Food security is more than production volumes and high yields

Taking Biodiversity Focus Areas under production or abandoning lower yielding, more extensive production systems is the wrong approach to mastering the looming global food crisis, our authors maintain.

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The war in Ukraine has brought the debates on food security, land use and yields to a new level. Suddenly, for some, any means seems adequate to increase production to compensate for production drops in Ukraine and export insecurity from there and Russia. The European Biodiversity area targets and the Farm-to-Fork-Strategy with its goals of 25 per cent organic agriculture, 20 per cent less fertiliser inputs and halving pesticide use by 2030 are suggested to be put on hold. Organic agriculture is claimed by some to be problematic, as with its lower yields, it would contribute to increased hunger in the world. This production focus is not new. Increasing yields to assure food security and the potential danger of hunger from extensive production systems have been debated again and again. Similarly, high yields are claimed to improve the environment, while extensive systems with lower yields and higher land demand would result in net environmental losses.

Here, we mull on these issues, bring some results from recent research together and ask whether such focus on yields helps to face the current challenges or does not address symptoms rather than causes.

What are yields?

Crop yields are a central indicator for farmers. Higher yields usually lead to higher revenues and food availability. However, they are not a measure for food security, which requires much more complex concepts. Next to food availability, food security encompasses access, use and utilisation, as well as stability of these over time.

Production and yields of single crops are not even of primary importance from a food availability perspective. More relevant is the quantity of food nutrients, i.e. protein, fat, micronutrients and calories provided by a given area. Wheat produced as animal feed contributes differently to food security than wheat directly consumed as food. Maize lost or wasted, or even used for biofuel, does not contribute to food availability. For duly assessing the contribution to food availability, temporal aggregation is needed to address the total food output from complex crop rotations. Crop and livestock production need to be addressed together to account for the feed use of some crop rotation elements. Spatial aggregation is needed to capture the total food production from a territory, where animals graze and where food and forage is produced.

Use less land and get more from existing cropland

Neglecting these complexities hinders thinking beyond yields and intensification. Some scientists argue that using genetically modified crops in Europe to the extent practised in the US could reduce European agricultural greenhouse gas (GHG) emissions by 7.5 per cent. The assumed yield increases for maize are a key driver behind this. However, what is neglected here is that in almost all European countries, way over 50 per cent, and in many more than 80 per cent, of this maize is used as feed for livestock, producing even more GHG and contributing less to food security than direct food production from croplands.

Neither do high yields just come from anywhere. Fertilisers, plant protection, water and other inputs are needed to grow crops. In intensive systems, these usually stem from external sources. Arguments for high production for food security thus work only if these inputs are available. In the context of the war in Ukraine, this has particular importance, given that Russia is both a central exporter of mineral fertilisers and fossil energy. Furthermore, high yields are not only based on the availability of external inputs, but also on many ecosystem services that in turn are threatened by intensive production systems. This is not to say that yield increases and efficiency should not play a role. But resource use could often be organised more efficiently. For example, too much fertiliser is applied in many high-input systems, and some reduction would often be possible without yield losses. Production factors such as soils could be improved to achieve higher yields with similar inputs and without increased environmental impacts. Then there is the case

of input use being low not because of explicit management decisions for extensive production, embedded in a corresponding agronomic and systemic context, such as for organic agriculture, but because of a lack of financial means to buy more inputs, without adapting other management aspects to this situation.

Suggestions for yield increases usually change production systems in given locations. A complementary strategy focuses on changing locations of given production systems by optimising crop location based on climatic and soil characteristics to realise maximally attainable yields. This has a high potential for improvement. Modelling studies show that with this strategy, cropland use could be reduced by 20 to 30 per cent and agricultural GHG emissions could be cut by 30 to 50 per cent. This is promising but requires flexibility in the most inflexible crop production input, which is croplands with their fixed location. Choosing production systems in given locations to maximise yields fits much better into the current economic and institutional organisation of agriculture than choosing the location for a given production system. For farmers, the location usually is not flexible due to property rights, while the choice of production systems and management is. Nevertheless, knowing the potential for improvement of such a reallocation of cropping activities is important. Given the usually large financial and institutional involvement of governments in agriculture, setting some incentives for such improvements may be investigated in more depth.

Providing room for less intensive production

Efficiency increases and production changes do not utilise the flexibility we gain when adopting such a broader understanding of yields as presented above, focusing on the nutritional value and not on the single crop yield. Thus, consumption changes come into play. First, food that is not eaten because it is lost or wasted along the value chain should ideally never have been produced. Second, reducing feed production, e. g. forage maize, which is in many industrialised countries one of the most important cultures, or barley, maize and other grains that are to a large extent used for feed, can free large cropland areas for direct food production – if consumers with high animal source food consumption are prepared to eat less of these products. Such a reduction could also lead to health benefits for many of these consumers. Model-based assessments of such and related scenarios show that optimising healthy diets for minimal environmental impacts or even sourcing food protein from novel alternative sources rather than classical livestock and crops could reduce cropland use by 80 to 90 per cent without compromising food nutrient supply. These shifts in consumption and corresponding shifts in cropland production lead to a smaller food system in terms of material, nutrient and energy inputs and outputs. This reduces the pressure on agriculture to produce high yields to meet a certain nutritional goal and thus provides the space for more extensive production, with fewer inputs and lower yields. Extensive systems tend to have lower environmental impacts at territorial level and to be associated with the provision of many ecosystem services, including those supporting agricultural production and hence food security in the long term, such as pollination, healthy and fertile soils, or water provision.

Clearly, as relocation of cropland use, such consumption changes require a thorough transformation of the food system, not just some incremental short-term adaptation. It is thus much more difficult for policy-makers and businesses to commit to such a vision than to mere production and yield increases.

Of prices and trade

Food commodity prices and trade are at the centre of the debate on food security. Ukraine is a key exporter of wheat and other bulk commodities. Some countries are heavily dependent on such imports, and the huge price increases could lead to famines. However, short-term activism to increase production elsewhere to compensate for potential losses is not the best answer. Food commodity prices are driven only partly by total production. They correlate strongly with energy prices and also depend on the demand for bioenergy and feed. Also, the reduced storage capacities over the past decades, relying on global markets and economising on expensive storage infrastructure play an important role, as do speculation and psychological aspects of market players.

Obviously, action has to be taken to assure food security for the regions heavily dependent on imports from Ukraine. For this, the debate needs to not only relate to quantities and prices, though. Rather, the interplay between self-sufficiency in commodity production, yields, the allocation of commodities between food, feed and energy and the dependence on food and feed imports and inputs such as fertilisers and energy needs to be critically assessed, ideally within a long-term strategy for food security.

What does this mean for future food production?

It is crucial to ask for which use we produce what, where and how to take action with regard to the big challenges food systems face today, including the immediate crisis. The debate needs to go beyond production quantities and yields, and decisions should be taken based on all potential options and accounting for all crises, including droughts and heatwaves and further climate change impacts. Only then is it possible to develop a diversification strategy that mitigates risks and ensures the resilience of the global and national food systems. For such, we have many options to take action, all with their respective advantages and drawbacks. Intensification and yield increases can reduce land use and environmental impacts per unit of product. But where applied, their aggregate impacts within a local ecosystem context bear the danger of transgressing carrying capacities. Extensive systems such as organic or agro-ecological approaches rather avoid this. Due to the relatively lower yields, though, the impacts from higher land use are curbed only when such is avoided by reducing the size of the whole food system. This necessitates changes on the consumption side and along value chains towards reduced waste and losses and reduced consumption of animal source food, all very challenging to achieve. Optimising production locations for highest yields has big potential to reduce land use without the drawbacks of intensification, but it requires huge interventions in production decisions. The potential benefits of novel food also face reservations, as these are mostly still in a prototype phase and consumer acceptance is often an issue. Finally, there are many aspects we have not even touched on yet. Examples include vertical farms and soilless production or new breeding technologies, the central role of training, knowledge and information requirements and provision, as well as the role of power relations and inequality.

The bottom line is to not be dogmatic. None of the named approaches will solve the problems alone; none may be banned on ideological grounds or pushed naively, and exercising due caution is always warranted. Let us embrace this complexity and wisely build on the rich basis for solutions, with which all these approaches together provide us.

References: **www.rural21.com**