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Conservation Agriculture newsletter

Getting Agriculture to Work for People and the Environment

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, seminar highlights need for soil security for sustainable agriculture

PACA Looks to Commence Field Operations in Vidarbha

The Shri Vasant Naik Memorial National Seminar, 'Soil Security for Sustainable Agriculture' was organized by Dr. Panjabrao Deshmukh Agricultural University, Akola, at the College of Agriculture, Nagpur, on February 27 and 28, 2010. The seminar was held in the background of increasing recognition by the scientific community that continuing degradation of soil resources is a cause of deep and increasing concern in achieving enhanced productivity and overall goals of sustainable agriculture. The threat to security of soil is multi-faceted, and is being further exacerbated by climate change related impacts. For this reason, it is important that the scientific community takes a considered view to look to alternate ways to approach and pursue problems facing agriculture so that issues of resource degradation can be tackled up-front and effectively to take forth the agenda of sustainable agriculture. Lead papers and individual presentations were made at the seminar embracing the following themes:

Dr. V.M. Mayande, Vice Chancellor, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, addressing the gathering with dignatories seen on the dias

- Soil degradation and restoration of degraded lands
- Integrated nutrient management
- Crop residue management
- Soil health and awareness
- Tillage and conservation agriculture
- Crop diversification and sustainability

On the second day, a two-hour session was devoted to deliberations on 'Conservation Agriculture' as a theme to address the urgent concern of putting agriculture on a path that will lead to its more sustainable pursuit. The main conclusions of the seminar are shared below for benefit of our readers.

Soil Degradation

Soil degradation resulting from inappropriate management strategy and agricultural practice has emerged as the single-most critical limitation to achieve sustainability goals for Indian agriculture. Estimates of the extent and nature of degradation at the national level were presented to emphasize the nature and magnitude of processes causing degradation, recognising however that strategies and measures to control degradation need to be developed and promoted, considering the specific nature of degradation and their causative factors. Erosion of surface soil resulting from impact of high velocity monsoon rains or high speed winds in summer months particularly in the arid and semi-arid regions was the dominant process causing degradation in these regions. Irrigation induced degradation of soils from processes of soil salinisation and sodification and water logging were increasingly limiting farmers' ability to sustain production.

Evaluation studies in the intensively cropped rice-wheat growing areas have indicated development of high density sub-surface layers in the soil due to mechanisation traffic that is increasingly impacting productivity by restricting root growth, and penetration and movement of water in the soil. In a majority of rainfed areas, soil structural deterioration was the primary cause of reduced capacity of soils to absorb and retain rainwater; adversely impacting the potential of rainfed agriculture. By far, the most serious concern related to depletion of nutrients in soils that is forcing farmers to apply more and more fertiliser to maintain their current yield levels, reducing their profitability. Evidence from several studies was presented to show that both the degree and extent of deficiencies of nutrients, macro and micro had substantially increased, further reducing inherent fertility of soil to a new low. Depletion of soil organic matter was considered the single-most critical factor as being at the root of soil degradation, leading to enhanced vulnerability of soils to physical, chemical and biological forms of degradation. This of course leads to reduced capacity of soils, limiting its ability to maintain high sustained productivity, biological diversity, and overall functioning of the soil system

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leading to development of a healthy ecosystem. The seminar viewed that soil degradation has become unacceptable and that it was time that the scientific community charted a path that will contribute to enhancing the quality and productivity of a basic resource base as a way to ensure sustained agricultural productivity to meet needs of the country's food security.

Maintaining Soil Health

A large number of presentations made at the conference reflected current efforts largely aimed at defining ways to enhance crop productivity and maintain soil health. By far, the largest number of presentations related to the theme 'Integrated nutrient management'. The single-most important conclusion that emerged from a number of long-term studies under different soil, agro-climate and cropping situations was the need to adopt integrated approaches involving judicious use of fertilisers and farm based organics (farm yard manure, crop residue, green manure etc) as a way to maintain soil fertility for sustained productivity. Most studies focused on crop yields with little, if any, emphasis on monitoring or understanding the impact of studied parameters on the state of soils.

Further, there was a complete lack of cropping and farming systems perspective in developing and promoting agricultural practice, resulting in most farmers being unable to effectively adopt recommended practices. Deliberations clearly brought out the need for extending the concept of 'integrated approach' beyond a single crop to encompass cropping systems/sequences and farming system as a whole to take into account actual farm realities while developing and promoting improved practices. Discussions further brought out the fact that while scientists tend to look at physical, chemical and biological forms of degradation from their own disciplinary perspective, what is needed is a more holistic view of problems and solutions that integrates different concerns. At the field level also, issues of resource conservation and those of enhancing productivity are being addressed separately, thus resulting in piece meal and ineffective approaches being pursued to address challenges of resource degradation. The conference also recognised that any approach or solution to problems presented must view immediate priorities and needs of farmers, while also addressing long-term goals of sustained productivity.

Conservation Agriculture

On the second day of the conference, a two-hour session was devoted to a discussion on the theme 'Conservation Agriculture' (CA) as a way to address multiple challenges facing Indian agriculture. Dr. V.M. Mayande, Vice Chancellor, Dr. PDKV, Akola, chaired the session that was facilitated by PACA functionaries, Dr. I.P. Abrol and Sanjeev Vasudev. At the outset, Dr. Mayande emphasised that issues of resource conservation and climate have to be viewed in totality since these issues are at the core of problems facing farmers, particularly in rainfed areas. With only 10 to 12 percent cultivated area having irrigation facility, livelihoods of most Vidharba farmers depend on rainfed conditions. Of late, the number of rainy days in the region has decreased from about 65 to less than 50, although the total amount of rainfall has remained nearly the same. This has resulted in torrential nature of downpour, not suitable for most standing crop. The temperature in the month of end February (time of the seminar) was as it used to be in March or April. He reiterated that solutions to problems need to be indigenous in nature and those that took an integrative view of problems facing farmers.

Following the VC's introduction, Dr. Abrol from PACA briefly introduced the theme 'Conservation Agriculture' that has emerged globally as a way forward to achieve goals of sustainable agriculture. The concept of the theme 'Conservation Agriculture' has evolved in response to the need for an alternate agricultural approach to those practiced conventionally, that was proving increasingly inadequate to address multiple challenges facing agriculturists. The agricultural system is becoming increasingly vulnerable to climate change. In this regards, challenges being faced relate to stagnating productivity of most crops, declining resource base productivity due to continuing degradation, increasing pressure on land and water resource to produce more from a reducing resource base, and high levels of subsidy.

The concept of conservation agriculture, as was explained, rests on three basic scientifically sound principles, (i) Agricultural practices must cause minimal disturbance to soil through operations such as ploughing, tillage etc., (ii) An organic cover should always be maintained on the soil by leaving crop residue on the surface or growing cover crops, and (iii) Adopting diversified cropping systems in spatial and temporal context including crop rotation, intercropping, agro-forestry practices, etc. These basic principles when translated into appropriate technologies and agricultural practices and adopted in an integrated manner can significantly contribute to reversal of processes causing soil degradation and gradually restore soil quality for optimal functioning.

During the discussions, questions were raised followed by discussions on the feasibility of adopting the proposed approach, the kind of technological and institutional challenges that such an approach posed, and the likely benefits in the short and long run. Conservation agriculture approach as was emphasised, was being adopted on millions of hectares of land in different parts of the world. Substantial effort was also underway in India particularly, through the efforts of Rice-Wheat Consortium. It was also clear that operationalising this approach would call for not only a change in the mindset of all involved but also new ways of identifying and prioritising research agenda with a focus on problems being faced by farmers. Questions were raised on the availability of machinery for seeding in bare soils and in the presence of crop residue, how the issues of weed control would be addressed, and how these practices would benefit farmers. Towards the end, summarizing the essence of deliberations Dr. Mayande observed that the Conservation Agriculture theme offered an opportunity to reorient our research and development efforts in ways that can effectively contribute to address the challenge of resource degradation and climate change. He stressed on a number of other issues, most important being:

- Conservation agriculture should not be branded as a new form of agriculture but as a concept that reflected a knowledge based approach to find solutions to problems facing the sector. The approach has evolved in response to widespread recognition that while past strategies and agricultural practices have significantly contributed to achieving the much needed increase in food production, issues of serious and widespread resource degradation has seriously impacted our capacity for sustained growth. It was in this context and of other issues such as climate change that CA principles offer a way forward to meet challenges.
- The Conservation agriculture theme provides a way to adopt integrative approaches for technology generation and promotion in contrast to largely single crop focused and discipline based approach to enhance crop yield. CA is an appropriate approach to address concerns of

enhanced productivity and resource conservation. It provides a way to integrate management of nutrient and pest control within the framework of the farming system approach. To pursue such an approach, emphasis needs to be placed on optimal utilisation of a farmers' own resource (land, water, etc.), and efficient use of purchased inputs.

- While the theme 'CA' is an enunciation of the basic principles that are needed to guide technology generation efforts, it was clear that relevant technologies need to be developed to suit different farming situations, resource endowments, and socio-economic conditions. For the same reason, replication (or extrapolation) of new technologies is likely to be limited to an agro-climatic and farming region although lessons learnt under varying situations would contribute to strengthening the knowledge base for future interventions. This would call for developing and promoting technologies for speifc agro climatic situations.
- Although the focus of the two-day conference on 'Soil Security for Sustainable Agriculture' had largely attracted soil scientists and agronomists, and principles of CA hold the potential of reversing soil degradation, it is not about soil science alone. Operationalising CA theme calls for involvement of scientists from many specialised areas. Thus, as an example, agricultural engineers developing new farm implements and crop protection specialists developing and promoting appropriate pest management strategies, were as important as social scientists to developing a better understanding of farming systems, and building a societal perspective in our research for development agenda.
- Conservation agriculture approach implies a virtual shift in paradigm in the way we have approached and sought solutions to field problems, and the way in which we have defined our research priorities and planned and implemented the research agenda. Successful implementation of the new approach calls for a cultural change in the way we work. Scientists belonging to different disciplines will need to work as a team with farmers respecting their knowledge and experience, to solve field problems together. We will also need to work in close tandem with development agencies that have the responsibility for wider dissemination of knowledge and technologies for empowering farming communities. The onus for ushering such a change rests with us, the scientific community and this is the real challenge.
- To sum up, the question before us is not whether or not CA is the way forward to address issues of resource degradation, soil health, and productivity; but how to make it successful. And then, this has to be our new agenda.

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A Brief on One Year of Cereal Systems Initiative for South Asia (CSISA) Project

The Cereal Systems Initiative for South Asia (CSISA) Project funded by the Bill & Melinda Gates Foundation and USAID and implemented jointly by CIMMYT and IRRI builds on resource conserving technologies (RCTs) developed, and lessons learnt from the Rice Wheat Consortium initiative. The project is working to boost deployment of existing resource conserving technologies and improving market information in nine identified "hubs" in the Indo-Gangetic Plains.

The initiative brings together a range of public and private sector organisations to enable sustainable cereal production in India, Pakistan, Bangladesh, and Nepal. The International Food Policy Research Institute (IFPRI), the International Livestock Research Institute (ILRI), and the International Maize and Wheat Improvement Center (CIMMYT) have collaborated with the International Rice Research Institute (IRRI), national agricultural research organisations, education and extension systems, NGOs, and private-sector companies to implement CSISA whose objectives are:

1. Widespread delivery and adaptation of production and post harvest technologies to increase cereal production and raise incomes.
2. Crop and resource management practices for sustainable future cereal-based systems.
3. High-yielding, abiotic stress-tolerant, and disease- and insect-resistant rice varieties and hybrids for current and future cereal and mixed crop-livestock systems.
4. High-yielding, abiotic stress-tolerant, disease-resistant wheat varieties for current and future cereal and mixed crop-livestock systems.
5. High-yielding, heat-tolerant and disease-resistant maize inbred lines and hybrids for current and future cereal and mixed crop-livestock systems.
6. Technology targeting and improved policies for inclusive agricultural growth.
7. Creating a new generation of scientists and professional agronomists for cereal systems research and management.
8. Project management, communication and impact assessment

Acknowledging the importance of (RCTs) to needs of Conservation Agriculture (CA) and on completion of a year's functioning of CSISA, we share with our readers a report on the progress made by the project.

You can download the evaluation highlights report by visiting www.conserveagri.org/csisa_report.pdf.

PACA Initiates Field Efforts in Vidarbha

As part of its overall plan to mobilise efforts within rainfed regions of the country, PACA has been looking to initiate field activities in resource stressed regions of the country. Some of these regions such as Mewat, Haryana; Vidarbha, Maharashtra; and Kandi, Punjab have already been identified by PACA as those that can benefit from application of Conservation Agriculture (CA) principles to bring relief to farmers through rebuilding of the resource base to bring about an improvement in farming conditions. These three regions exemplify typical worries that haunt agriculture today with some key concerns being climate change, dwindling resource capability, decline in agricultural productivity, and compulsive change in cropping pattern.

As a consequence of such situations, poverty and hunger have intensified in recent years, since the smaller farmer is the hardest hit. This has led to a downward spiral pattern developing with all efforts directed at smaller farmers struggling to find justification of an effective reach. The vicious circle is completed when neglect on account of inability to manage natural resources lowers the efficacy of land delivery, and with this, the poor farmer loses all that he can call his own and depend upon.

Background - Agricultural Scenario

The plight of farmers of the resource stressed Vidarbha region has been a matter of grave concern to all. PACA has felt for long that its initial efforts should focus on regions that are vulnerable, yet offer hope, and Vidarbha has emerged as one such region that PACA has decided to explore by assessing its actual field condition.

A beginning was made by identifying and sensitizing a competent volunteer who was gradually trained to initiate local efforts. Several visits were made to villages around Nagpur and the intervention area was identified on the basis of need criticality and convenience of management of pilot effort. Continued interaction with farmers led PACA to believe that reported problems could be addressed by applying the principles of conservation agriculture. This led to a meeting of a 3-member team from PACA at Hingna village that was attended by 35-40 farmers in late February, 2010. The two hour discussion served as an eye opener and helped build on the earlier conviction that the CA approach offered a way forward. The confidence portrayed by farmers and willingness to dedicate few demonstration plots to catch the ensuing kharif season put an effective seal on intentions of both sides.

Vidarbha is a semi-arid region of Maharashtra with black cotton soil (vertisols) generally found in this region, with depth varying from 3-8 feet. Most agricultural land is rainfed, except for a small percentage that is irrigated by wells. The average rainfall is around 800mm and even though sprinklers are used by some farmers, drip irrigation is not affordable by all due to poor economic condition of farmers. Scarcity of water has resulted in an increase of the fallow period.

The farmer of Vidarbha lives in uncertainty as a result of climate induced situations. Delay in monsoon, untimely rains; questionable quality and quantity of seed, fertiliser and pesticide; along with decreasing margin between input and output has made the condition of farmers pitiable. Major kharif crops grown are cotton, *toor* (pigeon pea)*, jowar* (sorghum), and soybean, while wheat and *chana* (gram) constitute major rabi crops. Given the proximity to Nagpur town, vegetables like spinach, coriander, tomato and brinjal are also grown and have a good market demand.

Agriculture is the prime vocation of farmers in Vidarbha. Most farmers have small land holdings ranging from 2-8 acres. Even though farmers are aware of the need and benefits of integrated agriculture, activities like cattle rearing have declined due to lack of fodder resources. Most farm operations are carried out manually, with help of bullocks, with tractor driven implements used by a few whose farm size exceeds 5 acres. Land preparation is generally done using a wooden plough followed by planking to level the land. Farming families, women in particular are involved with farming activities such as weeding, sowing and picking cotton.

Farmer Consultation - Observations

The following observations emerged at the consultation held with farmers on 26th February, 2010:

- Non-availability of seed and its quality was viewed as a major concern by the farmers
- The use of chemical fertilisers has been found to have comparatively increased, but there has not been any significant increase in yield
- Along with chemical fertilisers, the use of pesticides has also increased. In spite of this, results are not as expected, and there are reports of increased pest resistance to these pesticides, along with emergence of newer pest varieties
- Soil fertility has reduced due to lack of organic matter, biodiversity, and humus in soil
- Majority of farmers in this region do not retain crop residue on their fields since it is diverted for meeting fuel and fodder needs.

A section of farmers at the consultation organised by PACA at Hingna village near Nagpur

Discussions with farmers have also brought out certain observations pertaining to climate change. The overall soil-plant dynamics are dependent on rainfall and temperature. Uncertainties associated with these parameters affect many soil-plant bio-physical processes that in turn impact the overall productivity of crops. Rainfall and temperature variations have been found to affect the cropping pattern, along with pest and weed incidence for the past 6-8 years. Detailed effects/impacts of these parameters have been elaborated in the figure given at the bottom of this page.

Interaction with farmers affirmed their keenness to learn new techniques of farming and they showed a good understanding of reasons behind depleting soil fertility, yield, declining quality of produce, and impact of climate change.

Cotton is a major crop of the region given its black soil characteristics. However, the cotton stalk that is deep rooted and hardy will pose challenges to minimal soil disturbance needs desirable for pursuit of Conservation Agriculture

Some existing strategies being adopted by farmers to cope with uncertainties are:

- The cropping pattern of this region has changed in recent years. Earlier, *jowar* was cultivated on a large scale, but due to shortage of water, the farmers now prefer to grow soybean.
- Farmers having access to irrigation have stopped growing cotton/*toor, jowar* etc. and prefer to grow seasonal vegetables and flowers.
- Earlier, wheat and *chana* were grown in limited area, but nowadays, their cultivation is on the rise. Though the yield is not as expected, it reduces their input cost as farmers can sow their own seeds for 2 to 3 years consecutively.
- Lesser rains, higher temperature, and loss of water through evaporation force farmers to keep their land fallow from November to June.

After an informative discussion with farmers, a trip was undertaken to two farms, (i) A 5 acre farm that had standing crop of dry cotton stalk and stubbles of toor, with vegetables like onion, brinjal, tomato and coriander also seen as having been planted, and (ii) A 120 acre farm owned by a progressive farmer that had a similar cropping pattern but where cotton with *toor* (standing stubble) had been intercropped; with wheat and *chana* growing in the post rainy season in separate plots. This farmer was also pursuing horticulture with citrus, sapota, and pomegranate growing at the time of visit.

Conclusion

This visit and discussion with farmers resulted in building PACA's conviction that conservation agriculture principles could prove to be a means to address problems faced by Vidarbha farmers who are dependent on the rainfed system. On the other hand, farmers who had been briefed on principles of conservation agriculture showed enthusiasm to understand and learn the technique of CA. It was strongly felt that the next planting season would be an appropriate time to commence field efforts in Hingna for which implements needed would be procured by PACA and brought to the fields well in time leading to demonstrations and training of farmers.

This visit was followed by PACA's participation in a two day seminar on 'Soil Security for Sustainable Agriculture' at the invitation of the PDKV College of Agriculture at Nagpur preceded by a visit to the National Bureau of Soil Survey and Land Use Planning, an ICAR institution. PACA draws confidence from the fact that both institutions are sensitive to needs of resource improvement and are willing to work in a collaborative manner to meet needs of the Vidarbha farmer.

	CHANGE	EFFECT	IMPACT
WATER	• More frequent late onset or early departure of rainfall • Reduction in no. of rainy days • Sudden and heavy downpour • Intermittency of rains	• Un-timely/late sowing • Poor seed germination • Washed off seedlings and seed • Reseeding • Greater dependence on limited available ground water	• Yield and quality of produce adversely impacted • Increase in Input cost due to reseeding, increase in fertilizer and ground water usage • Reduced crop yields and income
TEMPERATURE	• Rise in temperature • Longer dry and hot summer period	• Increased evaporative losses • Increase in fallow periods • Increase in pest and weeds mainly during monsoon	• Early maturity of crops • Low yield

Dr. R.K.Malik

Zero-tillage and Weed Management in Rice-Wheat Cropping System of Indo-Gangetic Plains

Dr. Malik's article touches upon an area of relevance to conservation agriculture that needs much research to be focused in days ahead.

Agricultural scientists are facing increasing challenge to develop technologies to meet needs of higher food production. For countries that have a large population and where agriculture is managed on a marginal basis, it is also important to know where and at what cost the food can be produced. This creates a need to develop a sharpened focus on the kinds of alternative technologies needed to meet desired production targets. Conservation Agriculture (CA) is emerging as a key strategy to enhance the sustainability of such intensive production systems.

Zero tillage integrated with herbicides helps in managing resistance in Phalaris minor

Zero-tillage (ZT), a major component of CA, is being practiced in wheat for the last 10-12 years within the rice-wheat cropping system . This has also signaled the entry of Resource Conserving Technologies (RCTs) into South Asia. Since its introduction, more than 2 million hectares under the rice-wheat system has shifted to the zero-till mode of cultivation. Other technologies supporting zero-tillage soon followed, prominent being; precision land leveling, direct seeded rice, machine transplanted rice, and furrow irrigated raised bed planting. All such practices have given a boost to soil and water conservation efforts. At the same time, improved yield realisation was accompanied by lower cost of cultivation, resulting in better profit margins to farmers.

In recent years, zero-tillage has transformed rice-wheat cultivation across most of the north-western states that has brought about major changes in wheat crop environment due to minimal soil disturbance. Zero-tillage system has been able to reduce the fallow period between crops, resulting in a change in sowing period of the following crop. At the same time, scientists have shown concerns regarding negative effects of zero-tillage with regard to increased weed activity or a shift in weed flora in favour of perennial weeds.

These concerns have been mainly addressed through seeking answers to the following key questions:

1. *What will be the status of weeds with increased pursuit of practices such as zero-tillage?*
2. *Does zero-tillage contribute to increase in weed pressure?*

These research questions form the subject focus of this article based on the author's experience with promotion of RCTs in the rice-wheat cropping system in India.

Weed Scenario in Rice–wheat Cropping System

The aspect of weed spectrum is closely tied to tillage, cropping system, and growth of each crop in the cropping system. It has been observed that zero-tillage enables longer growth period (increase in growth cycle) of both rice and wheat grown in rotation, endowing both crops with more productive and efficient use of resources. In relative terms, wheat competes better than weeds; but with rainy season crops, the use of pre-seeding herbicide may instead create competition in favour of crops and thus point to a need for herbicides.

Better access to natural resources due to timely seeding and improved growth period creates competition in favour of crops. This leads to tightening of food supply position for weeds, making them more vulnerable to stress. The competition effect is larger where two crops are grown with a limited space between harvest of crop and the sowing of another crop. This situation prevails in north-west India, part of Pakistan and the *terai* belt of Nepal. In these areas covered by the RWC, the supply of weed seeds was limited because both population and growth of weeds was less. Here, at the time of wheat or rice sowing, fields were relatively clean because of a very strong canopy cover of preceding crop.

On the contrary, with the availability of more natural resources for weed under thin canopy cover crop conditions in eastern Indo-Gangetic Plains (IGP), the fields became dominated by perennials at the end of growth cycles of each crop. That is the reason why under a relatively lesser canopy cover, perennial weeds can easily grow. Similarly, a thin canopy of wheat or rice due to their late planting also leads to building of weed seed bank. Poor weed management before seeding crops under zero-tillage also leads to a continuous build up of stored food in the underground parts of perennial weeds. Such weeds remain green even at the time of wheat or rice sowing, making herbicide application very essential.

The Issue of Herbicide Resistance Management

Herbicide resistance was the most serious problem in wheat in the rice-wheat cropping system during early 90s. Efforts on herbicide resistance management before 1996-97 were concentrated around alternate crops (*Malik et al., 2002*). The problem of resistance was so serious that farmers in Haryana started sowing sunflower to exhaust the seed bank of wild canary grass. Crop rotation was possible only in a small area and farmers needed a viable technology for herbicide resistance management. Zero-tillage has made it possible to achieve three major objectives to create competition in favour of crop. These are, (i) optimum plant population, (ii) seeding at a time that is not conducive to wild canary grass emergence, and (iii) accurate fertilizer placement. Reduced population of this weed doesn't mean that farmers will stop using herbicides. Long-term trials at five HAU sites in different villages indicate that farmers can skip herbicide once every 3-4 years as there is a constant danger that the weed will evolve resistance to new herbicides. We know that using herbicides alone is not a long-term solution to manage resistance. Emergence of very heavy population during early phases of crop cycles can be prevented with zero-tillage, in particular.

Weed Management and Zero-tillage

Zero-tillage has been practiced for around 12 years in pearl-millet-wheat rotation and for about 8 years in sorghum–wheat rotation at research farms of CCS Haryana Agricultural University. Perennial weeds in rainy season have been managed by using glyphosate, applied few days before seeding pearl-millet or sorghum. Such plots fared better during all years, and the perennial weed pressure continued to be more under conventional tillage than under ZT. The decline in overall perennial weed pressure is even more impressive because both glyphosate in the rainy season and the excellent wheat canopy cover seen in the month of March and beginning of April does not allow accumulation of food into the underground parts of perennials. Another way to look at this is that net flow of food material into the underground parts of perennials is less. On the whole, once the pre-seeding herbicides are used on case by case basis, zero-tillage in both rice and wheat helps reduce the stress of perennials. In conventional agriculture, it needs to be understood that cultivation itself will encourage weeds if land space is not occupied by crops. A clear understanding has been developed that weeds will definitely occupy the space available between two crops or when crop canopies are thin.

Weedy rice and its development into an important problem is associated with low land rice ecology of eastern UP and adjoining parts of Bihar. Stale bed technique to exhaust the existing seed bank and use of hybrid seed to solve seed contamination problem could form an effective strategy. This would help in facilitating the adoption of zero-tillage in direct seeded rice in the region. Like any other technology, practical considerations may get in the way while charting the way forward. If we look at the whole system, the use of pre-seeding herbicides can be an efficient tool that can lead to flexibility in respect of using or not using post-emergence herbicides. This also makes it possible to boost the early crop canopy cover. Frequent use of herbicides in a zero tillage system seems to be only an ideological obstacle in the process of tillage reforms.

In Eastern sector where sugarcane is cultivated in the cropping system cycle, heavy infestation of purple nut sedge (*Cyperus rotundus*) and *Cynodon dactylon* may require the treatment of pre-seeding herbicides in fields where ZT has been planned. A shift in cropping system from rice to sugarcane encourages a shift in weed flora pattern from annuals to perennials. The use of pre-seeding herbicides like glyphosate can weaken such influences under zero-tillage system in crops such as sorghum, pearl-millet and rice. The use of glyphosate however, will not be a regular feature because the food supplying capacity of perennial weeds will weaken these weeds further. Additionally, the use of herbicide in rainy season crops can help bring about a new phase of tillage reform in favour of zero or reduced tillage.

Weeds of Wheat

Wild canary grass (*Phalaris minor)* is a great concern in most of wheat growing areas of South Asia. In certain locations where wheat productivity is high, the intensity of this weed is very high. Most parts of IGP have large differences in the baseline when the wheat crop is sown. In Eastern IGP, wheat sowing is delayed beyond December. Experience in Haryana and some other parts of India shows that zero-tillage has brought about a decrease in the population of wild canary grass. The observation on zero-tillage mediated reduced population of weeds that is in contrast with the increased weed problem in other countries; a deviation from general observation found in literature world wide. Very high population of this weed in idealised past practice of conventional tillage was mainly because of delayed wheat sowing leading to favourable temperature for the emergence of this weed. Scientists at CCS Haryana Agricultural University reported a definite trend towards a reduction in the population of this weed. Essentially, zero-tillage facilitated early sowing of wheat with relatively high temperature for this weed to emerge. To mitigate the damage from this weed in future, farmers should be encouraged to adopt zero-tillage in wheat as part of an integrated weed management strategy. Franke, along with his group working on his Ph.D Thesis at CCS Haryana Agricultural University have shown how the population of this weed is reduced under zero-tillage.

Details of resistance development and its management using integrated approach with focused attention on zero-tillage have been published (*Malik et al 2002 and Franke et al.2007*). Zero-tillage (ZT) in wheat helps reduce the emergence rate of *Phalaris minor* compared to conventional tillage (*Franke et al. 2007*). In a study conducted by *Franke et al. (2007*) at farmer's field in Haryana, correlating the number of germinable *P. minor* seeds in soil with the number of *P. minor* seedling emerged; it was found that ZT reduced the emergence rate of first flush of *P. minor* by 50% (Fig 1 A). Rate of emergence of second and third flush was also lower in ZT plots compared to conventional tilled plots (Fig 1 B & C). The first flush of *P. minor* is more damaging to the crops compared to later flushes and ZT is found to be relatively more effective in reducing first flush than other flushes.

Photo Above: Cyperus rotundus managed by pre-seeding herbicides with no infestation at later stages in ZT wheat

Photo Below: Cyperus rotundus infested conventional tillage wheat

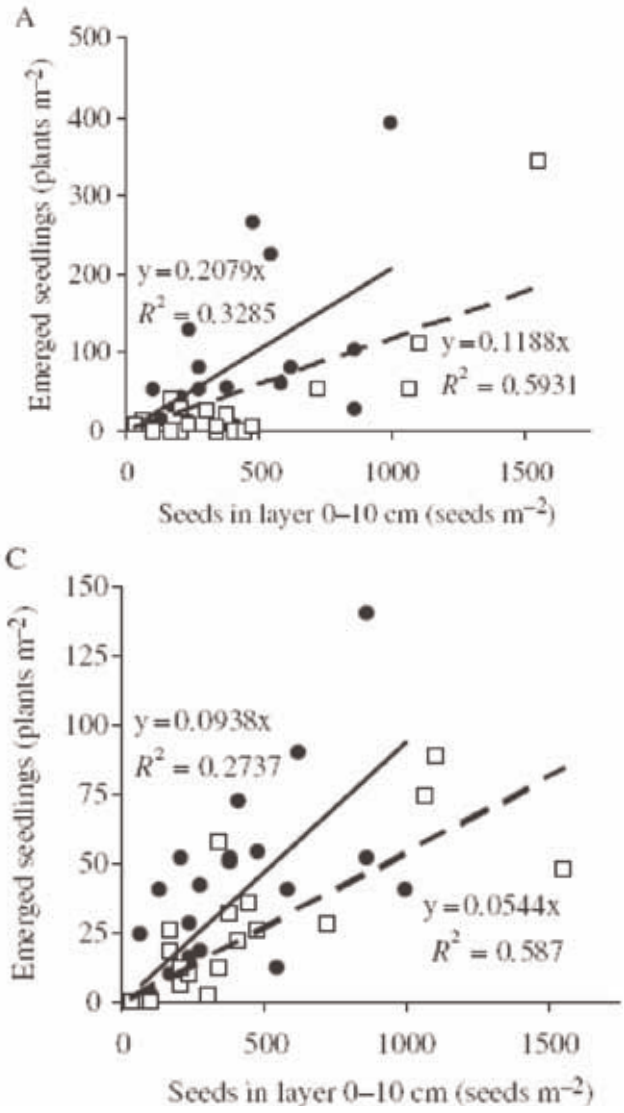


Fig 1. Emergence rate of the first (A), second (B), and third (C) flush of Phalaris minor under conventional (●, solid line) and zero-tillage (□, dashed line) in wheat (Source: Franke et al. 2007).

The latter work done at nine centres under National Agriculture Technology Project (NATP) of Indian Council of Agricultural Research (ICAR) has confirmed that zero- tillage reduces the population of most serious weed of wheat in South Asia.

Summary of Benefit and Costs of zero- tillage in Wheat (CIE 2002)

Producer Benefits	Net Present Value	
	A$m	(%)
Prevention of future decline in yield through re-emergence of herbicides resistance	103	5.7
Reduction in herbicide outlays	175	9.7
Reduction in tillage costs	950	52.5
Avoidance of long-term yield decline through degradation	24	1.3
Yield premium due to early sowing and closer spacing	557	30.8
Total Producer Benefit	1809	100
Net Gain	1809	

Emerging Issues:

- The ecological condition emerging from zero-tillage could create unfavourable conditions for emergence of wild canary grass. There has not been any shift pointing to other weeds during the last 12 years. Early wheat sowing by this technique meant that the most serious wheat weed can be kept under check in whole of IGP.
- Retaining more residue on the soil is important. Minimizing pollution both on-site and off-site is an important feature of reducing soil degradation. Maintaining residue can also help in decreasing early weed emergence that is very crucial for the success of direct seeded rice.
- Zero-tillage would help ease pressure on frequency of herbicide use due to relatively less population of weeds in the early stages of crop growth. Zero-till drilling alone may not help but can at best delay the evolution of herbicide resistance by using the same herbicide less frequently. Zero-tillage facilitates efficiency in the usage of inputs like fertlisers and pesticides. This is the best way to increase revenue from increased yield without increase in use of inputs.

New Publications For Download

We have created and uploaded two publications as below that can be downloaded from the Content page of our web site or by clicking on the link: www.conserveagri.org/content.htm.

1. Education Series - Soil #2: Soil Degradation
This booklet forms the second part of the Education Series covering the subject of soil. The booklet addresses issues and causes of soil degradation supplemented with suitable examples. In our future issues, we will cover topics regarding soil improvement and its quality.

2. Education Series in Hindi: *हमारी भूमि और मिट्टी* #1
This is a translated Hindi version of the Education Series booklet on Soil Resources #1. We hope it will help us reach out to farmers and Hindi speaking functionaries. This too can be downloaded from the link mentioned above.

Have you read our past issues and other content developed by us on the subject of CA? You can download those as well from link mentioned above.

"There is nothing new to learn-only to better understand"

Lesser known benefits in no-till farming

Carlos Crovetto, No Tillage Development Centre, Concepcion, Chile

No tillage is promoting a large change in the old paradigms, away from ancestral plowing, tilling the soil, burning straw and over-grazing. Today, the world has had many bad experiences with poor soil management in conventional agriculture. However, innovative no-till farmers around the world learning from their own experiences and working better with mother nature have stopped degrading the soil system by imitating how mother nature creates an organic, fertile and productive soil.

What is no-till farming? No-till farming is a complex management system that integrates natural processes and implements three key management strategies:

- Minimum soil disturbance
- Continuous crop residue cover
- Diverse crop rotations, and/or cover crops.

No-till farming encourages any issue focused on maintaining soil productivity and quality and its biodiversity in the context of sustainable agriculture.

Thus, a combination of the economic benefits of enhanced soil management through reduced labour requirements, time savings, reduced machinery and fuel savings with direct seeding, combined with the numerous environmental benefits has universal appeal. Indirect measures of social benefits as society enjoys a higher quality of life from environmental quality enhancement are difficult to quantify. No-till farming is a specific form of conservation agriculture (CA), working in harmony with nature using direct seeding techniques that increases soil C, can be of benefit to society and can be viewed as both "feeding and greening the world" for global sustainability.

I believe that the first lesson that these innovative farmers learned was to respect the soil, understanding that the soil is alive because it supports microorganisms and mesofauna vital to the production of an organic soil with a good soil structure that improves all natural parameters for more crop production with less cost and, most importantly, without soil erosion.

Many farmers today are beginning to understand many benefits provided by no tillage, however, there are a lot of unknown benefits that can improve the soil and make farmers more happy.

Some natural benefits of no tillage are described below:

1. Increases the microbial and mesofauna population in the soil which stimulates the life of microorganisms like nitrogen fixing Rhizobium bacterium in leguminous plants by symbiosis, by greater amount of adenosin triphosphate (ATP energy and soluble phosphate), provided by straw after decomposition on soil surface.
2. Stimulates microorganisms like azotobacter, azospirillium, green algae and other free living microorganisms, capable of fixing nitrogen in the soil.
3. Stimulates fungal life and important microorganisms in soil organic matter decomposition converting sugars into alcohol, which is perfect food for microorganisms that fix nitrogen for soil benefits.
4. Increases proliferation of endotrophic micorrhizal fungi hyphae. This symbiotic network extends the plant root system, enabling the plant to obtain greater amounts of phosphorus, zinc and water.
5. Minimises phosphate fixation in the soil, thereby increases the activity of vital enzymes like phosphatase. On Chequen Farm in Chile over 30 years without any kind of tillage, we have a six-fold increase in phosphate available for plant use (7 ppm to 38 ppm) by returning an average of 5 t/acre/year of crop residues.
6. Increases activity of earthworms, insects and arthropods, in addition to producing organic compounds that enhance soil aeration and increases plant available water. These organic compounds should be considered irreplaceable because they act like a soil amendment and catalyser of vital physiological principles for plant life on the planet.
7. Increases in organic matter (soil carbon) improves the soil cation exchange capacity (CEC) especially those soils with inherently low CEC, e.g. soil with kaolinite clay minerals found at Chequen Farm.
8. Enhances soil carbon sequestration from the atmosphere through plant photosynthesis, carbon dioxide (CO_2) is captured to form plant biomass and grain. After grain harvest, the straw is left on the soil surface with the roots in the soil as part of the natural carbon cycle.
9. Improves current global soil management because intensive tillage has been partially responsible for the increase of CO_2 in the atmosphere. The rapid oxidation of the carbon in straw by tillage and residue burning, are important contributing factors to the greenhouse effect affecting the planet's climate.

Summary

In order to receive these benefits, farmers should avoid any type of tillage or soil inversion on his property, and leave crop residues uniformly distributed over the soil surface. Diverse crop rotation (at least 3 years) is the third key to a successful no tillage system.

The present-day curricula of University Agronomy department teaching agricultural tillage systems are obsolete. To the majority of students, no tillage or soil improvement is not taught as a comprehensive system and in the best of cases, the students are taught minimum tillage, conservation tillage or conservation farming, which are of limited benefit because these tillage methods do not increase soil organic matter.

No one should doubt that the traditional farming and burning of crop residues are still very common around the world, and have left soils degraded. In many countries, there is hunger because degraded soils no longer can produce enough food.

Today, productive soils must receive sufficient chemical fertilizers. However, this inorganic fertilizer does not guarantee the natural physical, chemical and biological integrity of the soil. "The grain is for the man; the straw is for the soil," returning the straw is the cost to use the soil. We must feed the soil as well as we feed ourselves, the cows or hens or any living systems. Since the soil is a living system, we must speak about soil nutrition. The food for the soil is the straw (carbon and nutrients from fertilizers). Life on our planet depends on soil management. Our life and food security depend on improved soil management with no tillage through less intensive tillage, continuous soil residue cover and diverse crop rotations and/or cover crops.

Source: WASWC Newsletter, Volume 25, No. 4, (Oct-Dec, 2009)

Happenings

Soil Carbon and Adaptation to Climate Change

"A large proportion of the mitigation potential of agriculture (excluding bio-energy) arises from soil carbon sequestration, which has strong synergies with sustainable agriculture and generally reduces vulnerability to climate change" – International Panel on Climate Change, Working Group III, 2007

The document "Soil carbon and organic farming" is a review of the evidence of agriculture's potential to combat climate change. Based on this review, the report brings forth that soil carbon sequestration has the potential to reduce green house gas (GHG) emissions and make agriculture more resilient to the effects of climate change. Increasing soil carbon levels can make significant contribution to climate adaptation by improving soil structure and quality, and reducing the impact of flooding, droughts, water shortages, and desertification, thereby improving global food and water security. "Minimum-till" or reduced soil cultivation, one of the major tenets of CA, is being perceived as a farming solution for raising soil carbon levels. It is effective in maintaining soil carbon storage in semi-arid regions where carbon is being lost by erosion and by use of fallow periods. According to the IPCC scientific advisers, about 90% of agriculture's GHG mitigation potential resides in improving soil carbon levels.

Source: Soil carbon and organic farming- A review of the evidence of agriculture's potential to combat climate change, Soil Association, UK, November 2009.

COPENHAGEN- UN Climate Change Conference

Agriculture has a unique place in climate change and human development and will be seriously affected by climate change impact whilst holding possibilities for substantial mitigation. World Food Summit organised in November 2009 clearly recognised the need to 'proactively face challenges of climate change to food security and the need for adaptation of and mitigation in agriculture with particular reference to small agricultural producers and vulnerable populations'. Given this position, the creation of the 'Global Research Alliance to Combat Climate Change' was one of the the key outcomes of the Copenhagen conference.

Copenhagen provided a major opportunity to strengthen and deepen these links and to move towards more sustainable agriculture. Agriculture currently produces around 14 percent of global annual greenhouse gas emissions. In coming decades, agriculture will face twin challenges of not only reducing its contribution to greenhouse gas emissions but meeting dramatic increases in food demand. According to FAO, at the projected level of population growth,the world will be home to more than 9 billion people by 2050 requiring 70 percent increase in food production. The seemingly irreconcilable goal of reducing emissions sharply while simultaneously boosting food output was the main focus of discussions at Copenhagen.

A major achievement of the Copenhagen Conference is the recognition of the concern that agriculture counts amongst the main issues to be included in the 'Long–Term Cooperation Action'

An equally significant outcome of Copenhagen is the setting up of 'Global Research Alliance on Agricultural Greenhouse Gases' (GRA), by representatives of 20 countries from around the globe, including India. GRA will focus on research, development and extension of technologies and practices to grow more food (and more climate-resilient food systems) without increasing greenhouse gas emissions. This can be accomplished through partnerships among researchers with the objective of developing new knowledge and technologies that can be transferred to the farmers, and other land and resource managers around the globe. Anticipated products of the worldwide scientific collaboration will include cost- effective and accurate ways of measuring greenhouse gas emissions and carbon stored in soil; new farming practices that reduce emissions and increase carbon storage in farmland in different countries; and farming methods that sustain yields while helping to mitigate climate change.

Based on these deliberations, it can be concluded that conservation agriculture practices that can minimise GHG emissions to a great extent can be considered as an effective farming alternative in addressing food security needs of the world population, while optimising resource use.

Exposure Visit cum Training Program on Conservation Agriculture for Mewat Farmers

As part of project initiatives, a training cum exposure visit for selected farmers of Mewat was organized by CIMMYT at Karnal on 29-30 Dec, 2009 to provide them an opportunity to interact with the farmers of Karnal practicing conservation agriculture. The farmers of Mewat were exposed to a number of trials undertaken by Rice-Wheat Consortium (RWC) on farmer fields to test and promote CA practices in totality. The training helped Mewat farmers come out of their traditional farming perceptions and get an insight of CA based practices that could help revive their farming vocation to better address livelihood and food security needs.

European Parliament Report on Agricultural Technologies for Developing Countries

A science and technology option assessment (STOA) was carried out by the European Parliament on "Agricultural Technologies for Developing Countries". The study was aimed to investigate and to understand the contribution of certain important selected agricultural production systems and technologies to higher food production and food security with focus on small scale farmers in developing countries. Analysis of this study shows that Conservation Agriculture (CA) along with other agricultural production systems and technologies has potential to address the problems of soil erosion with reversing the process of natural resource degradation by strengthening natural biological processes above and below the ground. The study also pointed out that the potential of CA system in the 21st century agricultural development is based on the large amount of field based evidences from all continents regarding the role of CA systems in raising productivity and income, improving livelihoods and reducing production costs, increasing resilience of production, contributing to climate change adaptation and mitigation, enhancing water resources and protecting ecosystem services and the environment.

Source: STOA webpage final report on agricultural technologies for developing countries Annex 2 is on Conservation Agriculture

Following are some of the highlights of the training program:

- Seeding in the presence of crop residue: Field trials' demonstrating the use of Turbo Seeder to plant wheat after rice was the major highlight. According to the scientists, planting wheat using zero-till drill presented difficulties when crop residue was left on the soil surface. In comparison, Turbo Seeder developed by machinery manufacturers of Ludhiana proved to be very effective in planting wheat in the presence of residue, thereby resulting in reduced water usage, and possibly saving on pre-sowing irrigation. Experiments had further shown that residue retention helps moderate soil temperature to the tune of 3-4°C in the morning and by a similar amount in the evening, thus helping in conserving more water.
- Soil degradation: The group was appraised that many farmers in the region had been using Rotavator for soil preparation. Rotavator having 6 blades and the rotor moving at the speed of 240 rpm, implies that the blades hit the soil surface nearly 1200 times causing soil compaction and formation of a hard pan at about 8-10 cm soil depth. This was the main reason for the observed yellowing of the crops in the fields resulting from water stagnation due to soil compaction. Compared to this, crops in the zero-tilled plots were healthier due to better soil conditions. This calls for a serious rethinking about usage of Rotavator in view of the above experience.
- Intercrop: Participants also had an opportunity to see trials where berseem and wheat were grown as intercrops with an aim to assess their complementary role in use of water and nutrients.

European Congress on Conservation Agriculture

The European Congress on Conservation Agriculture- Towards Agro-Environmental Climate and Energetic Sustainability is being organised at Madrid, Spain, from 4-7 October 2010. The Conference is directed towards updating the knowledge of audience, promote exchange of experiences among professionals in the agriculture sector, and to publicise the role that conservation agriculture has within the current environmental, political and social frame.

Thematic areas of the Conference include:

- Conservation Agriculture: a model for energy efficiency and economic savings
- Legislative framework for the protection of the Environment: Opportunities for Conservation Agriculture
- Implementation and management of conservation systems: an achievable challenge to farmers
- Mechanisation in Conservation Agriculture: Modernisation of agricultural systems
- Environmental Benefits in Conservation Agriculture: Contribution to mitigating climate change and reducing soil erosion
- Conservation Agriculture: A practice at the service of biodiversity in agro-ecosystems

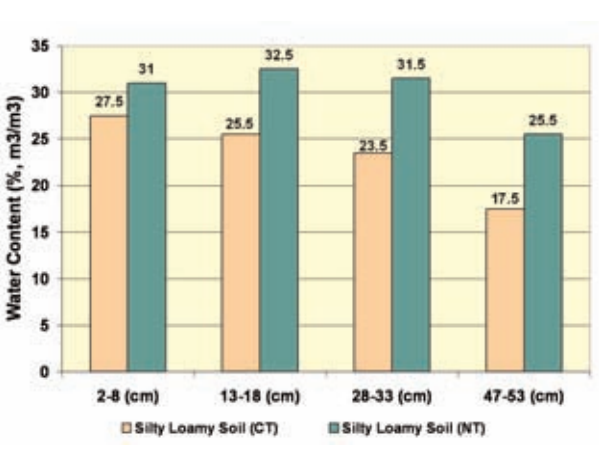
Last date for submission of abstracts is 15th March 2010. To know more about the Conference, registration fees and deadlines, visit the link www.eurocongressca.eu..

We look forward to hear from you on the contents of this newsletter and other publications developed by us. Kindly write in at info@conserveagri.org to share your thoughts.

INFOPIX

This section will present research data in pictorial form from past studies for benefit of readers

Effect of tillage systems on soil water content at different soil depths on different soil types



To assess the effect of different tillage systems on a soil's physical properties, experiments were performed at the IUNG-PIB experimental station in Poland at Grabow on heavy loamy sand and on a private farm at Rogow on a silty loam soil. Both experiments used wheat-straw as surface mulch. The analysis of these experiments reveal that the tillage system significantly affects the soil physical properties especially the soil water content. There is a significant difference in the soil water content with no-tillage (NT) as compared to the conventional tillage (CT). In both soil types, the available soil water content (averaged annually) is greater in a no-tillage system than in the conventional system at almost all soil depths.

Source: Czyz, E.A., and Dexter, A.R. 2008. Soil physical properties under winter wheat grown with different tillage systems at selected locations. Int. Agrophysics. 22, pp. 191-200

SNIPPETS

International Training Courses on Conservation Agriculture

African Conservation Tillage Network (ACT) is organizing a series of training courses at Tanzania, Lesotho, Burkina Faso and Zambia. The training programme aims to build up the desired capacity and ability of agricultural extension and research staff in the development and promotion of conservation agriculture technologies, thereby enhancing their ability to respond to farmers' needs in the application of these technologies.

Course content comprises:

- Introduction and current status
- Conventional agriculture: what has gone wrong
- Conservation agriculture: concept and principles
- Conservation agriculture: principles and farm level adaptation
- Natural challenges to the application of conservation agriculture
- Economics and social aspects of conservation agriculture
- Facilitating development and dissemination of conservation agriculture technologies
- Special sessions

More info regarding the course, application deadlines, etc. can be obtained by visiting the link www.act-africa.org.

Graduate Research Assistantship

Under the Collaborative Research Support Program (CRSP) of Sustainable Agriculture and Natural Resource Management (SANREM), a Graduate Research Assistantship is being offered to conduct research on technological innovation and social networks supporting conservation agriculture production systems (CAPS). The research involves a cross-national study of innovation processes leading to technological change in smallholder agriculture production systems consistent with the three principles of conservation agriculture. The applicant is expected to possess cross-disciplinary experience in agriculture technology studies, sociology, (or related discipline) with special interest in international development issues. Application deadline for this position is 31st March 2010. More info can be obtained from their site www.oired.vt.edu.

International Certified Crop Adviser Program

The international Certified Crop Adviser Program (CCA) beginning in 2010 is proposed to be put in place by the American Society of Agronomy (ASA) in collaboration with Indian Society of Agribusiness Professionals (ISAP). The program is being facilitated by International Rice Research Institute (IRRI) under Cereal Systems Initiative for South Asia (CSISA). As one of the objectives for CSISA, the CCA program is being developed for India as a way to further enhance professionalism and agronomic services to Indian farmers. For more details, please contact Dr. J.K. Ladha, IRRI- India Office, CG Block, NASC Complex, Pusa, New Delhi.

Conservation Agriculture - The Route

A recently released report titled "Farming for the Future: a Guide to Conservation Agriculture" revealed that conservation agriculture can help overcome families in Zimbabwe burdened by HIV and AIDS for the past 20 years. According to this report, the productive members of the family died leaving behind dependent members to take responsibility of farming and sick relatives. As a result, these household members could only cultivate small plots and grow smaller range of crops, as much of their time was spent in looking after the sick. This double burden started a cycle of food insecurity and loss of income. However, as per FAO, by practicing conservation agriculture that is cost effective, less labour intensive and results in improved and sustainable production, many of these families may be able to escape this vicious cycle.

The detailed report can be downloaded by visiting www.foodgrainsbank.ca.

2009 Rome Summit

A recently concluded summit at Rome in November 2009, aimed at reaffirming a pledge by world leaders to end hunger from developing countries by 2025. FAO, unable to get an assurance at this end, was promised by the delegates to meet their previous goal to half chronic hunger from 20% of people in developing countries to 10% by 2015. CGIAR researchers proposed top 4 priorities to achieve this goal in which 9 billion extra people had to be fed. One of these priorities focuses on the major tenets of conservation agriculture of no-till and residue retention as an in-expensive way to reduce soil degradation, green house gas emissions, and nutrient and water losses to considerably increase food production. We reproduce below an extract from the article titled "Four ways to feed the world" in New Scientist issue dated 18 Nov., 2009.

"STOP PLOUGHING!

For 1000 years, farmers have turned over the top layer of soil to bury and kill weed seeds. This is expensive, damages soils and releases greenhouse gases.

Most maize and soya growers in the Americas have abandoned the plough for "no-till" farming: they merely scratch furrows in the ground to plant their seed and handle weeds with herbicides and herbicide-resistant genetically modified crops.

But farmers do not need those if they smother weeds with organic residue such as straw, and rotate crops to frustrate pests, says Bram Govaerts of the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico, a CGIAR lab. This is known as conservation agriculture, and besides conserving soil, nutrients and energy, it cuts water loss. Govaerts has been managing experimental plots in Mexico using these methods, and finds that conservation agriculture can yield as much as traditional agriculture in good years, and even more during drought."

More information can be availed from: Four ways to feed the world, New Scientist, 18 November 2009, Magazine issue 2735, pp 1-8, by Debora MacKenzie

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