CA FAQs

Professional Alliance for Conservation Agriculture

Getting Agriculture to work for the farmer and environment

What is Conservation Agriculture?

Globally, the term 'Conservation Agriculture' is being used increasingly to refer to a way of raising crops that involves minimum disturbance of soil through tillage practices (ploughing, inter-culture etc), keeping the soil covered by maintaining crop residue on the soil surface, growing cover crops, and by adopting crop rotation/sequencing over time and space. Farming practices that are rooted in these three basic principles when adopted for growing field or horticultural crops over a period of time contribute to achieving productivity gains in a sustainable manner and are referred to as 'Conservation Agriculture' (CA). CA practices constitute a radical departure from the way crops have been raised conventionally. It is therefore important that all concerned (farmers, scientists, development agencies and others) clearly understand features of the new approach such that scientifically sound practices are developed and promoted.

Do the terms 'Conservation Agriculture' and 'Sustainable Agriculture' mean the same?

The difference between the two terms is that while the term 'Sustainable Agriculture' refers to a state of agriculture that we wish to achieve and is sound from a social, environmental and economic consideration, the term Conservation Agriculture refers to a practice that when adopted in an integrated way will contribute to achieving goals of a sustainable production system that will be more profitable for farmers, will be non degrading, environmentally benign, and suited to the prevailing socio-economic conditions. In short, Conservation Agriculture is the route to achieve goals of sustainable agriculture.

In what way are CA practices different from conventional agricultural practices?

As stated above, CA practices imply a major shift in the way crops are raised. In conventional agriculture, ploughing the land in preparation to crop seeding is considered a basic requirement. Normally, in any intensive production system, raising a crop without ploughing the land is almost unthinkable. In fact, it is not uncommon to hear a local version of the phrase *'The more you plough, the better harvest you get'* in many regions of the country.

Again, during the crop growing season and particularly in the initial stages of crop growth, farmers resort to inter-culturing operations that imply shallow stirring of soil, largely with an aim to control weed flora and for improved aeration of the soil. After harvesting, the crop residue is disposed in different ways depending on local conditions. In most situations, crop residue is fed to livestock. In other cases, crop residue may

be burnt or disposed in the market for timely field preparation to sow the next crop. Similarly, to counter adverse effects of declining soil fertility and increasing pest incidence in mono-cropped systems, farmers resort to increasing applications of chemical fertilisers and pest control chemicals, further reducing their profits. CA systems demand increasing adoption of crop rotations/sequences as a way to reduce use of external inputs to meet the requirements of fertility replenishment and pest control with a view to reduce dependence on external inputs that are also often associated with negative consequences. Thus, it is seen that CA constitutes a paradigm shift from the way agriculture has been practiced. Enabling farmers to adapt CA practices will require efforts of all concerned, including scientists, farmers and policy makers.

Do the terms 'Soil and Water Conservation' and 'Conservation Agriculture' refer to the same set of practices?

No, the terms 'Soil Conservation' 'Water Conservation' or 'Soil and Water Conservation' are more generic in nature and encompass the entire range of measures and practices aimed at conserving these two vital resources. The terms do not restrict themselves to agriculture aspects or in relation to crop production. Conservation Agriculture, on the other hand, refers to specific practices in relation to raising crops that promote optimal use of available soil and water resources while enhancing resource base quality.

How about 'Resources Conservation Technologies or RCTs'?

In recent years, the term 'resource conservation technologies' or RCTs, has been used to refer to practices like laser land levelling, bed planting of crops in bed-furrow system, or zero-tillage for planting wheat and other crops. These and other practices that enhance resource or input use efficiency have been termed RCTs. A distinction between RCTs and the Conservation Agriculture practice is important as the two do not refer to the same practice. Thus some RCTs like zero-tillage without residue retention on the soil surface and without suitable rotation while may be found attractive in the near term, may be quite unsuitable in the longer term. On the other hand, many practices that may qualify to be called RCTs e.g. bed planting, drip or sprinkler irrigation or land levelling may not strictly constitute 'Conservation Agriculture'. Thus, while there are many RCTs that will contribute to resource conservation under some situations, not all of them will get defined as Conservation Agriculture.

What about Organic Farming - How does it differ from Conservation Agriculture?

The term organic agriculture (OA) refers to the system of raising crops that does not involve use of chemical inputs (e.g. fertilisers or pest control

chemicals). The system has evolved as a reaction to the perceived adverse impact of chemicals on food quality and environment in the past. Organic farming calls for "do's" and "don'ts", also driven by market needs. On the other hand, Conservation Agriculture practices are guided by a set of scientifically sound universal principles, that when translated into appropriate location specific technologies and practices contribute to achieving goals of sustainable agriculture. The emphasis in CA is on how best to conserve and optimally use farmer's own resource endowments in an optimal way. CA is an approach to farming that integrates concerns of resource degradation on one hand and enhancing productivity through sustainable intensification on the other. In some ways, the two approaches i.e. CA and organic farming are not very contradictory. The aim of CA approach is also to reduce dependence on use of external inputs by adopting more integrated nutrient and pest management strategies. However, unlike organic farming the approach is not restrictive and therefore provides opportunities for wider adoption in a wide range of situations.

To what extent have farmers adopted CA systems?

The conservation agriculture system has evolved in response to farming problems that are basically the same around different parts of the world. CA practices are now being widely adopted in many countries across the globe, particularly large tracts in USA, Canada, and Australia. Amongst developing countries, farmers in Latin American countries of Argentina, Brazil, Paraguay, etc have been adopting CA principles to their respective situations. Globally, it is estimated that more than 100 million ha area is covered by CA practices. In India, a good beginning has been made with the wide adoption of zero-tillage sowing of wheat crop in rice-wheat cropping system in north-west India. However, as indicated earlier, CA principles extend beyond tillage and call for a more holistic development and adoption of practice rooted in the principles of CA. There is tremendous opportunity to build upon our past efforts and across many farming situations.

Our past experience is largely with irrigated rice-wheat cropping system. What are the opportunities for adopting CA system in rainfed situations?

Yes it true that in India resource conservation technologies have been developed in response to sustainability issues affecting high productivity irrigated rice-wheat system. However, CA approaches in other parts of the world have evolved in relation to a variety of rainfed farming situations and have been successfully adapted over vast areas. Thus, practices based on CA principles can be adapted under both irrigated and rainfed situations. Indeed, considering the nature and severity of limitations

influencing sustained productivity increases, rainfed and limited water situations would appear very promising for uptake and wider adoption of CA based practices and technologies. In India, rainfed farming is practiced under a wider range of soil and rainfall conditions. Widespread problem of resource degradation and climate related aberrations are the primary factors contributing to continued low levels of productivity. CA practices hold promise of reducing or slowing resource degradation and enabling optimal use of limited resources. Thus, CA approach can be adapted to a wide range of situations, both irrigated and rainfed.

In the past, most technologies have tended to benefit chiefly the relatively large farmer and very few, if any, technologies have benefited the small land holder poor farmer. How do you see CA approach in relation to the needs of a small farmer?

It is true that practices like zero-tillage and surface retention of crop residue were adapted by large farmers in countries like USA and Australia in the first instance. Over the years, the basic principles of CA, viz. causing minimal soil disturbance, maintaining crop residues on soil surface and crop sequencing have been adapted to suit a range of farming situations that include both medium and small farmers. As indicated earlier, CA is a larger approach and specific technologies that build upon basic principles of CA must be developed and adapted to specific situations. Thus, CA practices will equally benefit large and small farmers. In fact CA practices are likely to prove more attractive to small farmers who largely depend on their own limited resources and less on external inputs. Experiences in India have shown that institutional arrangements like custom hiring is proving very practical to obtain access to equipment like laser land leveller or a zero-till drill that might otherwise be costly to own by a small farmer. It would thus appear that CA practices have the potential to benefit small and large farmers alike. However, the technologies will need to be evolved considering specific conditions.

In India, wheat grown in the rice-wheat cropping system is the main crop in which zero-tillage has been adopted widely by farmers. What about other crops and cropping systems?

It is true that zero-till planting has evolved and been adopted widely for sowing wheat crop grown in rice-wheat cropping systems. However, a beginning has been already made by growing other crops adopting zero-till techniques. Scientists at Haryana Agricultural University are promoting the use of zero-till seed drill for sowing crops like *bajra* in the *kharif* season. Elsewhere, crops like maize and soybean have been grown successfully adopting zero-till technology. Adapting zero-till machine and CA practices for different crops and cropping system call for farmers and scientists

working in a participatory way so that technologies can be continuously refined and improved. Thus, CA approach has the potential for wide range of cropping and farming situations.

Is it true that zero-till planting is the key technology in pursuing CA approach?

YES and NO

Yes, because causing least disturbance of soil is one of the key principles of CA approach. Tillage operations cause soil disturbance that in turn, over a period of time, reduce soil's productive capacity by adversely affecting soils' physical, chemical and biological properties. Zero-tillage entails very little soil disturbance and farmers have adopted the practice because of benefits that come to the farmers by way of reduced cultivation cost.

NO, because zero-tillage is only one component of the practice that goes in to constitute CA approach. The other two equally, and perhaps more, important practices include keeping the soil covered and adopting appropriate cropping sequences in space and time. To keep the soil covered, it is important to leave some fraction (say a third or more) of crop residue on the soil surface. Maintaining residue on soil surface is what initiates a series of steps/processes that contribute to building the soil's productive capacity to sustain improved productivity. If this practice is not followed, the benefits of even zero-tillage may not last long. In fact, zero-tillage alone in the absence of crop residue maintained on soil surface may prove detrimental. On the other hand, zero-tillage when combined with residue left on soil surface results in build up of soil's productive capacity that helps achieve goals of sustainable agriculture. The third principle of CA, viz., adoption of crop rotation and sequencing further helps in better cycling and use of nutrients in the soil and building of favourable defence amongst disease and pest populations. In conclusion, what is desired is to pursue CA practices in an integrated manner to get optimal benefits of the new approach.

In conventional farming tillage operations are considered a necessary step to prepare a soil that is favourable for germination and initial growth of young seedlings. Tillage operations are also considered necessary for control of weed flora and soil aeration. How does one reconcile with these needs in the CA approach?

The principles that form the basis for CA approach to sustainable agriculture is the result of many years of experimentation, experience and knowledge gained under a range of agro-ecological situations. Thus, it is now well established that seed germination and emergence of seedlings from the soil very largely depend on proper depth of seed placement that

ensures adequate availability of moisture. These requirements can be met by developing appropriate equipment for seed placement in unploughed soil (e.g. through zero-tillage drill), and result in perfect germination and crop stand. As for weed control, it is true that one of the aims of tillage is to control or reduce incidence of weeds and pests. It is also likely that when the soil is not ploughed and the seeds are sown under untilled conditions, the dynamics of weed flora might change. Experience has shown that available chemicals can adequately control weeds in initial years, but with passage of time, if appropriate crop sequences are adopted, the weed infestations would be significantly lowered with lower dependence on chemicals. Thus, it would seem that while CA practices would require to be adjusted to the new pest scenario, available technologies can adequately address the altered situation.

For how long can crops be sown without tilling the land?

In principle, tillage is not required to raise a crop successfully. However, since CA based practices have been promoted in India only over the recent years, farmers have not had an opportunity to gain experience over many years. In countries like Brazil, where CA practices have been practiced for over two decades, farmers practically do not till the land and crop after crop are raised under no-till conditions without causing major soil disturbance. In India, zero-tillage has till now, been practiced largely for sowing wheat after harvesting rice crop. Farmers have been sowing wheat without ploughing the land after harvest of rice for about 6 to 8 years. Experience with cropping systems other than rice-wheat in India is limited. However, experiments on research stations of Haryana Agricultural University and Central Soil Salinity Research Institute have shown that in cropping system like bajra-wheat or soybean-wheat, both crops can be grown year after year without disturbing the soil. Thus, it would seem that while CA practices offer opportunity for continued no-till cropping, it would be important to build on experience and knowledge as we gain in both.

What about aeration of soil? Will not crops suffer due to lack of aeration in the absence of ploughing and post-irrigation tillage in early phases of crop growth?

It is widely perceived that tillage operations open up the soil and enable root zone aeration. However, much scientific evidence points to the conclusion that aeration of the root zone becomes a limiting factor for crop growth chiefly when surface soil conditions get saturated with water even for brief periods e.g. after irrigation or a spell of rainfall. This problem is greatly accentuated when the organic matter content of soil becomes very low, the soil structure becomes weak and soil aggregates breakdown. Crop yields are adversely affected due to short term aeration and oxygen

deficiency in the root zone. Unable to find a correct solution to the problem, farmers are inclined to increase the dose of nitrogenous fertilisers to compensate for possible yield losses on this account. Rarely is aeration of soil a problem when the soil is relatively dry. When zero-tillage is practiced and crop residues are maintained on the soil, the capacity of soils to absorb rain or applied irrigation water improves as a consequence of soil surface improvement and thus soil surface is not likely to remain saturated for any considerable time. Further, with time, the overall biological activity in the soil increases that further opens up the soil, creating many more pores and channels in the soil that improve soil aeration. Thus, in a way, CA practices contribute to encouraging the natural biological activities to perform the same functions as is expected from ploughing and tillage operations.

Maintaining crop residue on the soil surface as a part-recommended CA approach could offer many difficulties. In most rainfed or limited water availability regions biomass available from crop residues is almost entirely used as cattle feed or is used for fuel purposes. Leaving the crop residues on soil surface therefore might not be an attractive proposition to farmers?

Yes, this is true. Availability of crop residue varies widely with prevailing farming situation. In many irrigated areas, where plenty of crop residues are available, farmers often resort to burning crop residue to free the fields for cultivation and sowing the next crop. (rice-wheat farmers are a good example). The adverse impact of burning biomass on soil quality and the environment and health of local communities is now being understood. In limited water availability regions, competition for use of biomass for fuel and livestock feed will imply résistance by farmers to spare the same for needs of crop cover. This being so, there will be a need to demonstrate and convince farmers of the benefit of CA practices, both in the short and long term. Initially, the farmers will need to be encouraged to leave some residue so that seeing the benefits that will accrue; they are encouraged to adopt the practice on a wider scale. There will also be a need to consider and explore policy options that encourage farmers to adopt CA practices.

Have the CA practices been adopted by small farmers in a significant way?

As indicated earlier, CA based practices lend themselves for adaptation equally to small as well as large farmers. Initially, CA practices were largely adopted by relatively large farmers but over the past two decades CA practices have been increasingly adopted by small farmers in countries like Brazil, Argentina, Paraguay, etc. In India, zero-tillage practice was first adopted widely by rice-wheat farmers for sowing wheat crop following the

harvest of rice in the north-west region (states of Punjab, Haryana and western U.P.). The practice is now catching up with farmers in eastern UP and Bihar. Thus, it is safe to conclude that CA practices can be adapted to farming conditions of small farmers. What will be needed is that CA practices are adapted considering the conditions of small farmers e.g. the way they cultivate their land at present, the kind of equipment or power available to them, crops/and farming situation, etc. The need to enhance productivity and sustainable resource use is greatest for small farmers with little capacity to invest. If this can be met, CA practices offer an opportunity for sustainable enhancement of productivity and resource quality of small farmers.

What about nutrient management practice in CA systems? Will they be essentially same as in conventional systems?

Based on overall experience, it would appear that there would be a need for only marginal adjustments in the recommended fertiliser rates, placement and timings when CA practices are adopted in place of conventional practices. Tillage operations encourage mineralization of soil organic matter and therefore release of nitrogen consequent upon decomposition of organic matter. However, amounts are small on account of low levels of organic matter in our soil. Further, maintaining residue on soil surface will entail binding some amount of nitrogen for organic matter build up implying that somewhat higher amounts of nitrogen might be required in initial years of adoption of CA practices. Improved soil moisture and biological activity on the other hand would imply more efficient utilisation of applied fertiliser nutrients resulting in savings on account of the fertilisers, particularly nitrogen. With time, the dependence on fertiliser could decline. In particular, the observed increasing deficiencies of micronutrients would very likely decline.

Given that the adoption of technologies rooted in the principles of Conservation Agriculture offer multiple potential benefits, what is constraining their adoption?

Although zero-tillage has been recommended and adapted for some years, the concept of Conservation Agriculture in totality is being understood and appreciated increasingly only more recently. The biggest impediment in developing and promoting CA based technologies is the challenge of bringing about a change in the mindset of both, the farming community and scientists. Conservation Agriculture based practices constitute a radical departure from conventional agricultural practices and will therefore call for much effort aimed at educating the farmer on the benefit of the new approach. In many countries where CA practices have found wide acceptance a major initiative came from farmers that had a strong

support from scientific community. Farmers are relatively quick to adopt new technologies if they see a direct benefit. With their holistic understanding of the farming system and a strong capacity to innovative, farmers are generally quick to adapt new technologies to their farming situations. They also bring experience and traditional knowledge to bear upon new ways of farming. This makes it imperative that scientists and farmers engage themselves together in promoting and adapting CA practices under a range of agro-climatic and farming conditions. This is the way forward.

About the CA FAQ Book

The CA FAQ book has been written to clear the air about various aspects of CA from a conceptual framework. The form of Frequently Asked Questions has been undertaken to address questions in a more direct manner. We hope the issues presented and clarified will help bring clarity to the subject of conservation agriculture. This is a dynamic edition that we will keep updating electronically and we look forward to your feedback and further questions that merit inclusion. For a more basic understanding of conservation agriculture you may download the Factbook from the following link: www.conserveagri.org/factbook.pdf.

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) 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.

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