Land Use Management

Despite, or because of, the harsh restrictions that were introduced in response to the coronavirus pandemic in March 2020, we had one reassuring experience: Although everyday items such as toilet paper suddenly found themselves in short supply, food did not. Was, and is, our current agricultural sector – as the basis for our food supply – therefore equipped against pandemics and the resulting emergency situations?

At first glance, this seems to be the case, as obviously there were sufficient stocks, the necessary supplies have been sufficient, and even hoarding has failed to significantly affect the availability and subsequent delivery.

In this respect, the current German (and also European) systems of agricultural production should be viewed in a positive light. Achieving high yields with the use of the natural site conditions is and remains a guarantor for a secure food supply. Existing regional delivery chains supply domestic markets quickly, reliably and with a limited impact on the environment. Fresh vegetables grown in the vicinity of major cities supplement the basic food supply. The extensive or full-scale avoidance of the use of chemical pesticides has increased the quality of the produce.

Despite these positives, however, this assessment must not overlook the obvious weaknesses and disadvantages of our agricultural production systems. Uniformly large fields, reduced crop rotations, a decline in the diversity of biotopes and species with the degradation of the cultivated landscape, high rates of nitrate pollution in the groundwater, mass livestock farming solely according to labor-economic, industrial-looking aspects, as well as the unscrupulous use of off-farm means of production rightly call the sustainability of agricultural production into question. Agriculture must meet economic, social, ecological and cultural requirements, whereby – in crisis situations in particular – food production and the economic viability of farms as enterprises take priority.

From the economic perspective, agriculture requires minimum sizes of farms, fields and livestock in order to reduce unproductive periods of preparation and non-productive time. In both livestock farming and – in particular – arable farming, a trend has emerged for the greatest possible degree of uniformity (homogeneity), which has become even stronger in modern, mechanized agriculture. This homogenization is ultimately inexpedient and even disadvantageous, as it fails to take location- and weather-related variability and, in the case of livestock, individual variability into account. In arable farming, therefore, the only possible solution is “precision farming”, which was developed by the lead author at TUM School of Life Sciences in Weihenstephan, and must become the farming method of the future. The same applies to livestock farming, with the feeding and rearing of individual animals or groups of livestock in the form of “precision livestock farming”. Both methods provide the basis for the effective use of individual capacities and, in arable farming and the use of meadows and pastures, create opportunities to use the land which becomes exempt from agricultural use for other purposes. Mineral fertilization must focus more strongly on site-specific and timely supply of nitrogen fertilizers in particular. The continuous monitoring of crops using aerial photographs from drones and/or satellites allows for small-scale developments to be tracked. In connection with precise knowledge of the location, weather conditions, sensors on the fertilizer unit and refined algorithms, including the use of artificial intelligence, this enables the use of mineral fertilizers which is largely adapted to requirements and loss-free at the same time.

The use of organic fertilizers is far more difficult, where liquid manure with strongly varying active agents and the requirement for emission-free and crop-appropriate application technology pose challenges. In the longer term, it will be inevitable to replace liquid by solid organic fertilizers which are directly fed into the root areas of the plants.

In crop protection, it is necessary for one-sided and purely prophylactic applications of chemical agents to be overcome. Resistance breeding, with its constantly evolving molecular capabilities, can restrict the use of insecticides and fungicides to exceptional situations. The use of herbicides can be almost completely eliminated by mechanical and new physical measures, such as the use of lasers, also in combination with satellite control.

Field robotics is therefore becoming the lead technology in crop protection. This can apply the necessary measures on a strictly limited, prompt and local basis. It also opens up completely new possibilities for sowing and harvesting special crops and is therefore able to greatly reduce the considerable manual seasonal workload.

Land management is **socially-sustainable** when agricultural produce is made available to the consumers on a reliable basis at affordable prices, largely without losses, and at high and consistent quality.

The greatest challenge, therefore, is the prevention of food losses. In particular, it is up to society to drastically reduce the current practice of throwing away around 25–30% of all food that is purchased – using digital options as well. If this were the case, agriculture would not have to produce ever increasing quantities of food, and the land not needed for their production could be used for other socially-beneficial requirements.

A comparably serious problem is that areas with best soils are increasingly being built upon with constructions for commercial and logistics purposes, which could often be built in regions with less fertile soil, where they would also create much-needed jobs. Finally, action must also be taken to prevent that soil as the basis of agricultural production is more and more abused as object of economic speculation. In this context, socially-sustainable land use requires socially-accepted rules for a balance to be achieved between producers, retailers and consumers, as otherwise producers and consumers will lose out.

Ecologically, the requirements outlined above will lead to changes in agricultural structures and forms of cultivation. All agriculture is based on the application of biological and ecological knowledge, but also on the unavoidable interventions into the natural environment and the soil, which must be both mitigated and balanced. In arable farming, the consistent basis for achieving this is multiple crop rotation. With such an approach, the development and spread of specific pests and weeds ▸

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