during the process leading up to the agreement on the Sustainable Development Goals (SDGs) in autumn 2015. It provided a progress report on the fight against food waste and loss. Although the international community had made considerable efforts to achieve SDG Target 12.3, the report concluded that they were not enough to rectify current deficiencies in the supply chain, including production, delivery and the end consumer.

The report highlighted three particular benefits of eliminating food loss and waste: better food security, lower costs throughout the entire supply chain and finally better protection for resources and the climate. The report called for stakeholders to agree on concrete reduction targets without delay. Progress must be monitored regularly and there must be no ifs and buts. There are already some examples of good practice: Italy and France have both passed legislation to reduce food waste. Instead of dumping edible foodstuffs, supermarkets are now allowed to donate them. Similarly, the United States has announced plans to halve food waste by 2030.

The concern remains, however, that action on Target 12.3 will be limited to a few countries and will only involve larger companies. In addition, the mechanisms for monitoring progress are still inadequate in many areas. The report identified a lack of professional systems and methods for the systematic recording of data that is capable of identifying problem areas. To sum up: if we are to achieve SDG Target 12.3 by 2030, each and every country, town, company and in particular each and every consumer on Planet Earth must show greater commitment to efforts to fight food waste and loss.[10]

Too much meat

Another form of food waste is the high level of meat consumption. To produce one calorie of food from livestock farming requires between two and seven times as much feed as that needed to produce plant-based calories. Global meat consumption has increased fourfold in the last 50 years[11] and the average global consumption per head per year is now 32 kg[12]. In Switzerland it is 51 kg,[13] in Germany 60 kg[14] and in France 86 kg[15]. Although meat consumption has stagnated and in some cases even declined slightly in industrialised countries, it is rising in emerging nations, sometimes very rapidly.

Meat is increasingly produced on an industrial scale in intensive livestock units. This type of farming requires a much greater use of antibiotics. Livestock farming now accounts for 70% of the global use of antibiotics.[16] Excessive use of antibiotics encourages the development of resistance and it is estimated that some 25,000 people die each year in Europe from infections caused by pathogens resistant to antibiotics.[17]

In order to use resources as efficiently as possible, it makes absolute sense for humans to include some animal products in their diet. About two-thirds of the world's available farmland

is only suitable for grass or pasture.[18] Ruminants eat grass and so are not competing with humans for food; animals also provide manure and some, like hens and pigs, can eat food waste and by-products—a good sow will eat anything.

However, many animals are fed primarily on cereal and other arable crops: animals currently consume about one-third of current global cereal production.[19] In addition, much of the feed used in meat production in industrialised countries is imported; some 35 million hectares of arable land in the EU is "outsourced" in this way.[20] That means that more than one-third of all EU arable land is not available in developing countries for domestic food production.[21]

The driver behind such misguided trends in livestock farming is the economic pressure to produce as much meat as possible and as efficiently as possible. For those of us living in rich industrialised countries, this makes meat ridiculously cheap; it is also now affordable for the growing middle classes in developing countries, but the poor come away empty-handed. They are still unable to afford meat and livestock farming consumes their plant-based food. According to calculations by UNEP, the United Nations Environment Programme, the calories lost in the process to transform plant matter into animal feed would meet the food needs of 3.5 billion people.[22] It should also be noted that cheap meat is in fact expensive, given that the externalities accruing from the intensive, industrial production and the health impact of excess consumption of such meat are being socialised—and carried by all taxpayers.

Too poor to have enough to eat

More than one billion people live in extreme poverty and have to survive on less than US$ 1.25 per day.[23] Poor families in developing countries spend 50–80% of their income on food;[24]

even a small increase in food prices can threaten their very existence.

For example, weather-related crop failures in 2007 and 2008 increased the demand for renewable raw materials and meat and this, combined with speculative trading, triggered an increase in the price of basic foodstuffs. The FAO Food Price Index rose by 52% in one year from July 2007 to July 2008.[25] As a direct consequence, the number of people suffering from malnutrition increased from 70 million to 100 million. It caused hunger riots in some countries, and it even caused the government to fall in Haiti.

Apparent paradox: Food is too cheap

The problem, however, is not that food prices are too high but rather the reverse. Food is too cheap. To explain this apparent paradox, we need a little background.

The maxim adopted by the agriculture industry is to maximise production, minimise product costs and minimise labour costs. This reductionist approach, geared as it is to maximum yields, requires mechanized production and monoculture systems that favour high-yielding crop varieties. It requires vast amounts of mineral fertilisers, pesticides and water. This in turn overexploits non-renewable natural resources.

In terms of production volumes, this approach has been extremely successful. Even though the global population more than doubled between 1961 and 2011, grain production per capita increased by 30% in the same period. This increase in yields was accompanied by a fall in prices.[26] According to the Swiss Federal Office for Statistics, the average household in Switzerland currently spends just 6.4% of its gross income on food and alcohol-free drinks;[27] in Germany it is 10.5%.[28]

The holy mountain is turning green again

MARIMANTI, KENYA

"Life was good here in the past," explains the 82-year old Neftali Kian'a Miru from Marimanti, a village in the hot and arid Tharaka Plain. "We had enough to eat and people respected nature." But in the meantime, a lot more people live in this hot and dry region near the equator and they all need land and wood. The forests have shrunk, and even areas on Ntugi Hill, a holy mountain and place of their ancestors, have been cleared. There has been much less rain in recent years and droughts have increased.

More and more arable farmers have switched to modern hybrid varieties that produce a higher yield. But the seeds are expensive and the farmers cannot produce these hybrid seeds themselves. These new varieties cannot cope with the dry climate in Tharaka and the crops soon wither. In 2009, many families had to rely on food aid and earned nothing from their work in the fields.

Neftali's widowed daughter Sabella had to sell all her cattle in order to feed her three children. Sabella realised that things had to change. She joined a group of farmers who are taking part in an initiative run by the Institute for Culture and Ecology (ICE), a Kenyan NGO and one of Biovision's local partners. ICE is committed to protecting the environment, maintaining traditional cultures and working to improve the lives of rural communities. In particular, it encourages farmers to use a combination of traditional knowledge and modern, organic methods of cultivation. ICE also provides farmers with forgotten local agricultural crops.

ICE advisors train farmers from Marimanti in methods of organic cultivation and show them how erosion can be slowed and how the soil can be improved with compost. And they provide them with seeds and agricultural crops that are resistant to droughts.

Today, Sabella is cultivating five different types of finger millet and eleven species of sorghum. She grows five types of mung beans, eight types of cowpeas and three pea varieties. "Demand for my produce is high and the sale of seeds is also going very well," she says contentedly. Last year, she earned 50,000 Kenyan shillings (about 400 euros) just from seed sales, which was just enough to finance her son's education.

Her farmer group has also started to plant trees. The holy Ntugi Hill is already turning green again.[130]

P. 68 | **Ikwa, a waterfall on Kathita River in Tharaka (Kenya), is a place of their ancestors for the people living there and thus a holy place. Such holy places like Ikwa and the Ntugi Hill are threatened by the increasing demand for firewood and wooden building material. By educating people and with reforesting activities, Sabella Kian'a and her farmer group are engaged in maintaining these natural holy places.**

P. 69 top | **Farmland can be maintained with compost and improved with ecological means. In many projects of Biovision, practical knowledge about composting is disseminated, including in Marimanti (Tharaka, Kenya).**

P. 69 bottom | **Fertile soil is fundamental for the production of food. Worldwide, and especially in Africa, such soils are being lost. The photo shows erosion near Marimanti.**

Push-Pull keeps pests and weeds in check

Maize is a staple food in East Africa and is grown on most small family farms. However, pests such as the stemborer moth and weeds such as *Striga* (witchweed) are widespread. They can cause massive damage to harvests and in some cases wipe them out completely. Most families are unable to afford chemical pesticides and fertilizers; they also have a detrimental effect on biodiversity.

Push-Pull is a biological solution to the problem and was developed by Professor Zeyaur Khan from the International Centre of Insect Physiology and Ecology (*icipe*) in Nairobi. It is based on a mixed-cropping system whereby desmodium, a member of the flowering family *Fabaceae* is grown between maize plants. The smell from the desmodium repels the stemborer moths (the "push" aspect). A further benefit is that desmodium increases the nitrogen content of the soil. As a legume, it has a symbiotic relationship with the root bacteria and so fixes nitrogen. Last but not least, desmodium neutralises weeds in the genus *Striga*.

Napier grass is planted around the edge of the field and attracts the stemborer moth (the "pull" aspect). When the moth larvae end up on the sticky leaves they perish. This method of natural weed and pest control, which was developed by *icipe* in Nairobi, can increase maize yields by up to 300%. In addition, desmodium and napier grass provide nutritious fodder for the cattle; this in turn increases milk production.

At the start of this century, the Push-Pull method was almost unknown. It is now used on more than 120,000 farms in East Africa. It was also expressly cited as an innovative approach for sustainable agriculture in the Agricultural Technology for Development Report submitted to the UN General Assembly in October 2015.[131]