What is Conservation Agriculture?

Conventional "arable" agriculture is normally based on soil tillage as the main operation. The most widely known tool for this operation is the plough, which has become a symbol of agriculture. Soil tillage has in the past been associated with increased fertility, which originated from the mineralization of soil nutrients as a consequence of soil tillage. This process leads in the long term to a reduction of soil organic matter. Soil organic matter is not only providing nutrients, but also is, more than anything else, a crucial element for the stabilization of soil structure. Therefore most soils degrade under long lasting intensive arable agriculture. This structural degradation of the soils results in the formation of crusts and compactions and leads in the end to soil erosion. The process is dramatic under tropical climatic situations but can be noticed all over the world. Mechanization of soil tillage, allowing higher working depths and speeds and the use of certain implements like ploughs, disk harrows and rotary cultivators have particularly detrimental effects on soil structure.

Soil erosion resulting from soil tillage has forced to look for alternatives and to reverse the process of soil degradation. The natural approach to this is to reduce tillage. This led finally to movements promoting conservation- or even zero-tillage, particularly in southern Brazil, in North America, in New Zealand and Australia. Over the last two decades the technologies were perfected and adapted for nearly all farm sizes, soil and crop types and climatic zones and experience was gained with this new approach to agriculture. FAO supported this process for a very long time.

Experience has shown that these techniques, summarized as conservation tillage methods, are much more than just reducing the mechanical tillage. In a soil that is not tilled for many years, the crop residues remain on the soil surface and produce a layer of mulch. This layer protects the soil from the physical impact of rain and wind but it also stabilizes the soil moisture and temperature in the surface layers. Thus this zone becomes a habitat for a number of organisms, from larger insects down to soil borne fungi and bacteria. Those organisms macerate the mulch, incorporate and mix it with the soil and decompose it so that it becomes humus and contributes to the physical stabilization of the soil structure. At the same time this soil organic matter provides a buffer function for water and nutrients. Larger components of the soil fauna, such as earthworms, provide a soil structuring effect producing very stable soil aggregates as well as uninterrupted macropores leading from the soil surface straight to the subsoil and allowing fast water infiltration in case of heavy rain events. This process carried out by the edaphon, the living component of a soil, can be called **"biological tillage"**. However, biological tillage is not compatible with mechanical tillage and with increased mechanical tillage the biological soil structuring processes will disappear. Certain operations such as mouldboard or disc ploughing have a stronger impact on soil life than others as for example chisel ploughs. Most tillage operations are, however, targeted at a loosening of the soil which inevitably increases the oxygen content in the soil leading to mineralization and thus to a reduction of the soil organic matter which is, at the same time substrate for soil life.

Thus agriculture with reduced mechanical tillage is only possible when soil organizms are taking over the task of tilling the soil. This, however, leads to other implications regarding the use of chemical farm inputs. Synthetic pesticides and mineral fertilizer have to be used in a way that does not harm soil life.

As the main objective of agriculture is the production of crops changes in the pest and weed management become necessary. Burning of plant residues and ploughing of the soil is mainly considered necessary for phytosanitary reasons controlling pests, diseases and weeds. In a system with reduced mechanical tillage basing on mulch cover and biological tillage alternatives have to be developed to control pests and weeds. Integrated Pest Management becomes mandatory. One important element to achieve this is crop rotation, interrupting the infection chain between subsequent crops and making full use of the physical and chemical interactions between different plant species. Synthetic chemical pesticides, particularly herbicides, are in the first years inevitable but have to be used with very much care to reduce the negative impacts on soil life. To the extent that a new balance between the organisms of the farm-ecosystem, pests and beneficial organisms, crops and weeds, becomes established and the farmer learns to manage the cropping system, the use of synthetic pesticides and mineral fertilizer tends to decline to a level below the original "conventional" farming.

Therefore, although the entry point for the system is a reduction of mechanical soil tillage and thus a task for mechanization, it can only work if all agronomic factors are equally well managed. As a

consequence the Latin American Network for Conservation Tillage, RELACO, which was founded with the assistance of FAO 10 years ago, changed in its last meeting its name into Latin American Network for Conservation Agriculture.

Conservation Agriculture, understood in this way, provides a number of advantages on global, regional, local and farm level:

- It provides a truly sustainable production system, not only conserving but also enhancing the natural resources and increasing the variety of soilbiota, fauna and flora (including wild life) in agricultural production systems without sacrificing yields on high production levels.
- No till fields act as a sink for CO2 and conservation farming applied on a global scale could provide a major contribution to control air pollution in general and the global warming in special. Farmers applying this technique could eventually qualify for CO2 bonus points.
- Soil tillage is among all farming operations the single most energy consuming and thus, in mechanized agriculture, air-polluting operation. By not tilling the soil, farmers can save between 30 and 40% of time, labour and, in mechanized agriculture, fossil fuels as compared to conventional cropping. This accounts respectively for the air polluting gases.
- Soils under conservation agriculture have very high water infiltration capacities reducing surface runoff and thus soil erosion significantly. This improves the quality of surface water reducing pollution from soil erosion, and enhances groundwater resources. In many areas it has been observed after some years of conservation farming that natural springs that had disappeared long time ago started to flow again. The potential effect of a massive adoption of conservation farming on global water balances is not yet fully recognized.
- The system depends on biological processes to work and thus it enhances the biodiversity in an agricultural production system on a micro- as well as macro level including flora and fauna.
- Conservation agriculture is by no means a low output agriculture and allows yields comparable with modern intensive agriculture but in a sustainable way. Yields tend to increase over the years with yield variations decreasing.
- For the farmer, conservation farming is mostly attractive because it allows a reduction of the production costs, reduction of time and labour, particularly in peak times like planting and it reduces in mechanized systems the costs for investment and maintenance of machinery in the long term.

Disadvantages in the short term might be initially high costs of specialized planting equipment and the completely new dynamics of a conservation farming systems, requiring high management skills and a learning process by the farmer. Long term experience with conservation farming all over the world has shown that conservation farming does not present more or less but different problems to a farmer, none of them not to be resolvable. Particularly in Brazil the area under conservation farming is now growing exponentially and is in Brazil reaching the 10 Mill. ha mark. Also in North America the concept is widely adopted.

A programme on Conservation Agriculture was jointly carried out between AGSE and AGLS starting end of 1996 promoting the concept of a conservation agriculture based on reduced mechanical soil tillage, soil cover and crop rotations.