

Short Communication

The ongoing search for sustainable agriculture

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Agricultural land use has left its traces on the planet since sedentary agriculture started. Most of the ancient cradles of mankind and agriculture, such as the area between the rivers Euphrates and Tigris or the middle east are degraded and deserts today. Yet, it was only after the devastating dust bowls in prairies of the USA and Canada that people started rethinking agricultural practices, in that case the soil tillage. Conservation tillage as erosion reducing practice was developed [1]. But environmental degradation continued. Particularly after World War II, but even more so with the success of the green revolution, agriculture became a major factor in environmental degradation as it tried to replace natural processes with technology [2]. Severe environmental problems from pesticide pollution, eutrophication of waters with nitrates and phosphates, declining biodiversity are only some problems which continue worldwide without real improvement. At the same time yields started to plateau despite increasing input use, in some cases yields even declined. Organic agriculture is seen in this context as a solution as it uses no synthetic inputs. Yet, it has not proven a practical solution for widespread adoption, and it has still a major problem with soil erosion and soil biodiversity as well as the adaptation to climate change.

In the search for sustainable agriculture many “best practices” were promoted. Terms like Eco agriculture, agroecology and more recently regenerative agriculture became fashionable. Yet, in absence of a clear definition, those terms mostly described, like the term “sustainable agriculture” the desired outcome without specifying how exactly that could be reached. Also, most of these approaches focused on the problems of the green revolution assuming that the use of synthetic inputs like pesticides and fertilizers were the core problem. Yet, despite these movements the input use has been increasing and so have the environmental problems.

A different approach took the development of “Conservation Agriculture” (CA), which became popular in the late 1990ies and developed into a worldwide movement in the new millennium. It developed out of the problems of soil erosion, mainly in North and South America, starting with

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conservation tillage and eliminating soil tillage all together into no-tillage systems. In order to make no-tillage systems work over longer times without the need to revert to tillage again, additional elements had to be added, which were finally coined into the three principles of Conservation Agriculture:

1. Minimum or no disturbance of the soil, i.e., no-tillage and no other mechanical soil tillage throughout the cropping cycles.
2. Permanent soil cover with organic materials such as crop residues, mulch or living cover crops.
3. Diversified cropping systems with wide and diverse crop rotations or associations in the case of perennials such as plantation crops.

Those three elements were even quantitatively defined. The system can be complemented using inputs in a way that they do not interfere or interrupt the biological ecosystem functions. The integration of livestock is also a way for diversification with fodder crops; in this sense livestock should only be produced on locally produced fodder as to close the nutrient cycles as much as possible. Also, the integration of trees in the agricultural and pasture areas, for example as hedge rows or windbreaks compatible with mechanized operations are beneficial for the ecosystem as well as for farm economics and completely compatible with CA.

With the first farms starting to practice no-till farming developing later into full Conservation Agriculture in North America in the early 1960s and in South America in the

early 1970s by now there are more than half a century of practical and large-scale experiences available with this system [3,4]. Scientific research to understand the processes in Conservation Agriculture cropping systems and to optimise them was carried out mainly in Canada, Brazil and later also in African and Asian countries, such as South Africa, Zimbabwe, India and China to name some. With the first World Congress on Conservation Agriculture in 2001 in Spain the concept developed into a worldwide movement which is now covering more than 200 million hectares corresponding to 15% of the global cropland, not including perennial and plantation crops. These experiences showed that Conservation Agriculture correctly applied can lead to a truly sustainable agriculture, in a way that it does not leave a permanent footprint in the environment. Each intervention is only done to a point that the environment can recover to its previous stage before the next intervention. Natural resources such as soil and water are not only “less degraded”, but they are enhanced and can recover to their original states. Soil carbon is enhanced, water cycles are recovered, and biodiversity increases below and above the soil surface. The use of synthetic inputs is reduced, not because they are forbidden, but because they are not needed. Natural processes mobilize plant nutrients while losses through leaching and erosion are reduced to a minimum. Crops grow healthier and natural enemies of pests and diseases start reducing pressures as to make the use of pesticides only necessary in very few instances. The same occurs with weeds which are increasingly controlled by crop rotations, soil cover and the absence of soil movement, which would stimulate the soil seed bank [1].

The core element of these processes is the absence of mechanical soil disturbance, allowing particularly larger soil inhabiting flora and fauna to develop and to execute its environmental functions as in a natural environment. Research has shown that the slightest mechanical disturbance of the soil would lead to a degradation which cannot be recovered by natural processes. For example, conservation tillage, though reducing the erosion levels, still leads to soil erosion which is by orders of magnitude higher than the natural soil formation [10]. However, as in nature, the no-tillage must be complemented by the other two elements, the soil cover to provide feed for the soil life and protection of the surface horizons as well as the diversity of crops. With these three elements Conservation Agriculture can be considered a sustainable way of farming, which is readily available, proven in all ecosystems and cropping systems of the world [4] and for which the necessary mechanization technologies are developed and available [3].

Despite this good news Conservation Agriculture is still worldwide mostly unknown and only in very few countries promoted by supportive policies. Particularly in Europe both, politicians and scientists are opposing Conservation Agriculture for reasons which are rationally not understandable. The German federal agricultural research station Von Thünen Institute even published a study stating that despite all previous research ploughing would not decrease, but increase soil organic matter levels [5,6]. Other scientists published papers stating that Conservation Agriculture does not produce the alleged results by analysing metanalysis of different cropping systems which they lumped together under the term Conservation Agriculture without considering the definition of CA [7,8]. These stand against an increasing number of papers and experiences of practitioners proving the benefits of CA [9]. The reasoning can only be guessed. It could be the misbelief that sustainable agriculture, which seemed to be unachievable, is possible and the search for it could be over. Or simply the influence of commercial lobbies, such as agricultural machinery and in particular tractor manufacturers as well as the producers of agrochemicals is keeping politicians from supporting CA.

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