The balance between short-sightedness and utopian thinking

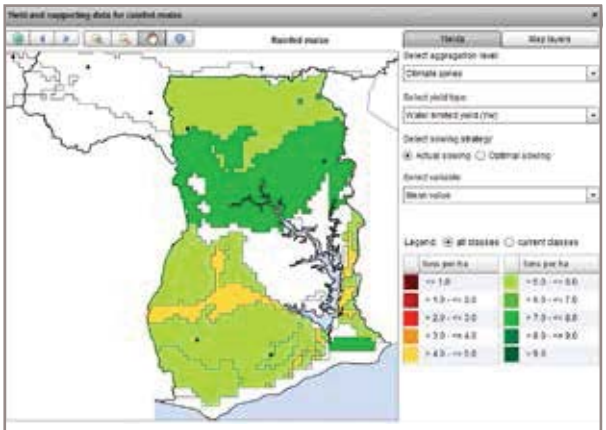
Perhaps the main reason why food provision is so high on the agenda today is that the world allowed itself to be lulled into complacency by the successes of the 1990s. Food prices were falling and, apart from some environmental problems, no clouds seemed to be on the horizon. Confident that we could feed a growing world population, agricultural innovation was neglected – a mistake that has been haunting us ever since.

The fairly dramatic price increases, especially of grain, between 2007 and 2008 were a wake-up call. The cost of food as a proportion of daily expenses had been decreasing for half a century but this might be coming to an end. This is not an acute problem for the Western world, which barely felt the increase in its disposable income. For people with limited purchasing power and an unbalanced diet, however, the price rises came as a hard blow.

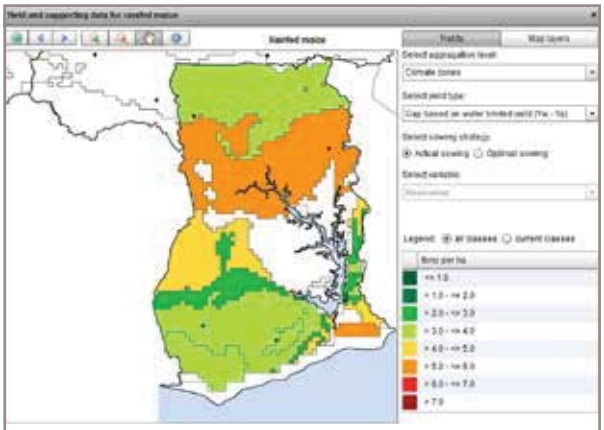
According to Martin van Ittersum, professor of plant production systems, the global agricultural system is undergoing a paradigm shift. Stagnating production growth, a rising world population, increasingly protein-rich diets, the development of biofuels, weather extremes as a possible harbinger of climate change, and market liberalisation are all current issues which require a response from politicians, industry and scientists. To call only for intensification of cultivation and a new green revolution is short-sighted and inadequate for tackling such a nexus of problems.

Based on a scientific perspective, Van Ittersum focuses on the difference between potential and actual farm yield, the so-called yield gap. How can we benefit from the growth potential of a plant? How high a yield is theoretically feasible in a given situation? What are the causes of the yield gap? How do we deal with the finiteness of certain inputs, such as phosphate? And how do we stay within ecological limits in the long term?

The crucial biophysical factors are nutrients, crop protection and the availability of water. In the Netherlands, a proper alignment of these factors since the 1960s has allowed a doubling of yield per hectare. In Asia, too, rice yields have increased substantially. In the Netherlands, new varieties combined with nutrients and crop protection were



The simulated water-limited yields



The yield gap (difference between water-limited and actual yields

behind this success, while, in Asia, it was mostly water and nutrients in combination with the new varieties. Nutrients will be the initial focus in closing the yield gaps in Africa.

Yield gap atlas

Van Ittersum is currently charting production possibilities and local shortcomings in a global yield gap atlas as part of an international programme funded by the Bill and Melinda Gates Foundation, among others. The first studies are already showing major differences: Relatively small yield gaps in the EU and Southeast Asia and large ones in sub-Saharan Africa and Eastern Europe. The studies conducted so far bring practical insights to light. For example, the yield gap in two rice exporting countries – Thailand and Vietnam – was found to be lower than in two other countries – Indonesia and the Philippines – which produce mainly for the domestic market. It was also found that the 'better' farmers had a lower yield gap, while using less fertiliser and labour per kilogram of rice. In two of these countries, such farmers had spent longer in school. Knowledge seems to be an important factor here.

Van Ittersum's research group also looked at the phosphate question, a concern because the mineral is both indispensable and finite. The picture seems less dramatic than many forecasted, however, in part thanks to the 'waste' of the past. The excess phosphate applied in a number of places actually formed a stock in the soil that can be made available in the future. In some places, particularly in Western Europe and parts of Asia, substantial replenishment will occur from the soil over the coming decades. The additional phosphate required may be less than the projected growth of food demand by 60%.

Tailored solutions

There is a general conclusion that Van Ittersum feels he can already draw from the current studies: To tackle the global food problem, solutions will need to be carefully tailored to local conditions. Intensification of agriculture, in the sense of more inputs achieving higher yields, will not be an end in itself. For a sustainably higher and more efficient production in some situations, including in the Netherlands, a more economical and precise use ofinputs may be an answer. In Africa, intensification will still be the solution to the yield gaps, but always in a way that is adapted to the local conditions.

To close yield gaps, technological solutions must go hand in hand with lifting social and economic constraints. This includes rights to land and to land use, critical infrastructure, and links to the world market for food and raw materials. Science can contribute to integrated studies in this field which map the whole range of problems and opportunities: Conversion from plant to animal, collective dietary patterns, or food waste – from post-harvest losses due to poor harvesting techniques and rot during storage, to preventing disposal and damage in the retail sector and by consumers.

In order to expand the opportunities for integrated research into farming systems and yield gaps, more than 150 scientists from around the world have been involved in the interdisciplinary research project SEAMLESS over the past years. This project developed research tools in several fields of science – agronomy, economics, environment, social science and IT – which can be used on different scales – on the level of the field, farm, region, country and world. SEAMLESS has ensured that the scientists can better understand each other in conceptual terms, allowing them to work together on solutions for the short and long term.

Food prices

In his research, Van Ittersum examined the delicate balance between short-sightedness (myopia) and idealised solutions (utopia). The myopic view focuses too much on food prices today: At the end of the last century they were low and lulled us into complacency; now they are high and a lot of new land is being reclaimed as part of a short-term solution to a long-term problem. Ideals such as organic agriculture can also lead to suboptimal solutions. The research programme is looking for forms of agriculture that score well on as many important factors as possible. Local sensitivity to the solutions is integrated in the research. How much of each input in terms of phosphate, crop protection and the like is actually needed? How does organic farming compare to the traditional approach? Can we invent biofuels that provide both a good energy output and profits to small-scale farmers without expanding acreage? These are all tricky questions, where the answer always must be sought at different scales and not lost in generalisations. Van Ittersum always strives to quantify the difference in yield and input use at the system level and illustrates this with both figures and maps.

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