

A REPORT ON CONSERVATION AGRICULTURE: DR. AMIR KASSAM WORKING WITH AKRSP-INDIA ON SUSTAINABLE CROP PRODUCTION INTENSIFICATION

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~ By Gurpreet Singh

I heard about Conservation Agriculture for the first time in AKRSP-I when Mr. Pramod Sahu (Senior Manager Agriculture AKRSP-I) told me about it. He gave me some readings on Conservation Agriculture, but what exactly it means in the field situation and what is its relevance I got to learn from Dr. Amir Kassam who is currently working as an adviser in sustainable agriculture intensification with the Food and Agriculture Organization (FAO), Rome, and is the Moderator of the FAO-hosted Global Platform for Conservation Agriculture Community of Practice (CA-CoP). Dr. Amir has been working across the globe for the noble cause of Sustainable Agriculture. He has been an advisor to AKRSP-I for the past 18 months on sustainable crop production intensification, including the restoration of soil health and addressing the causes of soil degradation and erosion.

It has been seen in the past half century that input intensive agriculture has taken its toll on various systems linked to agricultural land use, be it the water cycle or the soil health. When we talk about input intensive agriculture it not only includes water, fertilisers, pesticides and high yielding seeds but also includes heavy machinery for tilling the soil. The technologies imparted with the 'Green Revolution' have not only affected human health, water tables and cost of production but has also led to deterioration of soil health and functions. Heavy use of machines and intensively tilling the soil year after year has caused our soils to become degraded and eroded.

To cope with the emerging issue related to soil degradation and static crop production, Conservation Agriculture is offering a win-win situation for the environment and for the farmers in different part of the world. Dr. Amir informed us that globally Conservation Agriculture is practiced in all continents and in 2013 it was applied over an area of 155 million hectares of arable cropland (11% of the total arable cropland). Conservation Agriculture is a method of sustainable farming in which the soil is not disturbed or disturbed minimally, maintaining soil much cover by leaving as much of the residues of the previous crop in the field, and managing a diversified cropping system that is socio-economically and environmentally viable. The three broad inter-linked principles of Conservation Agriculture (CA) are (www.fao.org/ag/ca):

1. **No or minimum mechanical soil disturbance by** seeding or planting directly into untilled soil;
2. **Enhance and maintain organic matter cover on the soil surface** using crop residues and cover crops to protect the soil and feed soil life;
3. **Diversification of species** both annuals and perennials - in associations, sequences and rotations.

When the above principles are applied to cropping systems using locally formulated practices and other good agricultural practices, the benefits that can be harnessed include the following:

1. Improvement of soil health with every consecutive year during the transformation phase by improving soil organic matter, soil density, porosity and structure, soil flora and fauna, reduced soil loss due to erosion and improved productivity and profit.
2. Reducing costs involved in tillage, weeding, higher number of irrigation, heavy doses of fertilisers, and labour costs, all of which help to increase profit margins.
3. Cutting green-house gas emissions from the soil, and offering greater climate change adaptability.

Dr. Amir visited Saurashtra, Gujarat in the month of September 2014 which includes the Aga Khan Rural Support Programme, Gadu SHT in Junagadh District. We had a short training and orientation on Conservation Agriculture under his guidance. Dr. Amir demonstrated some important aspects of the soil in a groundnut crop. A small pit was dug in the groundnut field and the hard pan layer was shown to be present. The hard pan is a compressed soil layer which is formed below 20 to 25 cm depth or within the root zone, due to continuous use of mechanical field implements striking again and again at a particular point in the soil. The effect of the hard pan is visible in terms of decreased rainwater infiltration, poor soil water percolation and hindrance to root growth and proliferation, all of which affect nutrient and water retention, plant growth and yields. Conservation Agriculture with its basic principle of no or minimum soil disturbance and maintenance of soil mulch cover reduces soil compaction and enhance water infiltration and percolation and root growth as well as promotes soil microorganisms and fauna such as earthworms that help in incorporating organic matter into the soil and in building a network of soil bio-pores which improves the soil moisture regime. Conservation Agriculture is a remarkably different way of looking at agriculture production and land management, as it is totally opposite to conventional tillage agriculture involving ploughing and fine bed preparation for the cultivation of crops.

We were requested to establish on-farm trial or test plots of at least 100 square meters each for one year in partnership with lead farmers, and growing local crops following the CA principles for the purpose of self-learning and group training. Such a CA trial plot was identified in Gadu SHT of Aga Khan Rural Support Programme-India in village Kalej. The farmer, named Bhayabhai, took the lead to establish the CA trial plot of an area of 200 square meters for cultivating wheat as part of his cropping system. After the harvesting of the groundnut crop from the field, the sowing of wheat seeds was done without tilling the soil. This operation he carried out with a small hand hoe by making a narrow cut in the soil for the seed, and sowing was done by hand immediately following the opening of the thin furrow. When the plant grew to an age of 25 days, he applied dry mulch which was available with him, in between the rows which were 9 inches apart. He had been growing some 17 different crops in his field of one hectare which was a clear example of cropping system diversity. The wheat was sown in the month of December, based on the agro-climatic conditions in the region.

The field results of the CA plot are as follows:

S. No	Particulars	CA	Traditional
1	Area in square meter	200	200
3	Seed Rate in kg approximately	1.5	2.5
4	Murate of Potash in kg	2	2
5	Single Super Phosphate in kg	10	10
6	FYM in kg	100	100
7	Bio-fertilizer Azotobacter used in ml (applied in irrigation)	0.25	0.25
8	1 st Weed Management	Not required	Herbicide used (Pendimethalin)
9	2 nd Weed Management	NA	NA
10	No of flood irrigations done	6	7
11	Variety	Lok 1	Lok 1
12	Test weight of 1000 seeds in gm	45.8	41.4
13	Average major tillers in 10 plants (rounded of)	5	3
14	Average height of 10 plants (rounded of) in cm	37	33.2
15	Average Yield of 1 square meter area of random 5 locations in kg	0.565	0.482
16	Obtained Yield of 200sqm in kg	69.5	65.2
17	Projected yield per hectare in kg	3475	3262
18	Returns of seed Yield @ Rs.12 /kg price in market from 200sqm area	834	7839
19	Cost of production (ploughing, sowing, weeding labor, Amrit Pani, fertilizers, FYM, seeds included) in Rs	164	204
20	Projected Profit to farmer in 200 square meter in Rs.	670	5799
21	Projected Profit to farmer per hectare in Rs.	33500	28944

From the above data one can clearly see that some benefits which CA offers, are possible to be harnessed right from the beginning, although the differences are not substantial, they are nonetheless encouraging. Weed infestation in the CA crop was comparatively less, as the farmer did not apply any herbicide in the CA crop, his cost of production was reduced to some extent. It can be seen that one less irrigation was required in the CA crop compared to conventional tilled plot. The yield was 6.52% higher in CA over traditional plot, and the profit was 15.7% greater, which is a very encouraging result for the first year of the CA trial in the region; and the fact that this productivity and cost of production will show their positive trend with every consecutives year as the soil health improves over time. The initial apparent challenges will be related to farmer acceptance of the new understanding of no-till/Conservation Agriculture, adding and maintaining

crop residue cover, and the availability of appropriate implements in the local region in order to carry out no-till sowing over a large area. However, it is contemplated that once the participating farmers start actualizing the benefits of CA, such challenges will be accepted with optimism of change. Bhayabhai is now very elated about the CA testing in the groundnut crop next season, which will complete the establishment of one year of CA cropping cycle with the farmer.

Under the guidance of Dr. Amir, a second round of orientation training was organized in the month of January 2015 for the farmers who had adopted the CA trial in the 2014 Rabi season. Along with the field visit to different farms, some field demonstrations were also done by Dr. Amir regarding soil health characteristics and the importance of enhancing and conserving them.

Demonstration one – Water infiltration: A PVC pipe was partially inserted into the soil in a place where farmers till the soil and practice conventional agriculture. Water was poured in the PVC pipe to the brim. The rate of infiltration was observed by the farmers and field staff. The infiltration rate was exceptionally slow, almost negligible. It seems as if the soil surface was closed. Soon after, the same PVC pipe was inserted into a place near some bushes which had been untilled and was left naturally undisturbed. The same amount of water was poured into the pipe and the infiltration rate was observed. The water disappeared very quickly into the soil. When comparing the two observations, farmers could realize that the PVC pipe inserted in the second case had a comparatively much higher water infiltration and percolation rate. The reason, which Dr. Amir explained, was that the micro and macro-pores of undisturbed soil were much more extensive due to higher organic matter and action of microorganisms including earthworms, the density was less because of the greater porosity and better structure which enabled water to infiltrate and seep to the lower soil profile more readily. In conventional tilled field, increased soil density, dilapidated soil organic matter, declining soil life and formation of the hard pan in the root zone, all have a direct negative effect on the soil water infiltration and percolation rate.



PICTURE 1. DR. AMIR DEMONSTRATING SOIL WATER INFILTRATION AND PERCOLATION IN TRADITIONAL SOIL OF FIELD

Demonstration 2 – Soil Aggregate Stability: A soil clod was taken from the cultivated tilled field and a soil clod was taken from the untilled naturally undisturbed soil. The two clods were each put in a transparent plastic cup filled with water. It was observed that the soil clod from the cultivated tilled field broke up and was dispersed quickly into the water and settled at the bottom of the cup, making the water opaque as compared to the clod from the no tilled land which did not disperse at all and the water stayed clear. This difference was due to much greater aggregate stability of the soil which is not disturbed. Another thing which we could observe was that the clod from naturally undisturbed soil had many large bubbles coming out of it as compared to few tiny bubbles from the cultivated tilled soil clod. The no tilled soil has much greater amount of air space and air within the soil structure and continuous tillage cultivation also decreases soil aeration. It is a well-known fact that a well-aerated soil is better for root growth and soil biological functions whose effect is seen in the better production and performance of the crop and the soil. Soil from the cultivated tilled field

got dispersed and dissolved in the water leaving the water muddy, while the undisturbed soil did not dissolve in the water and water remained clear. This observation tells us that the tilled soil is not stable and is more prone to water erosion which can wash it away easily when wet, and when the top soil is splashed with rainwater, while the naturally undisturbed soil remains bounded to its different organic material and glues and gums produced by natural flora and fauna.



PICTURE 2 . NO DISPERSION OF A SOIL CLOD FROM UNTILLED SOIL

As vividly said and demonstrated, farmers accepted the benefits of Conservation Agriculture which can improve soil density, porosity, structure, its water and nutrient retention capacity and overall soil health. The farmers understood the reasons why conventional tillage agricultural practices lead to soil degradation and soil erosion losses with every consecutive year. This year we are enthusiastic to add 4 more lead farmers to adopt an on-farm trial plot each for understanding and experimenting, under the hand holding guidance of AKRSP-I and Dr. Amir Kassam, as he has suggested that it is important to move slowly, winning the confidence of the farmers, as it is the farmers who will drive the transformation and make his improved earnings from the CA-based cropping systems.

Some of the photographs are attached below from the field:



PICTURE 3 BHAYABHAI WITH HIS FATHER IN CA TRIAL PLOT



PICTURE 4: MULCH BETWEEN THE WHEAT ROWS ALONG WITH A TENSIO-METER



PICTURE 5: DR. AMIR KASSAM EXPLAINING THE IMPORTANCE OF CA TO A FARMER



PICTURE 6: GROUP PHOTO WITH FARMERS AND AKRSP-I FIELD STAFF