

Conventional and Conservation Agricultural Systems

A. R. Sharma

ICAR - Directorate of Weed Research, Jabalpur, Madhya Pradesh, India

Correspondence to

**E-mail:* sharma.ar@rediffmail.com

Introduction

Adoption of green revolution technologies during 1960s led to increased productivity and elimination of acute foodgrain shortages in India. These technologies primarily involved growing of high-yielding dwarf varieties of rice and wheat, increased use of chemical fertilizers and other agrochemicals, and spread of irrigation facilities. This was also accompanied by the other so called modern methods of cultivation, which included maximum tilling of land, virtually clean cultivation with complete removal of crop residues and other biomass from the field, fixed crop rotations mostly involving cereals, and elimination of fertility-restoring pulses and oilseed crops in the high productive north-western plain zone of the country.

Conventional Agriculture Systems

Over the last 4 decades of adoption of these technologies, there have been emerging concerns about the natural resource degradation. It is realized that soils are getting impoverished due to imbalanced use of fertilizers, discontinuation of traditional practices like mulching, intercropping and inclusion of legumes in cropping systems. Further, the use of organic manures, compost and growing of green manure crops has also decreased considerably due to various reasons. Similarly, water resources are under great stress due to their indiscriminate exploitation and also getting polluted due to various human interferences. Burning of fossil fuels, crop residues, excessive tillage including puddling for rice cultivation are leading to emission of greenhouse gases, which are responsible for climate change and global warming. Further, there is now a growing realization that the productivity levels are stagnating and the incomes of the farmers are reducing due to the rising cost of the inputs and farm operations. It is feared that modern cultivation practices are not sustainable in the long-run, and

there is a need to change the way we do crop production in arable lands.

Historical Perspective

Jethro Tull (1671-1741), who is regarded as 'Father of Tillage' carried out numerous experiments dealing with cultural practices. He believed that soil should be finely pulverized to provide proper pebulum for the growing plant. He propounded a theory that 'Soil particulars are ingested through openings in plant roots due to the processes caused by the swelling of growing roots'. Dust Bowl era between 1931 and 1939 exposed the vulnerability of plough-based agriculture, as wind blew away precious top soil from the drought-ravaged southern plains of US, leaving behind failed crops and farms. It was realized that tillage is the root cause of agricultural land degradation – one of the most serious environmental problems worldwide – which poses a threat to poor production and rural livelihoods, particularly in poor and densely populated areas of developing countries.

In the early 1940s, Edward H. Faulkner (1886-1964) wrote a book 'Plowman's folly', which the *Nature* magazine termed "an agricultural bombshell" when he blamed the then universally used mouldboard plough for disastrous tillage of the soil. He questioned the use of plough for cultivation of crops, and showed that all standard wisdom used as a rationale for ploughing and working the soil was invalid. His ideas were considered 'mad' and without merit, until after his death when soil experts and scientists began to admit 'We didn't pay attention, and we should have.'

Masanobu Fukuoka (1913-2008) worked for more than 65 years at his farm in Japan and developed a system of natural farming. He did not plow his fields, used no agricultural chemicals or prepared fertilizers, did not flood his rice fields

as farmers have done in Asia for centuries, and yet his yields equaled or surpassed the most productive farms in Japan. His book ‘The One Straw Revolution’ contains the spiritual memoir of a man whose innovative system of cultivating the earth reflects a deep faith in the wholeness and balance of the natural world. In recent times (2007), Prof. David R. Montgomery wrote the award winning book ‘Dirt – The Erosion of Civilization’, which shows that with any form of tillage including the non-inversion tillage, the rate of soil degradation and soil erosion is greater than the rate of soil formation. According to his research, tillage has caused the destruction of agricultural base and of its productive capacity nearly everywhere, and continues to do so.

Conservation Agriculture

The concept of conservation agriculture has been developed to reverse the process of land degradation and ensure sustainable crop production. This involves (i) minimizing soil disturbance – no tillage and minimum traffic for agricultural operations, (ii) maximizing soil cover–leave and manage crop residues on soil surface; and (iii) stimulating biological activity through suitable crop rotations including use of cover crops, and green manures. Further, this requires a systems approach, i.e. efficient seeding machinery, nutrient, water, weed and pest management. This technology has been adopted globally on more than 125 M ha in about 50 countries, largely in rainfed areas. The major countries are; USA, Australia, Canada, Argentina, Brazil, Paraguay, Uruguay and New Zealand.

In India, this realization started in early 1990s when some experiments were initiated on zero-till wheat in north-western India, primarily through the efforts of IRRI, CIMMYT and NATP. There was good success obtained in many states, and the area under zero-till wheat reached up to 3 M ha by the beginning of current century. However, the acreage have stagnated now and some farmers have even switched back to minimum or conventional systems because of some practical constraints and lack of technical know-how. Harvesting of major crops like rice and wheat started with combines and the residue management has become a major issue in many states including central India. Burning of residues *in situ* is rampant despite restrictions imposed and incentives offered by the governments. This is the most unhealthy practice as

it leads to loss of precious plant nutrients and environmental problems. In recent years, there have been some major developments, which have led to a change in our approach for promotion of conservation agriculture. New generation farm machinery has become available which can place the seed and fertilizer at an appropriate depth in the desired amounts. Further, these machines can work in standing as well as loose crop residues; thus, providing a very effective mulch cover for moisture and nutrient conservation, temperature moderation and weed control. Availability of new herbicide molecules has further necessitated a change in our thinking about weed management. Further, other triggering factors for shift towards conservation agriculture are labour scarcity, deteriorating soil health, declining factor productivity, rising cost and low income. Thus, conservation agriculture systems help in overcoming the problems being experienced in conventional farming systems.

Major Initiatives

Indian Council of Agricultural Research has launched a Consortia Research Platform on Conservation Agriculture in the XII Plan, which is a major step for developing, capacity building and adoption of these resource conserving technologies. Directorate of Weed Research at Jabalpur has also taken lead in developing and promoting conservation agriculture - based technologies in diversified cropping systems in the black soil region of Central India. Besides converting our own research farm with conservation agriculture - based technologies, we have also taken up the task of disseminating these technologies on the farmers’ fields on a large scale. Needless to say that the technology is spreading like wild fire for growing wheat and chickpea in the winter season, and greengram in the summer season. The farmers after having some initial apprehensions are fully convinced with these technologies. There is a growing demand for suitable farm machinery like happy seeder, which can do sowing, place fertilizer and also work under residue conditions. Undoubtedly, this technology has the potential for revolutionizing wheat cultivation in Central India, for which, greater collaborative efforts are needed by different institutions, state departments, and other agencies concerned with agricultural development.