CONSERVATION AGRICULTURE FACTBOOK

PROFESSIONAL ALLIANCE FOR CONSERVATION AGRICULTURE
Getting Agriculture to Work For the Farmer & Environment

Introduction

The subject of conservation agriculture has emerged as a need given the declining productivity of land and increasing cost of inputs that is putting tremendous pressure on the farming community. Higher yield expectation from land given many more mouths to be fed also brings pressure to the subject of food security. Considering that markets with its globalisation influence is beyond a farmer's means of influence and price realisation is not a point of control, the situation has deteriorated to their disadvantage. Climate change on the other hand is a reality and agriculture is both a sufferer and contributor, and can not ignore this reality.

It is in this scenario that Conservation Agriculture (CA), that applies a resource conservation approach without compromising on yields, can work to reverse trends. At the same time, using reduced resources (or expecting much more from it) helps address concerns of the poor farmer, and can positively address needs of climate change. With poverty, food security, and climate change being areas of concern, means of conventional agriculture need to be realigned to meet renewed demands that address aspects of food security, livelihoods, and environment. It is in such a scenario that conservation agriculture is finding merit as a pursuit to meet needs of sustainability.

CA in its current manifestation was introduced 3 decades ago and is currently being practiced on more than 100 million ha land worldwide in more than 50 countries, with roughly 2 mn. ha. existing in the Indo-Gangetic Plains. India has made a beginning by embracing a few components of the concept but hurdles facing the Indian farmer need to be overcome. These relate, among others, to lack of information and knowledge, training, availability of equipment, and policy support. Wherever success has been noticed, can largely be attributed to the willing change of mindset brought about by farmers that has fuelled the movement.

The Threat to Agriculture

Climate change has emerged as a major challenge in achieving goals of sustainable agriculture. Agriculture impacts climate change causing green house gas emissions, and is at the same time impacted by effects of climate change as well. Amongst elements of climate change, the most important relate to increasing uncertainty in availability of water due to increasing frequency of drought and/or excess water events resulting in uneven water availability over time and space.

The rise in temperature and its implication for the whole range of agricultural practice is yet another critical element of climate change. Developing and promoting strategies that minimize contribution of agriculture to GHG emissions and that impart greater resilience to production systems constitute a major challenge to all; researchers, farmers, and policy makers alike.

Conservation agriculture practices hold the promise of providing both a strategy for mitigating climate change and also working as an adaptive mechanism to cope with climate change. Sufficient evidence has accumulated to conclude that CA practices can contribute to sequester significant quantities of atmospheric CO_2 in the form of soil organic matter. Similarly, CA practices can cause significant reduction in GHG emissions through improved use efficiency of inputs and by improving overall efficiency of the production system. Thus it would appear that wider adoption of CA practices provides a win-win situation in meeting current challenges facing the agriculture sector.

Beyond the subject of climate change, agricultural pursuit is being affected by the widespread problem of resource degradation including decline in soil and water quality, water availability, biodiversity, etc. Various other socio-economic factors, namely migration of youth to urban pastures, lowering yields, persistent incidence of pests, and rising cost of inputs are also impacting agriculture adversely. While large farmers are also affected, it is the small land holder farmer who is reaching a point of criticality with no option left to try. To put some numbers to this problem, roughly 60% of the area is rainfed, substantially involving small farmers, and while 40-45% of the land is cultivated by small and marginal farmers, they constitute 80% of the farming community.

CA is a way of pursuing agriculture that will work to the benefit of those pursuing it, but looking to the situation it becomes clear that CA needs to be directed at resource starved farmers, many of whom are being pushed to a point of giving up on agriculture pursuit. The consequences of such an action can be disastrous for our nation given its population, land use, and food profile.

What is Conservation Agriculture?

Conservation Agriculture (CA) refers to a system of raising crops with minimal disturbance of soil while retaining crop residue on soil surface. Beyond this, crop sequencing and rotation needs to be practiced within an eco-regional context. CA is a concept of resource-saving agricultural production that strives to achieve goals of enhanced productivity and profitability while protecting natural resources, meeting needs of farmers, and addressing concerns of climate change. With CA, the farming community can become providers of more healthy living environments through reduced use of fossil fuels, pesticides and other pollutants.

This can be achieved through mainstreamed practices with minimal gestation and more importantly without jeopardising existing systems or impacting yield. As with other approaches there is a new discipline to be adopted to pursue outlined objectives and farmers need to be made aware of these and develop confidence to pursue efforts voluntarily.

Key Principles of CA

CA is not a prescriptive approach and much would depend on local socio-physical-economic dynamics, and it is thus important to understand what CA has to offer vis-à-vis conventional agriculture. Looking to the emerging scenario, the CA approach addresses needs of agriculture through three key principles:

Minimal Soil Disturbance: The practice of ploughing the field (or tillage) to prepare for sowing or seed bed preparation has been in vogue since times immemorial. Farmers have perceived that tillage or soil loosening would improve soil fertility, increase its ability to absorb rainwater, and help in controlling unwanted weed flora. In this manner, tillage practiced over the years has led to accelerated oxidation, resulting in reduction in soil's organic matter content, finally leading to reduced overall productivity.

Maize grown through zero-tillage approach

Organic matter is critical to having a good and stable soil structure and repeated tillage operations cause deterioration of soil's physical properties making it vulnerable to rainwater runoff and erosion. It has thus been found that tillage operations over time cause a decline in soil fertility and overall productivity resulting from deterioration of soil's physical, chemical and biological properties. The practice of conservation agriculture advocates minimal soil disturbance and hence much less or no tilling carried out.

Permanent Organic Soil Cover: In conventional agriculture, crop residues are used either as fodder for livestock or burnt with a view to control pest, disease and weed flora, and to permit timely tillage operations. Contrary to this practice, if residues are allowed to remain on the soil surface, they act as a layer of mulch. This layer protects the soil against harmful effects resulting from exposure to rain and sun, provide micro-organisms in the soil with a constant supply of "food", altering the micro-climate in the soil for optimal growth and development of organisms.

The mulch layer plays an important role in improving biological activity, soil organic matter content, and in turn helps improve physical, chemical, and biological soil properties. However though CA advocates this approach, many socio-economic factors will govern its adoption, given the opportunity cost attached to crop residue.

Soyabean in surface residue managed plot

Diversified Crop Rotation: When plant residue is not burnt and soils are not ploughed; control of pests, diseases, and weeds has to be achieved through crop rotation and an integrated pest management approach. Such crop rotation practice interrupts the infection chain between subsequent crops and offers a "diet" to soil micro-organisms. Crop rotation also promote exploration of nutrients by crops from different soil layers and helps in reducing pressure created by mono-cropping. Thus, crop rotation functions as a biological pump to recycle the nutrients. The resultant higher microbial activity stimulates nitrogen fixation and humus formation with an objective to complement natural soil biodiversity and create a healthy soil micro-environment. Pursued scientifically as part of CA practice, this option has much to offer to the cause of soil health.

Wheat intercropped with sugarcane

How Does it All Add Up?

Benefits from adoption of CA practices come about in many ways, both direct and indirect. The direct benefits come in the form of reduced cultivation costs due to savings on account of fuel and labour costs every time a field is prepared for crop seeding. Indirect benefits come over a period of time with the adoption of CA practices by way of environmental and resource sustainability.

CA practices, viz. minimal soil disturbance and retention of crop residues on soil surface, adopted over time help modify soil characteristics in a number of ways that are beneficial to sustained productivity. Crop residues when left on the soil surface result in a kind of soil skin that provides food and shelter to micro and meso flora thereby increasing soil biotic load and biological activity. Soil cover helps the surface layer to become a habitat for a number of organisms from larger insects to soil borne fungi and bacteria. These organisms gradually decompose the residues that in turn result in stabilizing soil structure. The larger component of soil fauna such as earthworms further create macro-pores from surface to lower layers of soil, greatly increasing the capacity of soils to absorb and transmit water to lower layers, increasing water supply to crops during drier periods.

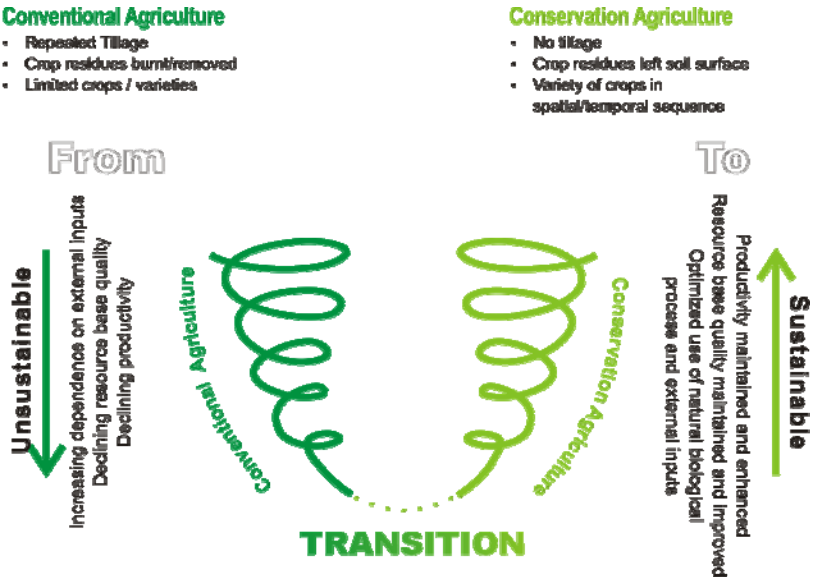
Crop residue maintained on the soil surface

Presence of crop residues on the soil surface act as a physical barrier that reduces the direct impact of raindrop on soil surface and reducing the splash effect by dissipating the energy of falling raindrops. This helps in reducing or preventing breakdown of soil aggregates, resulting in reduced erosion and improved infiltration of rainwater. Residues on soil surface also reduce speed of runoff water and wind over the surface providing greater opportunity for rainwater to enter the soil and reduce sediments and solutes carried by it. This creates an environment whereby more rainwater is stored in the soil and is available for crop use, particularly advantageous in rainfed situations with limited water availability.

Residue on the soil surface also reduce wind speed, resulting in reduced evaporation from the soil surface and loss of stored water, keeping the soil moist for a longer time and improving efficiency of rainwater. They also reduce variance in soil temperature thus providing a favourable micro-environment for biological activity.

It is clear that adoption of CA practices can bring multiple benefits in enhancing the quality of soil for high and sustained productivity. Benefits from adoption of CA practices increase with passage of time as the processes contributing to soil improvement begin on the surface

layers and gradually extend downwards to a larger volume of root zone. In addition to minimal soil disturbance and maintaining crop residues on the soil surface, appropriate crop rotations or sequences adopted over time and space greatly help reduce the incidence of pests and are able to make efficient use of inputs like fertilisers and pesticides. The chart below represents the process diagrammatically.



Key Issues to be Addressed to Promote CA

Change in Mindset: CA constitutes a major departure, and a paradigm shift from the way agriculture is being practiced conventionally. Bringing about a change in the mindset of all concerned; scientists, farmers and policy makers will call for persistent efforts aimed at creating awareness of challenges, opportunities and benefits in adopting new concepts and approaches to achieve goals of sustainable agriculture.

Adaptive Research and Demonstration Efforts: While principles that form the basis of CA are well researched and understood, they need to evolve in relation to specific farming situations. This will call for a strengthened adaptive research effort involving CA topics. Adaptation of machinery to needs of small farmers, backed with credit and policy support will constitute an important element of overall effort. Unlike conventional technologies that are more prescriptive in nature, CA practices will be based on experience gained by farmers and learning from other situations. Scientific backing will be needed to support efforts in the field to offer relevant solutions from the local context.

Adoption of Region Specific Efforts: Adoption of CA based practices will depend much on the crop/cropping pattern and the nature of soil. Similarly farmers' ability to maintain crop residues on the soil will depend on the amount of residue available with the farmer, how they use crop residue currently and how comfortable they feel in leaving the residue on the soil surface. These considerations imply that CA technologies will evolve based on different farming situations.

Policy and Institutional Support: Wider adoption of CA practices will call for appropriate policy and institutional support, both at local and national level. As an example, maintaining residues on soil surface might call for incentives to encourage farmers to shift from current usage practice. CA practices bring benefit to the community as a whole by way of ecological and environmental improvements and for this reason, support to implementation of CA programs should be considered as part of environmental services.

Networks of Farmer Groups and Scientists: Learning from farmer to farmer is now established as the most effective way to further the cause of change. As such, sharing knowledge and experience across sites will be an important way to advance CA adoption. There will also be a need to organize knowledge networks as also document best practices using IT tools for greater information access and dissemination.

Ensuring Availability & Access to Machinery: Lest it be felt that CA is a means to address needs of large landholder farmers, the need to mechanise may have to be addressed in a manner suiting the smaller farmers. To this end a different set of equipment and system of custom hire services could offer a solution. Much learning can be incorporated from Brazilian, Paraguayan, and African experiences.

Benefits

Conservation Agriculture contributes to achieving more sustainable production system by enhancing the return from natural resources and increasing the variety of soil biota, flora and fauna without sacrificing yields. Benefits from adoption of CA practices can come about in many ways, both direct and indirect.

The direct benefits will accrue from reduced cultivation costs due to savings on account of fuel and labour costs every time a field is prepared for crop seeding. Indirect benefits will show up over a period of time by way of environmental and resource sustainability made possible due to adoption of CA practices. Presented below are few benefits that the CA approach promises:

- Conservation farming facilitates reduction of production costs, particularly at times of peak demand such as land preparation and planting. By not tilling the soil, farmers can save up to 30-40% of time, labour and fossil fuels as compared to conventional cropping. Already it has been observed in India that fields that aren't tilled have a saving of Rs. 1,200/acre on account of tractor hire and fuel costs alone.
- Soils under CA possess very high water infiltration capacities that significantly reduce surface run off and soil erosion. This improves the quality of surface water by reducing pollution from soil erosion and enhances ground water resources.
- No till fields backed with maintenance of crop residues act as a sink for CO_2 and as such conservation farming applied on a global scale could be a major contributor to address concerns of air pollution and climate change. Farmers applying this practice could eventually benefit from the system of carbon credits.
- Adoption of CA system offers opportunity for diversification of the cropping system. Cropping sequences when adopted in appropriate spatial and temporal patterns can enhance natural ecological process reducing vulnerability of yield stability by reducing pest/disease incidence.
- CA based zero-till and surface managed crop residue systems are an excellent opportunity to eliminate burning of crop residues that contribute to large amount of green house gases like CO_2, CO, NO_2, SO_2 and large amount of particulate matter.

Moving On

PACA would welcome hearing from you on any of your needs on the subject. As part of our endeavour, we bring out a bi-monthly newsletter that you can subscribe to by visiting www.conserveagri.org/links.htm or sending us a mail at info@conserveagri.org requesting for inclusion of your email address to our mailing list. We are also involving ourselves with field projects and that can be another way to be involved with PACA through a collaborative mechanism. If you are involved with improving the lot of farmers and have developed conviction with CA as an approach, we would love to hear from you. Finally, should you otherwise be interested to contribute in any manner, you could get in touch with us to share how you would like to be part of this movement.

Listed below are web sites that share information on the subject that you could visit through the "Links" page on our web site.

4th World Congress on Conservation Agriculture 2009, New Delhi

FAO - Conservation Agriculture Technology (CAT)

ECOPORT Conservation Agriculture

Asia-Pacific Association of Agricultural Research Institutions (APAARI)

Africa - African Conservation Tillage Network-ACT

Argentina - Argentinean Direct Drilling Association (AAPRESID)

Australia - Western Australian No-Tillage Farmers Association (WANTFA)

Europe - European Conservation Agriculture Federation (ECAF)

United Kingdom - New Agriculturist Online

Japan International Research Centre for Agricultural Sciences (JIRCAS)

The Conservation Farming Unit of the Zambia National Farmers Union

Conservation Agriculture: Conserving Resources Above-and Below the Ground

Is Conservation Agriculture an Option for Vulnerable Households?

Agriculturist online : Reporting Agriculture for the 21st Century

CIMMYT: Bringing Conservation Agriculture Home to Mexico

ACIAR: Australian Centre for International Agriculture Research

Science Daily : Agriculture And Tropical Conservation: Rethinking Old Ideas

Agriculture.indiazclub.com simplifying business

CropLife International : New Report Examines Innovative Conservation Technologies in Agriculture

Conservation agriculture holds promise for food production in Africa

People and Food and Agriculture: Conservation Agriculture

Brazilian Federation of No-Till Farmer Associations FEBRAPDP

About the Factbook

The Conservation Agriculture Factbook attempts to deliver the first level of information to a reader involved with agriculture and interested in knowing more about Conservation Agriculture (CA) as a concept and its elements. It will help you understand the need for the CA approach, its benefits, important elements of the practice, and how to move ahead, in an easy-to-understand manner to inform and point to other knowledge sources. In particular, the Factbook addresses the subject from a developing country's perspective whose needs are much different from those of farmers located in developed economies. We'd like to acknowledge FAO's knowledge base on the subject that has contributed to this effort.

About PACA

Professional Alliance for Conservation Agriculture (PACA) is a platform that has emerged from concerns surrounding agriculture, given its increasing importance and diminishing interest in today's world. Recent discussions surrounding food security, diversion of croplands for other applications, impact on climate change, and diminishing returns to farmers are all adding to heightening worry for farmers and policy makers alike. PACA will endeavour to be an agent of change working within the agriculture system, to contribute to improved food security for benefit of humans and environment. It will take a professional approach through a collaborative mechanism to address needs in a participative manner based on sound scientific and social principles.

PACA is promoted by Centre for Advancement of Sustainable Agriculture (CASA) and Society for Strategy Technology & Delivery for Development (SocietySTADD) as a platform to motivate concerned stakeholders involved with agriculture who wish to address the deteriorating situation. It hopes to function as a catalyst to incubate an alliance of concerned and well meaning professionals for the cause of agriculture.

Professional Alliance for Conservation Agriculture
1st Floor, NASC Complex, DPS Marg, Pusa, New Delhi - 110 012 INDIA
Tel.: +91-11-26496962 / +91-98101-12773
Website: www.conserveagri.org
Email: info@conserveagri.org

MARCH 2009