Summary

Economical and ecological motives cause farmers to increasingly reduce the intensity of cultivation. Doing without the plough is one aspect and the first measure to be taken towards conservation farming and which involves another fundamental aspect; cultivating at an optimum depth. Farmers often determine the proper work depth by judging from the degree of compaction or cohesiveness of the soil, which is down to the extent air and water can circulate. Any research that is undertaken in this context centres on finding the right work depth that offers the best potential for achieving highest yield in a given field by promoting nearly full emergence and unconstrained growth of roots and shoots.

In blanket cultivation, farmers determine the proper work depth by using a number of parameters, the median form of which is obtained by estimate and experience. However, this method is not very effective when applied to large fields with varying soil conditions. This is the situation where localised farming becomes important. In localised farming a field plot is not defined by the borders of the field but by the varying soil conditions within the same field. After conducting extensive surveys on work depth variation relative to the degree of compaction or cohesiveness of the soil there is evidence that work depth variation has a positive effect on profitability, because it leads to a reduction in tractive power required and fuel consumption as well as to an increase in work rates.
Another aspect is erosion, although this poses different requirements on work depth variation. These are influenced by topography, the amount of crop residue left on the surface and soil structure. Therefore, an approach was developed to prevent erosion relative to the degree of slope and amount of crop residues left in a given plot. This method aims at controlling work depth by an algorithm so that a defined amount of organic material is left on the surface of the field. This way, it is possible to give areas susceptible to erosion special treatment and adapt the work depth accordingly to ensure sustained farming. As the differences in yield potential of any given field inevitably lead to variations in the amount of crop residues, the work conceptualizes and evaluates two methodologies to determine the amount of such residues. To do that, we modified one active and one passive implement in such a way that it was possible to control the depth of the work via an electronic spool valve.
In-field testing took place at three different sites in Germany for a period of three years. These tests provided the database for the evaluation of the effect of variable work depths on agronomic parameters. We defined a depth range as well as depth variants for each individual test to take weather and soil conditions into account, which have an inevitable effect on cultivation.

The tests revealed that germination decreased in particular in those plots where cultivation had been shallow and where larger amounts of straw had been left in the seedbed area. However, reduced germination had no impact on the eventual yield, a phenomenon that is explained by the ability of cereal crop to compensate. While work depth had only a marginal effect on the tillering height of the individual plants it did have a significant effect on yield levels at two test sites. The extensive in-field tests give evidence that there is no immediate correlation between yield levels and cultivation depth, yet at the same time they show that a combination of work depth and weather conditions does have a major effect on yield levels. As a result, shallow cultivation involves a significant risk with respect to sustained yields.

In summary, site-specific cultivation offers new and hitherto unexploited options to protect the resources of the land while optimizing costs and yields. It is in particular the combination of localized cultivation and planting techniques that holds an extensive potential in an overall setting of changing weather conditions.