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Global agriculture faces major challenges. In large areas, soil erosion and the loss of fertility progressively reduce crop yields and can lead to land being abandoned and turning to desert. Households, industries, and growing urban areas compete with agriculture for increasingly scarce water supplies. Rising fuel and fertilizer prices hike up production costs.

Conservation agriculture (CA) provides sustainable ways to address these and other challenges. CA crop management systems are based on three principles: (1) minimum soil movement (for example, no soil inversion by tillage), (2) a soil surface cover of crop residues and/or living plants, and (3) use of crop rotations to avoid build-ups of pests and diseases.

The principles of CA appear to have wide adaptation, and CA systems are used for numerous crops in diverse soil types and environments. Nevertheless, the techniques to apply the principles depend heavily on local conditions: climate, soil characteristics, and farmer's circumstances such as wealth, land size, the availability of labor or a tractor, to name several factors. Expected benefits from CA include:

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- Higher, more stable crop yields.
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Research and extension

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Basic research: Results of long-term trials

As of 1990, CIMMYT conducts long-term sustainability trials comparing conservation agriculture and conventional practices at three experiment stations in Mexico (Figure 2): the Central Highlands (El Batán, 19°N, 2,240 meters above sea level, and Toluca, 19°N, 2,640 m, both in the state of Mexico) for mixed, rainfed systems; and Ciudad Obregón (27°N, 39 m), state of Sonora, in northwestern Mexico, for irrigated wheat-based systems.

With the same crop variety, fertilizer application, and weed control, different agroecosystem management can lead to enormous differences in the performance of wheat and maize crops, under rainfed conditions. Surface retention vs removal of crop residues is the key factor: conservation agriculture practices result in high and stable yields, compared with the conventional practices of heavy tillage and removal of crop residues; with zero-tillage, removing all residues eventually causes the system to collapse (Figures 3-4).

Conservation agriculture is a viable option for large-scale, irrigated farming. Long-term trials in northwestern Mexico showed no significant differences in wheat yields during the first five years (10 crop cycles), among practices (Figure 5). However, from the sixth year on, the use of permanent beds + the burning of all residues at the beginning of each crop cycle caused a dramatic drop-off in yields. The application of irrigation seems to eliminate or postpone yield losses from soil degradation, as a result of burning residues. The improvement of sodium levels observed in permanent beds with residue retention is of great relevance for saline areas with irrigated agriculture.
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Figure 6. The effect of tillage and residue management on farmer income (MEXN$), CIMMYT long-term sustainability trial, Ciudad Obregón, Mexico.

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