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Conservation Agriculture newsletter

Getting Agriculture to Work for People and the Environment

Karnataka Farmer Shows the Way to Conservation Agriculture

This article presents a case study of Suresh Desai, a farmer from Karnataka, India, and has been adapted from an already published article titled "No-till sugarcane cultivation with alternate row irrigation, Belgaum, Karnataka, India".

EDITOR's NOTE

Food availability and security are major issues coming under further strain with increasing variation in climatic parameters. Agriculture being dependent on natural resources is at high risk and scientists the world over are doing extensive research and experimentation to develop coping strategies. Farmers of different agro-ecological regions too are equally keen to address the emerging situation. They not only have a sound understanding of the problem but many are in fact capable of carrying out adaptive efforts to sustain their agriculture. There is a need to understand and acknowledge such efforts and those being pursued to conserve natural resources. Keeping this objective in mind, this article presents Suresh Desai's innovative farming practices citing conservation of natural resources on one hand, and high productivity with lower inputs on the other that have helped him make a positive move towards sustainable agriculture.

Like any other farmer of the region, Suresh Desai with a landholding of 4.5 ha in Belgaum district of Karnataka grew sugarcane - a water intensive cash crop, and tomato, adopting conventional practices and relying heavily on external inputs like fertilisers, pesticides, etc. Suresh's yield for sugarcane was about 75- 90 tonnes a hectare, very much like that of his neighbours. However, Suresh started having second thoughts as he noticed a process of degradation unfolding in his fields. The crops became increasingly affected by pests and disease, the soil gradually lost its native fertility and structure, and water supply started dwindling.

Factors that stimulated thought

At that point, it occurred to him that, in fact, there was plenty of residue available mainly from the sugarcane fields that were hitherto not being put to any particular use. With prices of external inputs escalating, Suresh began venturing into experiments that could bring a change in cultivation practices in his sugarcane field. *Suresh observed that the driving factor for shifting away from conventional farming was largely on account of economic considerations.* The understanding that organic materials were available and that their use could reverse the process of land degradation pointed a way out to Suresh.

Evolution of the Suresh Desai Model: Changes Adopted in the Field

CHANGE 1: COMPOSTING

The first attempt was made at composting the residue and using this to fertilise the sugarcane crop. In this way, Suresh was able to reduce the input of chemical fertilisers to a certain extent. However, composting involved a lot of labour for collecting, mixing, watering, and finally hauling the organic matter back to the fields to be ploughed in. Suresh reasoned that if the work of transporting compost from the composting site to the field was avoided, it would mean a considerable saving in terms of time and labour.

CHANGE 2: IN-SITU ORGANIC RESIDUE APPLICATION

As a next step, organic residues were incorporated *in situ* in the fields that produced them. With this effort, Suresh was able to reduce the application of chemical fertilisers by 50%, while maintaining the same production levels.

Around this time, problems related to irrigation in heavy black cotton soils started to show up. In particular, groundwater level had declined drastically, while the fields became slowly gorged with water and laden with salts. *The learning from this was that it was irrigation itself that was responsible for this slow but steady decline in quality of soil.*

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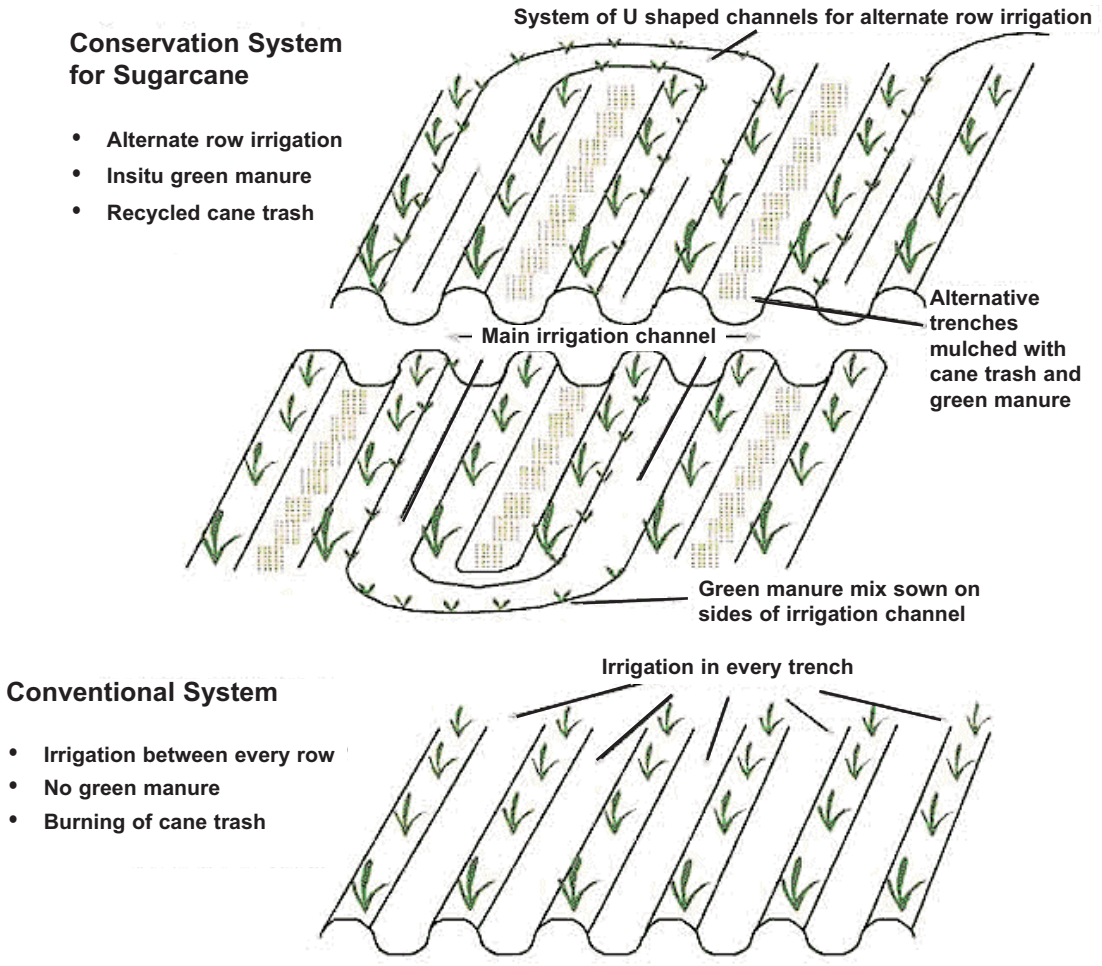


Fig. A1: Suresh Desai Model

CHANGE 3: TRASH AS A MULCHING SOURCE

Salt accumulation in the root zone brought the third change in Suresh's thinking and agricultural practice. Suresh imagined that if the trash obtained after cutting of the canes could be kept "on" the soil as mulch, evaporation losses would be significantly reduced, the need for irrigation would diminish, and the salinity problem would eventually be overcome.

By keeping all the trash on the fields as mulch, Suresh found that irrigation became very difficult since the trash obstructed the flow of irrigation water. The idea that the trash could be kept in one row and that the water could be provided in the next row became the solution to this problem. He calls this the "one-in-two" irrigation system. Moreover, by connecting two parallel irrigation rows with a perpendicular trench at the ends, he made watering the fields much easier as depicted in Fig A1 above.

In this manner, in one go, Suresh Desai was able to reduce his irrigation requirement by 50%, and after harvesting the cane, the remaining trash was gathered in the row previously used as the irrigation channel.

CHANGE 4: GREEN MANURE AS SOIL CONDITIONER

Continuing in this way for three years, Suresh observed a remarkable improvement in his soil quality and an amazing increase in soil life. He also started using a soil conditioner and introducing green manure between the rows of cane and found that dependence on chemical fertilisers reduced. He also noticed that his crops seemed healthy and that there was no more need for chemicals to combat pests and diseases.

CHANGE 5: NO-TILL ADOPTION

Furthermore, because of the intense soil life and the action it manifested on the soil, Suresh toyed with the idea that cultivation could perhaps be stopped altogether, that he did. Now for more than 10 years, his fields have not been ploughed and the only soil work attended has been periodic maintenance of irrigation channels.

This is how Suresh Desai's Model evolved while responding to different problems raised during the course of his experimentation.

Impact of Experiments/Innovation

IMPACT ON NATURAL RESOURCE BASE

Water Resources

Ever since ploughing was stopped, the water-retention capacity of the soil improved further. Consequently, irrigation frequency was reduced from once every 10-12 days to once every 20-25 days, thereby achieving a further saving of 50% in water requirement.

Suresh discovered that cane crop thrived even when irrigation was further reduced to 1 in 3 rows. This meant further saving of water. Now Suresh is experimenting with pushing the lower limit of irrigation to 1 in 4 rows.

Impact on soil health on account of innovative practices pursued on the farm		
Factors	**Ways of Soil Fertility Improvement**	**Impact on Soil Health**
Reduced irrigation	• Minimized accumulation of salts in the root zone • Reduces nutrient leaching • Minimizes soil compaction	Using these four factors, the soil becomes very fertile, healthy and sweet, reducing irrigation requirement only once in 25 days. The proof of this is Suresh Desai's canes that grow fast, are vigorous, sturdy, and problem free.
Trash composting	• Reduced evaporation • Increases in soil fertility by the decomposition of trashes	
Green manuring	• Increases the soil nutrient base, mainly nitrogen	
Soil conditioning *(slurry consisting of 250 grams of wet yeast and 500 grams of jaggery, mixed with 10 kg of cow dung and little water used as soil conditioner)*	• Enhanced decomposition of sugarcane trash by enhanced proliferation of fungi • Increase in water retention capacity of soil	

On the whole, Suresh's system enables a reduction in water usage by 75-80% in comparison with conventional usage, for a crop that is known to be water intensive.

Soil Resources

Soil fertility in the farm is maintained by the combined effect of four factors i.e., (a) Reduced irrigation, (b) Trash composting, (c) Green manuring and, (d) Soil conditioning. This has been represented in a table on the following page.

IMPACT ON ECONOMY

The farmer has been able to drastically reduce his cash investment per hectare mainly on account of 30% reduction in labour and the indicated reduced water requirement. Comparative figures between Suresh's farm and that of conventional farmers is given below. Investment figures indicated are averages.

Suresh Desai	in INR*	Others	in INR.*
Cost of inputs/ha.	3,700	Cost of inputs/ha.	15,000
Yield 100MT/ ha. @ Rs 600/MT	60,000	Yield 110MT/ ha. @ Rs 600/MT	66,000
Net profit	56,300	Net Profit	51,000

** INR = Indian Rupee, 1 USD = INR 46.70*

In certain conventional cases, when farmers want to push their yield above 120 tonnes, the cost of input can soar up to INR 24,700 per hectare. In case conventional cultivation is pursued, costs increase further on account of additional external inputs used.

Other Impact

The overall impact was felt much beyond the factor of mere yield as seen below:

- The canes matured faster in 8-8.5 months compared to 11-12 months in conventional system.
- Sugar recovery is better in such cane than in synthetic fertiliser based crop (11.5% against 11%).
- Even though smut and grassy shoot posed problems in the region, the cane on Desai's farm did not show evidence of any of these. Neither chemical nor botanical sprays were needed.
- An average yield of 100 tonnes per hectare is being obtained at Suresh Desai's farm. Others who follow conventional practices get an average of 110 tonnes per hectare, but at a much higher cost/tonne.
- Suresh claims that the amount of irrigation water needed is even less than that consumed by sprinkler irrigation.
- As minimum tillage is practiced and there is no fallow or replanting of sugar cane, labour requirements have reduced.
- The focus on natural biological cycles has caused an impressive increase in soil biodiversity. This biodiversity is now working for him, maintaining yields.
- The use of traditional dry farming crops in the green manure mix functions as a gene pool for rapidly disappearing species.

The Continuous Process of Learning and Design Improvement

Suresh's farming experience has led him to develop an altogether new plan for his sugarcane cultivation covering:

- Increased spacing between settes and rows
- Stimulation of tillering by the "snapping method"
- Inter-cropping with dryland food crops between sugarcane

In conventional practice, the space between rows of cane is 0.75 to 1 m, and within rows the space between settes is about 15 cm. This close planting system requires up to 7.5 tonnes of seed material per hectare. In Suresh's new design, only 1,000 to 1,250 kg of seeds will be required per hectare. The new improved plan comprises a paired row technique with a distance of 1 to 1.25 m between the paired rows, a 30 cm foot distance between the settes within a row, and a 2.5 to 3 m distance between a set of paired rows as shown in Fig. A2.

Suresh is confident that with increased spacing as recommended in his new design, more tillers will appear. He also uses an effective technique to stimulate tillering. This involves snapping off the first shoot after a 45-day period of growth. Suresh already has some experience with this snapping method which is a traditional practice in his area.

(Contd. on page 6)

Indigenous Conservation Agricultural Practices Developed by Tribal Farmers of Mizoram

Dr. Kamta Prasad

The lead author of this article is Dr. Kamta Prasad, with significant contribution from Dr. Brajendra, Dr. Rakesh Kumar Singh and Dr. R.P. Verma

Mizoram is a mountainous state, covering an area of 2.11 mn ha, with sub-tropical to humid climate, high gradient, and annual average rainfall varying from 1762 to 3469 mm. Compared to other hill states in the North Eastern region of India, the slope of Mizoram hillsides is steeper and more susceptible to large-scale soil erosion. The major cropping system is “slash and burn” cultivation also known as “shifting cultivation” (also locally known as *jhum*) that occupies an area of 36,285 ha. Another major problem is of moisture deficiency in winter. Both these factors adversely affect crop productivity. However, to combat these problems, farmers have evolved, developed and perfected various location specific, viable, and low cost traditional soil conservation techniques to suit specific environmental conditions. Therefore, these technologies need to be identified, analyzed and documented, since often the treasure of knowledge and wisdom is associated with them. Analysis is also necessary for a perfect blend of traditional knowledge with modern scientific knowledge leading to the development of sustainable, location specific, viable, low cost and profitable technologies.

A preliminary survey was conducted to have a first hand knowledge of the area for which seven agriculturally important districts were selected. One community development block, 2 villages, and 30 farmers per village were randomly selected per district. The study was carried out applying Participatory Rural Appraisal (PRA) technique with farmers/persons being key informants, most conversant with the village situations and its problems. About 15-20 farmers per village were asked to identify the most knowledgeable, respected and helpful farmers in the village and rank them as per their choice. From the list, top 5 persons per village were identified as key informants.

The listed practices were discussed and verified in the meeting convened in each village. All practices were shared and only practices where consensus was reached was retained for further in-depth study.

Some of the prominent indigenous techniques that emerged are described as under:

Maintenance of ground cover throughout the season

Due to burning of biomass, soil upto a depth of 20-30 cm becomes loose and prone to erosion. To minimize erosion, fast growing crops such as watermelon, cucumber, muskmelon, pumpkin, snakegourd etc. are sown in the month of March such that the bare field is covered at a faster rate before occurrence of heavy rainfall in the month of April. At the next stage, slow growing crops like paddy, sesame, lady’s finger, winged bean, chilli, brinjal, papaya, colocasia, yam and maize is sown to utilize the space left open to provide extra cover to the soil to minimize erosion. In every *jhum* field, cereals and leguminous crops are grown together. The fast growing legumes provide soil cover early in the season, shielding the impact of raindrops. Sowing is done by dibbling of seed of different crops by a person or different persons at different hills, disturbing the soil surface to the minimum. It is pertinent to mention that when crops like maize, vegetables and early paddy were harvested in the months of June, July and September, respectively, sesame, french mustard and soyabean were sown to utilize the vacated space and residual soil moisture for economic gain as well as to minimize soil erosion. Thus, the crops in *jhum* are taken in relay, overlapping cropping systems maintaining ground cover throughout the crop season to check soil erosion.

***Jhum* Without Burning**

This type of *jhum* cultivation is practiced by farmers in Serchip district where slope is high, making the soil vulnerable to erosion at a much faster rate when cultivated after burning of bio-mass. In course of time, farmers have realised the problem and evolved a new practice under which slashed biomass is left unburnt for partial *in-situ* decomposition and soyabean seed is broadcast over slashed biomass. Farmers believe that in this system, soil erosion is minimized and yield of soybean crop is higher as compared to crop grown after burning of biomass.

Surface Seeding

This is the simplest system of zero tillage or conservation tillage which is generally practiced in paddy fields. In low lying poorly drained heavy rice soils, at the time of harvesting of paddy in the month of November, soil moisture is too high which does not allow timely tillage operation for sowing till the month of January. This has forced farmers to leave the field vacant. They have evolved a practice of sowing mustard by broadcasting in

Fig. B1: Resultant crop from surface seeding

the saturated soil surface without any tillage operation. However, sowing on the open soil surface makes it possible for seed to be damaged or eaten by birds and to protect the seed from damage by birds, farmers essentially prepare a thin layer of cow dung on the seed surface after sowing. It is widely practiced by small and marginal farmers in Serchip and Champai districts and the practice cuts down cost of production and does not require implements.

No Till or Pot Holing

Kharif crops residue, weeds, etc. are slashed and left on the ground to dry and act as mulch. Sowing of bean, pumkin, okra, etc. are then done in the month of October-November without disturbing the soil, except for planting holes that may be made using a digging stick or hoe. Under this system, very minimum soil surface area is exposed to direct sunlight so that evaporation can be kept to a minimum and the crops can use the maximum residual soil moisture. In this manner, farmers are able to use residual moisture that would have otherwise been lost. This system enables farmers to grow a second crop after harvesting of *kharif* crops without irrigation and helps reduce cost of cultivation and soil erosion, yet increases the farmer's income. It is now a well established practice in wet rice cultivation areas of Mizoram.

Fig. B2: No till or pot holing

Mulching

Acute moisture stress during winter is a common phenomenon owing to negligible rainfall, and evaporation and seepage of water from hill top to lower reaches. To save tree saplings and other crops, weeds, crop residue, stubble, trash etc. are slashed and spread over the field as mulch. Mulching often minimizes erosion and conserves *in-situ* moisture, besides reducing the weed menace and is particularly practiced with the sugarcane crop. Under this system, trash and bagasse are not used as fuel for jaggery making but rather spread in the field as mulch. After an in depth enquiry, it was observed that if this practice would not have been followed by the farmers, they might not have been able to take up the ratoon crop of sugarcane because of acute moisture stress condition which does not allow sugarcane clumps to survive without mulching. Mulch protects the clumps and newly emerged tillers from direct sunlight as well as checks the evaporation loss of soil moisture. Trash mulching is widely practiced for sugarcane crops in East Lungdar Block of Serchip district. In new Serchip block of Serchip district, it is also practiced for rabi maize. After crop harvesting, stem remains are cut into 2-3 pieces and spread in the field as mulch. The crop residue left on the surface cushions rain drop impact, and reduces runoff water loss, resulting in improved water penetration, minimization of soil erosion, and improvement of soil structure and fertility. It also reduces cost of cultivation, minimizes water requirement and increases yield.

Fig. B3: Mulching with bagasse and trash

These indigenous soil and water conservation methods play an important role; however they are highly location specific. Agronomic and vegetative measures alone have not been very effective where marginal lands like steep slopes are put under cultivation as a result of pressure on land. Some of these measures are labour intensive and difficult to mechanise. Mechanisation is also difficult due to undulating topography which poses difficulty in transportation of men and materials, increases cost, and accelerates erosion due to heavy disturbance of soil, etc. Despite such limitations, these are good measures that farmers are experimenting over a long period of time. Further, these techniques are sustainable, cost effective, and use locally available materials and expertise. Hence, these practices should be promoted to make agriculture an economically secure pursuit through indigenous soil and water conservation practices. Further, research should be conducted to improve existing practices so that findings can be applied to other similar situations.

Your Feedback is Important to Us

As always, we look forward to hear from you on your opinion about the PACA newsletter and how it can be improved further. Write in at info@conserveagri.org to help us improve our content.

Have you read our past issues? You can download them and other reading material from the following link www.conserveagri.org/links.htm

Karnataka Farmer Shows the Way to Conservation Agriculture

(Contd. from page 3)

Initially, Suresh recommends growing of green manure crops in the larger space between paired rows. But, the ultimate aim is to use this space to grow other "dryland" food crops, such as grains, oilseeds and pulses. These "dryland" crops will benefit from the moist soil environment created by irrigating the canes.

Suresh estimates that he will be able to maintain the same cane yield with this new system. In any case, he will have reached a very high level of efficiency in utilisation of irrigation water. Suresh sees this as his major achievement and this is a great source of contentment and meaning in his life as a farmer. Notwithstanding all his innovations and savings of water, Suresh has been able to maintain his yield at around 100 tonnes of cane per hectare.

Although, Suresh recycles all organic residue as trash compost, he uses the same cane variety as other farmers (Nr.7/40) which is apparently a low-trash variety. He does not use any extra manure such as farmyard manure, compost, bagasse or press mud or any foliar sprays such as cow urine or vermiwash that could further improve his yields.

Diffusion effect

At present, around 250 neighbouring farmers are following Suresh Desai's method, or variations thereof with a total of more than 300 hectares coming under this system of farming with the diffusion process still continuing.

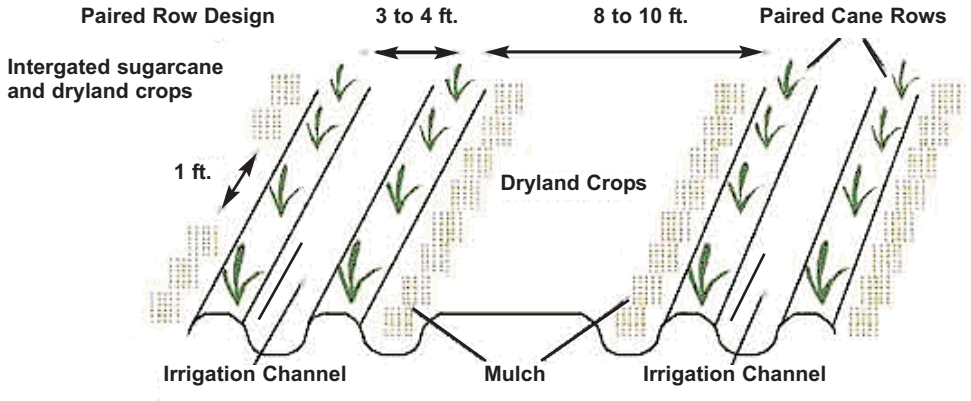
As part of his simple extension approach, Suresh organises "farmer days" inviting farmers to view his fields. The concept is explained and discussed right in the sugarcane field, and if some farmers are convinced about switching over, steps to be taken are clearly spelt out. For most farmers, Suresh advises the use of compost and oil-cake initially to give the organisms needed for the processing of the trash a boost as the oil-cake serves as a trap for the fungi.

Not all farmers stop using chemical inputs in totality. Some have not gone beyond the 'one-in-two' irrigation method. On the other hand, some farmers who have adopted his method have obtained much better results than Suresh himself. Many variations of the method can now be seen in and around Bedkihal, Belgaum District, Karnataka, where Suresh has practiced the new form of sugarcane farming. Some farmers use trash composting with drip or sprinkle irrigation while some use extra organic inputs such as press mud or bagasse, while some others continue to use a small quantity of chemical inputs. The number of farmers taking up Suresh's method is growing slowly but steadily.

Constraints observed

One of the constraints observed is that labourers are not willing to work in his fields because of fear of snakes and scorpions that are believed to live under the mulch in spite of the fact that no untoward incident has ever

Fig. A2: Suresh Desai's U-shaped channels for alternate irrigation



occurred during the eight years that Suresh has been farming using the alternative approach. However, now that more farmers are following his method, this constraint is disappearing.

Limitations to wide adoption

Only farmers living in the surrounding areas have access to his fields to build the necessary conviction.

Recently, a few mentions been found in the local newspapers and radio programmes. Preparation of audio-visual material, such as slides and video have now been initiated so that a much larger public can be reached.

Farmers who visit Suresh's fields might be initially disappointed, as no "bumper" crops will be seen to satisfy their expectations. They will on the contrary see crops that look sturdy and remarkably healthy, but for the rest, the yields will seem nearly the same as theirs. There is a tendency to evaluate 'success' of alternate practices in terms of "yields" alone. This is misleading because what is important is not only the "profit", but also the "quality" and "long term sustainability". As Suresh has managed to cut down on resources deployed and inputs, including labour, his investments have remained low while his yields are close to others. However, his net profit is higher than that of a conventional farmer.

From Suresh's experience, it can be seen that a diverse soil biodiversity is a powerful tool to build the foundation of sustainable agriculture. As Suresh has demonstrated, individual farmers are an important source of innovation and should be supported in their field experiments and further in diffusion of their learning. They should be encouraged not to stop experimenting once they have achieved one result but should continue striving to improve their farming system in the face of an ever changing agro-ecosystem. Finally, what is important is that Suresh is happy and satisfied with his results, encountering fewer risks and does not need increased cash investment to get stable and assured returns.

Synergy Between Innovations and CA Principles

Most innovations adopted by Suresh Desai's are inclined towards principles of CA. The detailed illustrations of the amalgamation of Suresh Desai's innovations and CA is presented in table below.

Similarity between Conservation Agriculture practices and Suresh Desai's Farming

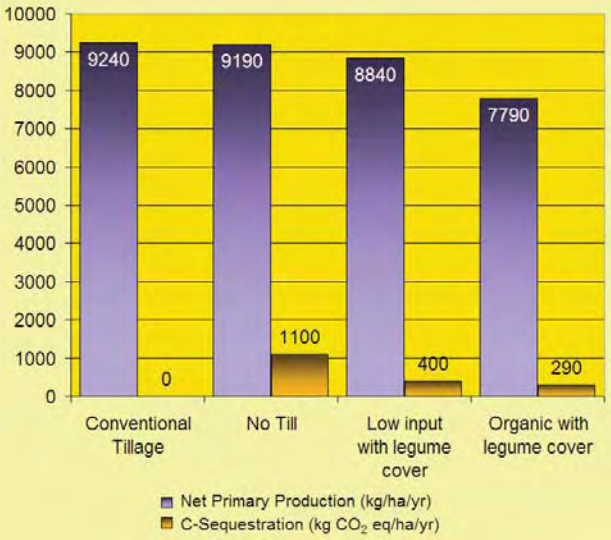
	Innovations in Suresh Desai's farming	
CA Principle	**Innovation**	**Contributing Factor**
Minimum soil disturbance	Adoption of no-till farming	- Improved soil health
Keeping soil surface covered	In-situ residue management (using sugarcane trash residue as mulch)	- Reduced irrigation demand - Combated soil salinity
Diversified cropping practices	Adoption of intercropping ('dry land' crops as intercrop + Sugarcane as main crop)	- Regular source of income - Controlled pest infection - Enhanced fertility

INFOPIX

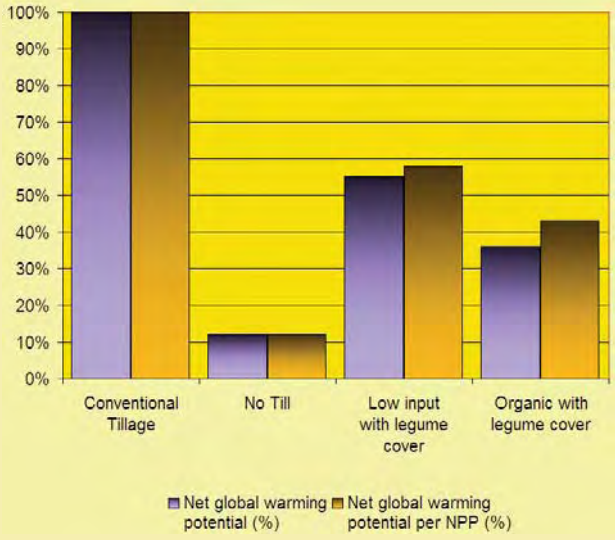
This section will present research data in pictorial form from past studies for benefit of readers

Above Ground Net Primary Production and Global Warming Potential

NET PRIMARY PRODUCTION



NET GLOBAL WARMING POTENTIAL



In a Michigan State University study, Robertson, et al. (2000) calculated the net primary production (NPP), C-sequestration and global warming potential (GWP) for conventional tillage, no tillage, low input with legume cover, and organic with legume cover. The results revealed that no-tillage systems have the highest C-sequestration (1100 kg CO_2 eq/ha/yr), and the lowest net global warming potential (12%) compared to conventional and organic faming systems. The net global warming potential per NPP in a no-till system was also found to decrease by 88% compared to the conventional system with less difference in the NPP (9240 in CT and 9190 in NT).

Source: Robertson, G.P., Paul, E.A., Harwood, R.R. 2000. Greenhouse gases in intensive agriculture: contributions of individual gases to the radiative forcing of the atmosphere. Science 289, 1922-1925

Climate Change and Conservation Agriculture: Overarching Themes for Agricultural Research and Development – The Case Study of Mewat

This article by PACA editorial team is the first of many to follow highlighting PACA's observations and learnings from its involvement in the World Bank supported NAIP project it is executing in Mewat District of Haryana

Climate Change is a global issue and a subject of intensive discussion and within it agriculture is both a culprit and a victim. Most climate change related discussions focus on likely impacts of change and the ways in which we can cope with the change i.e. what should be the adaptation strategy. We well know that while climate change is a global phenomenon, its impacts vary according to the nature and dimension of change with the exact nature of impact being specific to a situation, its natural resource endowment and socio-economic condition.

Climate Change - a reality

According to current projections (IPCC), the arid and semiarid regions will likely experience drier regimes and increased vulnerability to extremes of events like drought or high rainfall that will adversely impact vulnerable sections of farming and render them more vulnerable to food security.

With monsoon type climate, in Indian agriculture, the arid and semiarid regions in particular, are already beset with large variability with respect to amount and distribution of monsoon rains. Late arrival of monsoon rains, their early withdrawal, or long spells of drought/interval between rain events render the farming community vulnerable to adverse impacts. Over a period of time, the farming community has evolved crop and management strategies to cope with natural variability, but there is growing evidence that the frequency of extreme events e.g. amount and distribution of rainfall is increasing. For example, this year (2009-2010), monsoon rain nearly failed during the main crop growing period, but there were spells of heavy rain towards the end of growing season over most parts of the dry-semi arid north-west India.

To understand how such events, projected to occur in greater frequency and severity in future impact agriculture and the natural resource base, we carried out a preliminary survey in the Mewat district of Haryana interacting with a number of stakeholders, particularly the farmers. The detailed situational analysis as has emerged from the stakeholder interaction is presented in Fig. C2.

Agricultural scenario in Mewat

Mewat district lies in the southern most part of Haryana sharing its south western border with Rajasthan. The region receives a mean rainfall of about 550 mm over a period of 25-30 days that too is erratic. The soils of the region are light to medium in texture and low in organic matter. Water is the primary constraint. Over major parts of the district, the quality of groundwater is poor and unsuitable for irrigation. Due to increased pumping through shallow tube wells, groundwater levels are falling and salinity problems accentuating. Average land holding is about 1.75 ha. with nearly 33% of farmers having land holding less than 2 ha. Farmers with land area more than 10 ha represent less than 1% of all farmers and about 5 % of land area. Pearl millet (*bajra*) or sorghum *(jowar)* are the principal rainy season crops followed by mustard or wheat in the winter as depicted in Fig. C1.

Depending on the water availability and quality, farmers use limited available amount of ground water to give 1 to 2 irrigations for mustard or 3 to 4 for wheat. They do not apply any irrigation to 'kharif' crops to save on water for more remunerative mustard or wheat crops that will follow. Livestock rearing is an important activity and a source of income for the farmers of the region.

Monsoon rains in 2009-10 and their impact

KHARIF CROP

Kharif crops being monsoon dependent are normally sown in end-June or early-July. Farmers take the first opportunity to seed Bajra as the main crop. Alongside they seed Jowar, Guar, or Dhaincha *(see description below Fig. C1)* which are the primary source of fodder for livestock or household fuel. This year, due to almost complete failure of rains till mid or later part of August, the area sown to kharif crops remained practically fallow, causing a major hardship to farmers in terms of fodder availability. Many farmers were compelled to dispose off their low yielding cattle for reasons of lack of provision of adequate feed/higher fodder, and feed costs. Some resourceful farmers were able to grow 'kharif' crops using ground water, but this had unintended consequences in terms of salinity build up in soils, reducing the prospect of Rabi crop.

RABI CROP

Although failure of normal timely rains prevented farmers from raising the main 'kharif' crop, widespread rains in later August and early

FALLOW	KHARIF CROP (Bajra/Jowar/Guar/Dhaincha)				RABI CROP (Wheat/Mustard)					FALLOW	
June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May

Fig. C1: Normal Cropping Pattern of Mewat

KEY: Bajra - Pearl Millet, Jowar - Sorghum, Guar - Cyamopsis tetragonoloba, Dhaincha - Sesbania aculeata

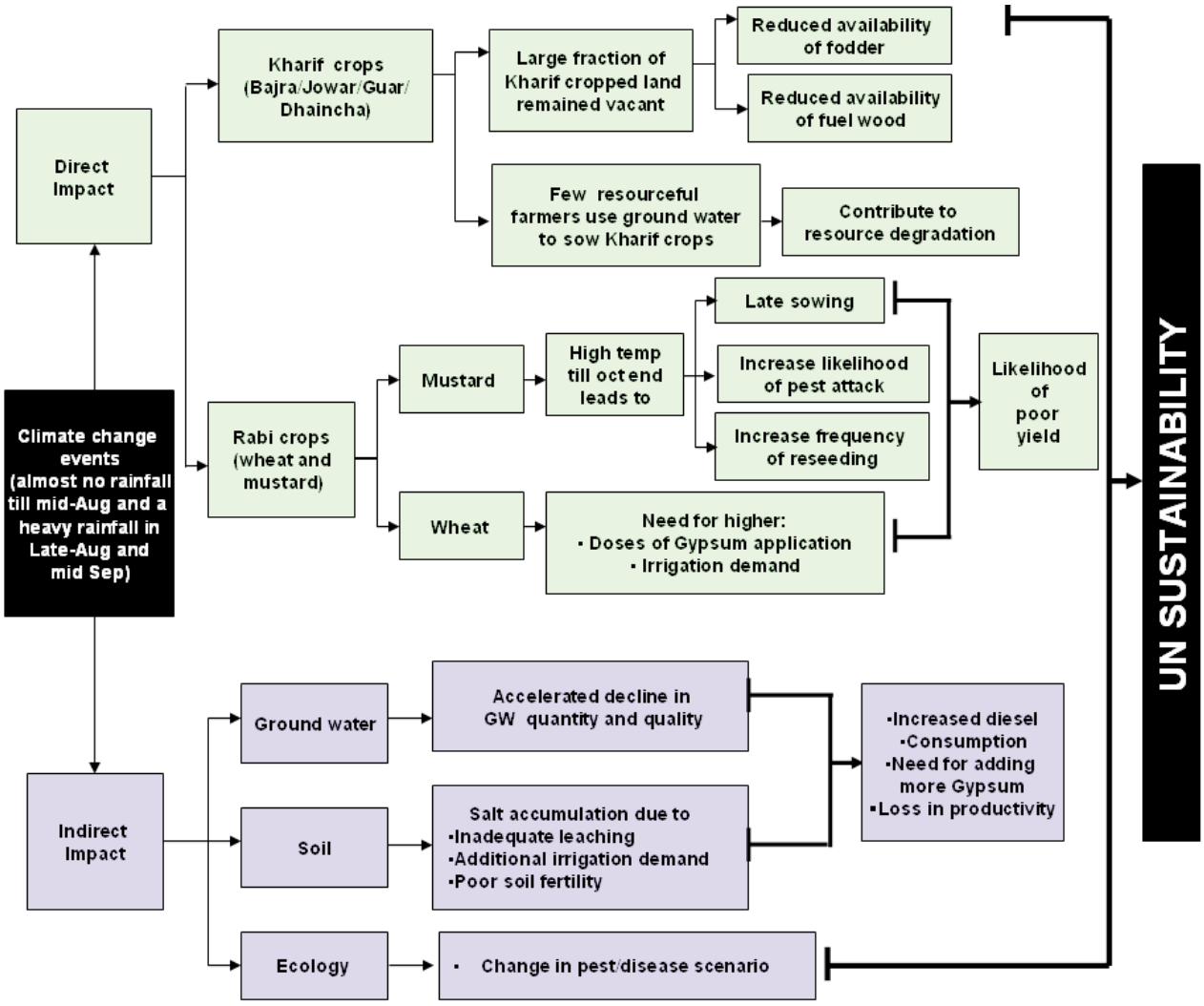


Fig. C2: Direct and indirect impact of climatic variability in Mewat

September were considered favorable for prospects of good Rabi crop; mustard and wheat. However, the farmers felt that although the soils had sufficient stored water, the ambient temperature continued to be higher than normal (by about 2°C) forcing them to delay planting of mustard by about 8-10 days, thus reducing the yield prospect. Some farmers who attempted seeding the crop before the temperature lowered had to reseed the crop due to complete mortality of germinated seedlings. Delayed sowing of mustard also increased the prospective of flowering coinciding with low temperature spells in January, enhancing vulnerability to adverse effects of frost; thereby affecting yield. The other dominant crop in 'rabi' season is wheat. Farmers tend to devote their area to mustard or wheat, depending on availability of groundwater. Groundwater of the region being salty, their use for irrigation results in building up of salt in the root zone of crops that adversely affects soil property and crop yield. For this reason, farmers in the region resort to applying 20-25 bags of gypsum per acre before sowing wheat crop. This year, however, we were informed that due to inadequate leaching of salt accumulated from previous season irrigation due to inadequate rains, farmers had to apply additional 10-15 bags gypsum per acre as a corrective measure. Similarly, some farmers who had used groundwater to sow kharif crops had to use additional quantities of gypsum to enable a good crop stand and growth of Rabi crops. There was also evidence that the farmers were inclined to apply enhanced doses of fertiliser to rabi crops to make up for fertility loss due to inability to raise crops like 'dhaincha' normally included as one of the kharif crops. We were also appraised that Rabi crops this year would need to be irrigated more frequently due to overall higher evaporation demand as a result of temperature and humidity considerations. Thus, it would appear that the impact of aberrant weather would extend well beyond the immediate crop.

Natural Resource Base

Both, the quality and quantity of groundwater are a critical factor for sustained agricultural productivity, and both are under threat. There are serious concerns that the water table in the region is declining due to over exploitation, and that, the salt content of tube well supplied water is increasingly intensifying soil degradation, forcing farmers to increase inputs (application of gypsum, fertilisers, irrigation needs) in turn causing low yield. In extreme cases, soil degradation has resulted in total

Salt affected barren patches seen in mustard crop at Mewat

loss of productivity. Our initial assessment shows that rainfall events as experienced this year is causing greatly accelerated resource degradation, adversely impacting resource capacity for sustained productivity.

Other related impacts

The changing patterns of weather events are impacting farming activities in other ways. Farmers growing vegetables in the vicinity of Aravalli Hills bordering Mewat are reporting forced maturity of crops like tomato due to high temperature and salinity. There are also reports of new pest species; late rains and higher temperature being more conducive to termite attack. All these point to the need for better understanding of climate related impacts as an input to developing sound coping strategies.

Coping with the challenge - Potential of CA practices

To be able to cope with changing patterns such as reflected in this year's rain calls for changes, modifications and adjustment in the entire range of agronomic practices, such that the adverse impact on social and economic factors on one hand and quality of resource base on the other are minimized.

The impact of climate events is primarily mediated through reduced overall availability of water and increased ambient temperatures. Conservation agricultural practices which are rooted in three basic principles i.e., causing minimal soil disturbances, keeping the soil covered through practices such as mulching, and adopting crop rotation/mixed cropping offer a sound approach towards adapting agriculture to climate change. table below gives the mode of benefits which CA practices will likely bring to bear on overall ability of the system to cope up with the new situation.

We therefore conclude that while climate change is an overarching challenge to sustainable development of agriculture and needs to be at the core of research agenda; principles of conservation agriculture offer a basis to develop an adaptive strategy to cope with the developing situation to adapt to the onset of such change.

CA Approach	Practice	Mode of Benefit
Minimum soil disturbance	• Develop implements for direct seeding of crops in un-disturbed soil	• Ability to make optimal use of stored rain water in soil
Keep soil covered	• Leave crop residue on soil surface	• Reduce runoff and soil erosion resulting in enhance rain water conservation • Reducing evaporation losses from soil surface • Moderate the impact of increased temperature • Improved leaching of salts • Reduced irrigation need and therefore deceleration in the pace of soil degradation due to saline groundwater use
Adopt crop rotation	• Identify shorter duration crops/ varieties and that provide better soil cover • Mixed cropping including legumes	• Better ability to cope with uncertainties of rainfall. Reduced losses of water through evaporation. • Improved use – efficiency of water and nutrients

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Advanced Course on Conservation Agriculture, CIMMYT, Mexico

CIMMYT's Conservation Agriculture course is a unique training opportunity for scientists working in the public, private or non-governmental sectors globally in areas of agronomy and sustainable management of natural resources. This course lays emphasis on various conservation agriculture and resource conservation technologies like conventional and reduced till, permanent bed planting for both irrigated and rainfed conditions, and using alternative crop residue management strategies. The course will run from May-June 2010 and its application deadline is 31st March 2010. For more information regarding this course, click on the link or copy and paste in your browser:
http://www.cimmyt.org/english/wps/events/courses/pdf/Announce_CA_course_2010.pdf

National Seminar on Soil Security For Sustainable Agriculture

The XIV Vasant Rao Naik Memorial National Agricultural Seminar on "Soil Security for Sustainable Agriculture" is being organized at the College of Agriculture, Nagpur on 27th & 28th February 2010. The seminar aims to bring together scientists, researchers, policy makers, planners, administrators and NGO's on a common platform to share and discuss technological advancements, experiences and other issues related to soil security for sustainable agriculture. Major themes include: (a) Integrated Nutrient Management (b) Soil Sustainability through Crop Diversification (c) Crop Residue Management (d) Soil Health and Awareness (e) Restoration of Degraded/ Problem Soils (f) Tillage and Conservation Agriculture and (g) Soil and Climate Interactions. More information can be downloaded from the link given below:
http://www.pdkv.ac.in/pdf/National%20SeminarFeb27-28-2010.pdf

Winter School on Enhancing Input Application Efficiency for Seeds, Fertiliser and Chemicals using Precision Farm Machinery, Decision Support Systems (DSS) and Electronic Controllers for Precision Agriculture in Vertisols

A training course is being organized by Central Institute of Agricultural Engineering (CIAE), Bhopal, between January 1-21, 2010 that will focus on various aspects of precision farming. The major objective of this course is to develop competencies of scientists/researchers for planning, monitoring and evaluation activities for precision farming techniques and tools for precision agriculture for better efficacy and efficiency. For more information regarding this course, click the link:
http://www.ciae.nic.in/WinSch-PFT-Brochur-Final.doc

Professional Vacancy Announcement - FAO

The Food and Agriculture Organization (FAO) announces vacancy for the post of an Agricultural Officer (Sustainable Production Intensification) to be based in Rome, Italy, for a period of 3 years. Under the supervision of the Director and the direct supervision of the team leader on sustainable crop production intensification, the incumbent will contribute to FAO's strategic objective on sustainable crop production intensification focusing on provision of technical support to national programmes with principal emphasis on production systems and related issues, such as climate change, ecosystem services and biodiversity. The candidate is required to possess an Advanced University Degree in Agricultural Production Systems or Agronomy, with five years of relevant experience in agricultural/rural development related to production systems, including rice-based systems in developing countries The last date for sending applications is 15th February 2010. Details regarding duties and responsibilities, selection criteria etc. can be obtained by viewing same at FAO site www.fao.org.

18th Annual No-Till Conference

This conference is being organized at Des Moines, Iowa, from January 13-16, 2010. It intends to cover a wide range of topics pertaining to equipment modification, no-tillage techniques, and crop rotation strategies. Detailed information regarding this conference can be downloaded from the link:
http://www.no-tillfarmer.com/file_open.php?id=17

8th International Wheat Conference, Russia

The 8th International Wheat Conference is being organized on June 1-4, 2010 at St. Petersburg Russia. The Conference is divided into various plenary sessions, with plenary session 9 exclusively focusing on conservation agriculture technologies for wheat production. The last date for submission of abstracts is 15th January 2010. For more info, click the link:
http://www.8iwc.org/files/8IWC-2nd-Circular.pdf

2010 Conservation Tillage Conference

A conference is being organized by The University of Minnesota and Corn & Soybean Digest on 27th & 28th January 2010 to help producers improve their conservation skills by refining their fertility management, learning about new technologies, and reducing production costs. The topics include soybean production in no-till, government policy concerning reduced tillage, benefits and challenges of reduced tillage etc. For more information about this conference, check the link:
http://cornandsoybeandigest.com/tillageconference/

Chinese visitors seek partnership in conservation agriculture

A delegation of eight scientists from the Chinese Academy of Agricultural Sciences (CAAS) and China Agricultural University (CAU), Beijing, arrived in Mexico on 28 November to learn about activities in CIMMYT's northern Mexico conservation agriculture (CA) hub. Their visit is associated with efforts to develop new collaborative activities between CIMMYT and relevant Chinese institutions to generate and promote locally adapted CA cropping practices for major Chinese maize and wheat production systems. Read more at:
http://blog.cimmyt.org/?p=2564

Conservation Agriculture For Sustainable Agriculture in Rural Development (CA-SARD) Project

Conservation Agriculture for SARD is an FAO project that started in 2004 and is currently in its 2nd phase that will end in 2010. The project focuses in contributing to promotion of growth and improved food security in Kenya and Tanzania through scaling up of Conservation Agriculture (CA) as a Sustainable Land Management (SLM) option. To know more about project approach and activities, click the link:
http://www.act-africa.org/ca-sard.html

Tanzania: Conservation Agriculture Tools Made Locally

Tools for use in conservation agriculture practices that are generally unaffordable are now being made locally in Tanzania which were earlier imported from India and Brazil. This has been largely possible due to the support from FAO and government. According to the managing director of Nandra Engineering Works Limited, this kind of agriculture being new, their company has so far manufactured and sold over 1,000 rippers and the demand is still rising. Prices of locally made rippers, planters and seeders were very expensive and had to

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be imported from India and Brazil. Most farmers in Tanzania are using conservation agriculture practices due to saving in time with respect to field operations. The US Government last month donated USD 37 million to assist Tanzania address its problems of food shortage, global recession, and conservation activities. Information can be downloaded by clicking the link: **http://allafrica.com/stories/200912141651.html**

Punjab Agricultural University (PAU) Training Programmes in January 2010

A number of training programmes are being organized by Punjab Agricultural University, in January 2010. To download details of the training program, click link: **http://web.pau.edu/pau_docs/training_schedule_january_2010.doc**

PUBLICATIONS

Consolidated responses on Giller's article

Peter Hobbs has consolidated the responses to Giller et al. paper ""Conservation Agriculture and small holder farming in Africa: The heretics view". For detailed information, click the link given below:
http://conservationag.wordpress.com/ken-gillers-paper-on-conservation-agriculture/

Importance of zero-tillage with high stubble to trap snow and increase wheat yields in Northern Kazakhstan, Turi Fileccia, FAO Investment Centre Division, June 2009
http://www.fao.org/ag/ca/doc/Importance_Zero_Tillage_Northern_Kazakhstan.pdf

Rockstrom, J., Kaumbhuto, P., Mwalley, J., Nzabi, A.W., Temesgen, M., Mawenya, L., Barron, J., Mutua, J., and Damgaard-Larsen, S. 2009. Conservation farming strategies in East and Southern Africa: Yields and rain water productivity from on-farm action research. Elsevier.103: 23-32

Boahen, P., Dartey, B.A., Dogbe, G.D., Boadi, E.A., Triomphe, B., Larsen, S.D., and Ashburner. 2007. *Conservation agriculture as practiced in Ghana.* Nairobi. African Conservation Tillage Network, Food and Agricultural Organization of the United Nations.

Kurt G. Steiner, & Steve Twomlow. 2003. Weed Management in Conservation Tillage Systems. African Conservation Tillage Network, Information Series No. 8
http://www.act.org.zw/docs/act_is08_print.pdf

Reicosky, D.C. 2005. Conservation Agriculture: CO_2 Mitigation, Environmental Benefits And The Kyoto Protocol. In: Proceedings of the Fifth Conservation Agricultural Conference, June 23-24, 2005, Samara, Russia. p. 26-38.

We have uploaded 2 publications for your benefit and both can be downloaded from www.conserveagri.org/links.htm:

1. **Bibliography** - An updated Bibliography is available with extended coverage of CA based publications.
2. **Education Series: Our Soil Resource #1** - This booklet forms the first part of the coverage of the soil subject as part of our Education Series. Progressively other subjects of significance will also be taken up as part of the Education Series.

The Royal Society Report on Science and Sustainable Intensification of Global Agriculture

Conservation Agriculture technologies have resulted in substantial increase in agricultural production, thereby improving on food security and farmer income. Conservation Agriculture technologies for crop diversification and crop intensification are now ready for scaling up, and further adaptation.

The Royal Society has published a report to focus on the role of science towards sustainable intensification of global agriculture. The study was aimed at understanding the factors responsible for the existing gap between agricultural science – research and actual farming, and to seek possible solution for minimizing this gap so as to ensure better food security.

Lack of availability of water and good soil, changes in pest/diseases scenario and climatic variability are leading to a dramatic yield reduction. Addressing these constraints requires technologies and approaches that are underpinned by good science along with urgent international efforts with a clear sense of long-term challenges and possibilities. Sustainable intensification of global agriculture in which yields are increased without adverse environmental impact and without cultivation of more land is the pressing need of the 21st century.

Amongst other studies, the case study on CA concludes that conservation agriculture as a sustainable intensification agricultural technology and approach, if practiced in a holistic manner has the potential to meet this pressing need of the 21st century. Illustrating it further, the case study of Burkina Faso in this report shows that over 20 million ha of savannah land (with similar agro ecology as Burkina Faso) have been sustainably intensified and diversified in Brazil using conservation agriculture principles. Progressing into the same track from 2002 to 2007, an FAO conservation agriculture pilot study was carried out in Burkina Faso, aiming at: (a) expanding crop choices to increase production of livestock feed, (b) improving soil-crop-water management for sustainable production intensification, and (c) diversifying and expanding the range of food, feed and tree crops and their integration with livestock into the existing cotton- and maize-based systems. This took place at five pilot locations in southwest Burkina Faso, mainly involving minimum till, crop rotation, crop cover management, and farmer field schools for integrated production and pest management.

CA technologies introduced through the pilot project have resulted in substantial increase in agricultural production, thereby improving on food security and farmer income. The increased livestock feed availability during the dry season has helped smallholders enhance their income from livestock products, while also improving soil moisture supply and soil health. CA technologies for crop diversification and crop intensification are now ready for scaling up and further adaptation.

Source: Reaping the Benefits: Science and the Sustainable Intensification of Global Agriculture. The Royal Society Policy Document 11/09, Issued October 2009.