

THE TREASURE IN THE SOIL

MORE SOIL PROTECTION FOR A RESILIENT AGRICULTURE

Arable soils are complex ecosystems consisting of fungi, plants and microorganisms. A holistic approach has given rise to a variety of approaches to protecting water resources. Nature-based solutions in particular have proven to be helpful strategies for climate adaptation.

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Agriculture has always had to adapt to weather and climate. Agricultural practice is therefore always also "risk management". However, the last three years have shown that the scale and speed of change are significantly greater and more unpredictable than in the past. It is becoming particularly important, even existential, for agriculture to develop (or rediscover) adaptation systems that minimise the risks posed by climate change.

Initiatives such as the Global Alliance for Climate-Smart Agriculture (1) focus primarily on an industrial agricultural model and genetic engineering rather than ecological systems. This is understandable, as promoting agroecological methods would harm the business interests of the members, e.g. patenting and fertiliser and pesticide sales. The breeding of drought- or insect-resistant plants using genetic engineering is

touted as the solution. However, drought or insect resistance are characteristics that plants develop through direct interaction with their environment over several generations. This involves a large number of genes, not all of which are yet known, let alone capable of being quickly and precisely modified using genetic engineering.

The Water Efficient Maize for Africa (WEMA) initiative, funded by the Bill & Melinda Gates Foundation and Monsanto, was considered a flagship project of climate-smart agriculture. It was designed to help smallholder farmers adapt to climate change by using drought-tolerant seed varieties. However, it mainly promoted hybrid maize and genetically modified varieties. These high-yield seeds require a lot of agrochemicals and cannot be re-grown. An analysis by the African Centre for Biodiversity pointed out the limited benefits of the new varieties as early as 2015 and warned of dependencies that could threaten the livelihoods of smallholder farmers.





SUCCESS WITH OLD VARIETIES

Finding old varieties can also lead to success without breeding: for example, collecting over 2,000 different rice varieties, the MASIPAG network has twelve varieties that survive when flooded for several days; 18 varieties that cope well with drought; 20 varieties that show tolerance to salt water and 24 that are resistant to certain pests. (1) MASIPAG is a farmer-led network of grassroots organisations, NGOs and scientists that promotes the sustainable use and management of biological diversity. The network is committed to helping farmers gain control over genetic and biological resources, agricultural production and the knowledge associated with it.

(1) Misereor (07.06.2017): MASIPAG success story: How small farmers in the Philippines are regaining control over their seeds. Online: www.kurzelinks.de/gid267-pskb [last accessed: 31.10.23].

Small farmers, such as debt, the loss of their traditional variety of crops and the increasing influence of multinational agricultural corporations in the African seed market. (2)

Manipulating individual genes in plant DNA results in new traits that are significantly less stable than those produced by conventional breeding, where natural selection processes determine how the genetic material reacts to the new combination and the new traits are genetically more broadly anchored. Seeds from heterogeneous, seed-stable varieties are genetically much more diverse than the high-performance varieties currently in use, and the individual plants in the field vary more greatly. This offers great potential for adaptation to changing environmental conditions, such as drought or wetness.

Climate resilience with soil biodiversity and biopores

In order to make agroecosystems climate-resilient, it is particularly important to remedy the long-standing reduction in the water absorption, storage and filtration capacity of intensively farmed soils. According to the Federal Environment Agency, soil water reserves in Germany have declined significantly during the growing season over the last 40 years or so.

Depleted, compacted soils are much less able to compensate for extreme weather conditions than soils with a healthy soil structure. A soil structure that can store water well – i.e. a sponge-like structure – can only be created biologically, through the development of biopores by soil organisms. This cannot be achieved technically. In order to store water efficiently and release it to plants, pores must be of a certain size. Not too small and not too large. To achieve this, you need a good supply of humus and nutrients for soil life. Wide crop rotations, catch crops, undersown crops and high-quality organic fertilisation, e.g. with quality compost, are important.

(4) Mineral fertilisers and pesticides, on the other hand, impair soil life. Organic farming has long offered measures that improve the condition of the soil compared to

can significantly improve conventionally farmed land. Organically farmed soils therefore have an infiltration rate of 137 per cent compared to conventional soils and can therefore store on average twice as much water. (5) This is mainly due to a higher humus content in the soil and higher biological activity. (6) Compared to conventional methods, agroecological techniques also lead to significantly higher carbon stocks. The Swiss Research Institute of Organic Agriculture (FiBL) measured an average of 3.5 tonnes per hectare more carbon in organically farmed soils than in conventionally farmed soils. (7)

Fungi as allies

Since the early 1990s, research into mycorrhizal fungi has been steadily increasing. Since the early 2000s, this form of symbiotic relationship between the fine root system of plants and fungi has also been researched for its effect on soil and plant health in agricultural systems.

Virtually all the improvements promised to us with the help of (new and old) genetic engineering, such as resistance to drought, pollutants and salinisation, as well as diseases and harmful organisms, could already be implemented in agriculture today if we made better use of the symbiosis in which mycorrhizal fungi live with plants. Mycorrhizal colonisation improves plant health by improving nutrient status and, as a result, optimises the ecological performance of the agricultural system. (8) Mycorrhizal fungi not only stabilise soil aggregates and prevent soil erosion, but also, in interaction with other soil organisms, prevent the colonisation of pathogens on the roots, significantly improve the nutrient uptake of plants and ensure improved resistance to water stress. (9)

However, it has long been known that mineral fertilisers and pesticides harm mycorrhizal fungi. (10) The highly efficient interaction between fungi and roots is disrupted, thereby impairing nutrient uptake. This leads to a very one-sided, nitrogen-heavy plant nutrition, which makes the plant susceptible, prompting the (wrong) response of using so-called plant protection products – i.e. biocides – which disrupt the ecosystem and the soil microbiome even more. (11) We would be much better off using nature-based solutions instead of compensating for our mistakes with technology.

Creating sponge landscapes

Droughts and water shortages must be addressed while it is still possible to store the water provided by our freshwater ecosystems for the next drought. There is still much room for improvement in water management to mitigate the effects. The drainage of wetlands, drainage systems in forests, the straightening of rivers and the clearing of the landscape contribute to the fact that water in river basins is not retained as blue and green water. Europe's rivers, lakes and coasts have been altered for centuries by weirs, reinforced banks, dams, diversions and

dredged channels. Development or straightening affects 40 per cent of European surface waters, and 17 per cent are designated as significantly altered or artificial. (12)

Nature-based measures to protect and restore wetlands and rivers to ensure they are healthy and functional are another important key to mitigating the effects of climate change. They can help to store water and increase infiltration into the soil and aquifers. In addition, they can cushion temperature fluctuations and alleviate the associated water stress. In contrast, concrete basins for water storage and extraction are proving to be superfluous, as water is best stored in groundwater, where it arrives filtered and is stored in a cool, dark place.

We need water retention in the landscape and the renaturation of watercourses. Agroforestry systems – the cultivation of trees on arable land – or permaculture – a cultivation method that takes natural cycles as its model to form self-regulating ecosystems – offer great potential here. After j u s t seven years, the agroforestry system tested by the Swiss Agricultural Research Centre AGROSCOPE resulted in a substantial 18 per cent increase in humus compared to the cultivated area – not only in the topsoil, but down to a depth of 60 centimetres.(13) This significantly increased the water retention capacity. The integration of trees and hedges can reduce surface temperature and evaporation, optimising the water retention capacity and thus the system's resistance to extreme weather conditions. Biodiversity and the presence of beneficial organisms increase. This increases resilience to pest pressure and disease. From 2014 to 2017, the AG-FORWARD project aimed to promote agroforestry practices in Europe in order to advance rural development. It involved 100 scientists from 27 institutions in 14 European countries. The results show positive effects of agroforestry in many areas directly and indirectly related to climate protection and climate adaptation.

Water shortages can also be prevented and humus formation promoted by adapting the line of vegetation to the terrain in order to reduce erosion and increase water infiltration. This is called keyline design.(15) When implementing keyline design, landscapes and water flow are analysed on the basis of geomorphology. On this basis, cultivation and planting patterns can be created that can direct both surface and soil water along the terrain contour so that it can be better absorbed, distributed and stored. Other ideas go even further: not only are trees planted, but natural biotopes, hollows and dams are also adapted to the relief in order to slow down water and allow it to seep in.(16)

So it is obvious: ecologically adapted systems can do much more than genetic engineering could ever deliver. Why

their use is so hesitant is solely due to the economic interests of outdated industries that want to continue profiting and politicians who rely more on pseudo-helpful technologies than on legal frameworks for greater sustainability.

Notes and references:

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- (15) Baumfeldwirtschaft (n.d.): Keyline Design: Retaining & directing water in the fields. Online: www.baumfeldwirtschaft.de/keyline-design/.
- (16) SEKEM (17 June 2017): A flourishing oasis in the Egyptian desert. Online: www.kurzelinks.de/gid267-pskp.

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