

Global achievements in soil and water conservation: The case of Conservation Agriculture

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Abstract

In response to the dust bowls of the mid-thirties in the USA, soil and water conservation programmes involving reduced tillage were promoted to control land degradation, particularly soil erosion. The farming and land management practices that were considered to adequately address soil and water conservation objectives were based on no-till seeding and maintenance of soil mulch cover. This collection of practices led to what became known as conservation tillage, although no-till systems by definition avoid soil disturbance by no-till direct seeding, and maintain an organic mulch cover on the soil surface.

This article is an overview of achievements in soil and water conservation on agricultural lands through the experience derived from the adoption and spread of Conservation Agriculture (CA) world-wide. CA is an agro-ecological approach to sustainable production intensification. It involves the application of three inter-linked principles that underpin agricultural production systems based on locally formulated practices: (i) permanent no or minimum mechanical soil disturbance, which in practice entails direct seeding through mulch into no-till soils; (ii) maintenance of soil cover with crop residues and green manure crops, particularly legumes; and (iii) diversified cropping system involving annuals and perennial in rotations, sequences and associations.

In 2011, CA had spread over 125 million hectares (9% of the global cropped land) across all continents and most agro-ecologies, including small and large farms. In addition, there is a significant area of CA orchards in the Mediterranean countries. CA is now considered to be a practical agro-ecological approach to achieving sustainable agriculture intensification. It offers environmental, economic and social advantages that are not fully possible with tillage-based production systems, as well as improved productivity and resilience, and improved ecosystem services while minimizing the excessive use of agrochemicals, energy and heavy machinery. While there are challenges to the adoption of CA, there is also increasing interest from producers, the civil society, donors and private sector institutions to further promote and service the uptake and spread of CA globally.

Key Words: No-till, Soil erosion, Agro-ecological, Ecosystem services, Save and grow

1 Introduction

Reducing soil disturbance by tillage in agricultural land began in the Great Plains in the USA in the 1930s in response to the devastation caused by prolonged drought (Derpsch, 2004). This period became known as the “dust bowls”. Initial research on ‘conservation’ or reduced tillage involved early versions of a chisel plough, by which plant residues could be retained on the soil surface to alleviate wind and water erosion (Duley and Fenster, 1954; Mannering, 1979). Stubble mulch farming was also developed (Fenster, 1960), and this became a forerunner of no-tillage farming. This collection of practices led to what became known as conservation tillage, although no-till systems by definition avoid soil disturbance by no-till seed drilling, and maintain an organic mulch cover on the soil surface (King and Holcomb, 1985; Kassam et al., 2009).

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The book, *Ploughman's Folly* by Edward Faulkner (1943), an extension agronomist in Ohio, was an important milestone in the development of conservation agricultural practices. Faulkner questioned the wisdom of inversion ploughing and explained the destructive nature of soil tillage. He stated: "None has ever advanced a scientific reason for plowing". Further research in the UK, USA and elsewhere during the late-1940s and 1950s made no-tillage farming possible. The practice began to spread in the USA in the 1960s, and in Brazil, Argentina and Paraguay in the 1970s, with farmers such as Herbert Bartz, Manoel Henrique (Nono) Pereira, Frank Dijkstra and John Landers in Brazil, Heri Rosso, Rogelio Fogante Victor Trucco and Mario Gilardoni in Argentina, Carlos Croveto in Chile and Akinobu Fukami in Paraguay championing the transformation of tillage farming into no-till farming systems. In Brazil, no-till research was pioneered in Londrina in 1971 with initiatives from Rolf Derpsch on plots often visited by Herbert Bartz; in 1972 Rolf Derpsch sent his no-till wheat seeder to Herbert Bartz's farm "Rhenania" at Rolandia, Paraná (30 km from Londrina), to seed a demonstration plot of half hectare of wheat after soybean.

In the USA in 1973, Shirley Phillips and Harry Young published the book *No-tillage Farming* (Phillips and Young, 1973), the first of its kind in the world. This was followed in 1984 by the book *No-Tillage Agriculture: Principles and Practices* by E. R. Phillips and S. H. Phillips (Phillips and Phillips, 1984). In Southern Rhodesia (now Zimbabwe), Tom Borland, a weed control specialist, published an article in 1974 in the *Rhodesian Agriculture Today: Which way weed control and tillage ?* (Borland, 1974), after a study tour to the USA where he met with most of the no-till pioneers including Harry Young. He also published a series of articles on no-till in *The Rhodesian Farmer* magazine over the period from 1976 to 1979, and were later reprinted in *South African Farmer's Weekly* (Borland, 1980). This was followed in 1984 by Brian Oldreive in Zimbabwe designing an approach called Farming God's Way (subsequently called Foundation for Farming) comprising no-till, mulch cover and rotation (Oldreive, 2006). In West Africa, research on no-till farming was started in 1970 at the International Institute for Tropical Agriculture (IITA), Nigeria, and a series of articles and bulletins on mulch farming techniques and no-till farming were published in the 1970s and 1980s (e. g., Lal, 1973, 1974a, 1974b, 1975, 1976a, 1976b, 1983).

In addition to these pioneers, there have been many other innovators in no-till farming since the early seventies who have made tremendous contributions to its growth and popularity. To mark the 40th Anniversary of the publishing of *No-Till Farmer*, its editor Frank Lessiter published a list of "40 Legends of The Past from North America" (Lessiter, 2011). Elsewhere, other no-till farming champions⁴ have included: John Baker in New Zealand, Terry Wiles, David Sharp, Ivo Mello and Ademir Calegari in Brazil, Gino Minucci, Mario Nardone, Jose Araya, Roberto Peiretti, Hugo Ghio, Jorge Romagnoli, Horacio Aguero and Luis Giraud in Argentina, Bill Crabtree, Steven Powles and Allen Postlethwaite in Australia, and Wolfgang Sturny in Switzerland.

The modern concept of no-till farming—now generally known as Conservation Agriculture (CA) — involves the simultaneous application of three inter-linked principles based on locally formulated practices (Friedrich et al., 2009; Kassam et al., 2009, 2011a): (i) permanently minimising or avoiding mechanical soil disturbance (no-till seeding); (ii) maintaining a continuous soil cover of organic mulch with plants (crop residue, stubble and green manure/cover crops including legumes); and (iii) growing diverse plant species in the cropping systems that, in different rainfed and irrigated farming systems (e. g. arable, horticulture, agro-forestry, crop-livestock, plantation, mixed systems with root and tuber crops and groundnuts, rice-based systems), can include annual and perennial crops, trees, shrubs and pastures in associations, sequences or rotations, all contributing to enhancing soil quality and system resilience.

CA, in conjunction with good crop, nutrient, weed and water management, is at the heart of FAO's new sustainable agricultural intensification strategy (FAO, 2011) which takes an ecosystems approach to enhance productivity and resilience as well as the flow of ecosystem services while reducing emissions that come from the agriculture sector (Kassam et al., 2011a). These characteristics are also an integral part of climate-smart agriculture that seeks to increase productivity in an environmentally and socially sustainable way, strengthen farmers' resilience to climate change, and reduce GHG emissions and sequester carbon (World Bank, 2012). At the heart of sustainable agricultural intensification, or sustainable land management, is the integration of soil and water conservation practices in agricultural production, with concurrent objectives of enhanced economic returns and environmental management.

This paper is an elaboration of the achievements in soil and water conservation as reflected by the uptake and spread of the practice of CA.

⁴ There have been many champions of no-till farming in different parts of the world. Our aim is not to offer a comprehensive list but to mention some names of "early" pioneers.

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