W05L01: Productivity benefits

Dr. Sanjay Kumar
Chairman, Dept. of Agronomy, BAU, Sabour

Productivity Benefits of CASI

- System productivity
- Water productivity
- Energy productivity
- Input use efficiency

Envisage the future of CASI= An evidenced from farmers participatory research in EGP (n>350)

5-10% System Yield

46-62% Energy

8-17% Irrigation Water

16-56% Profitability

26-44% Labor

11-16% CO2 reduction

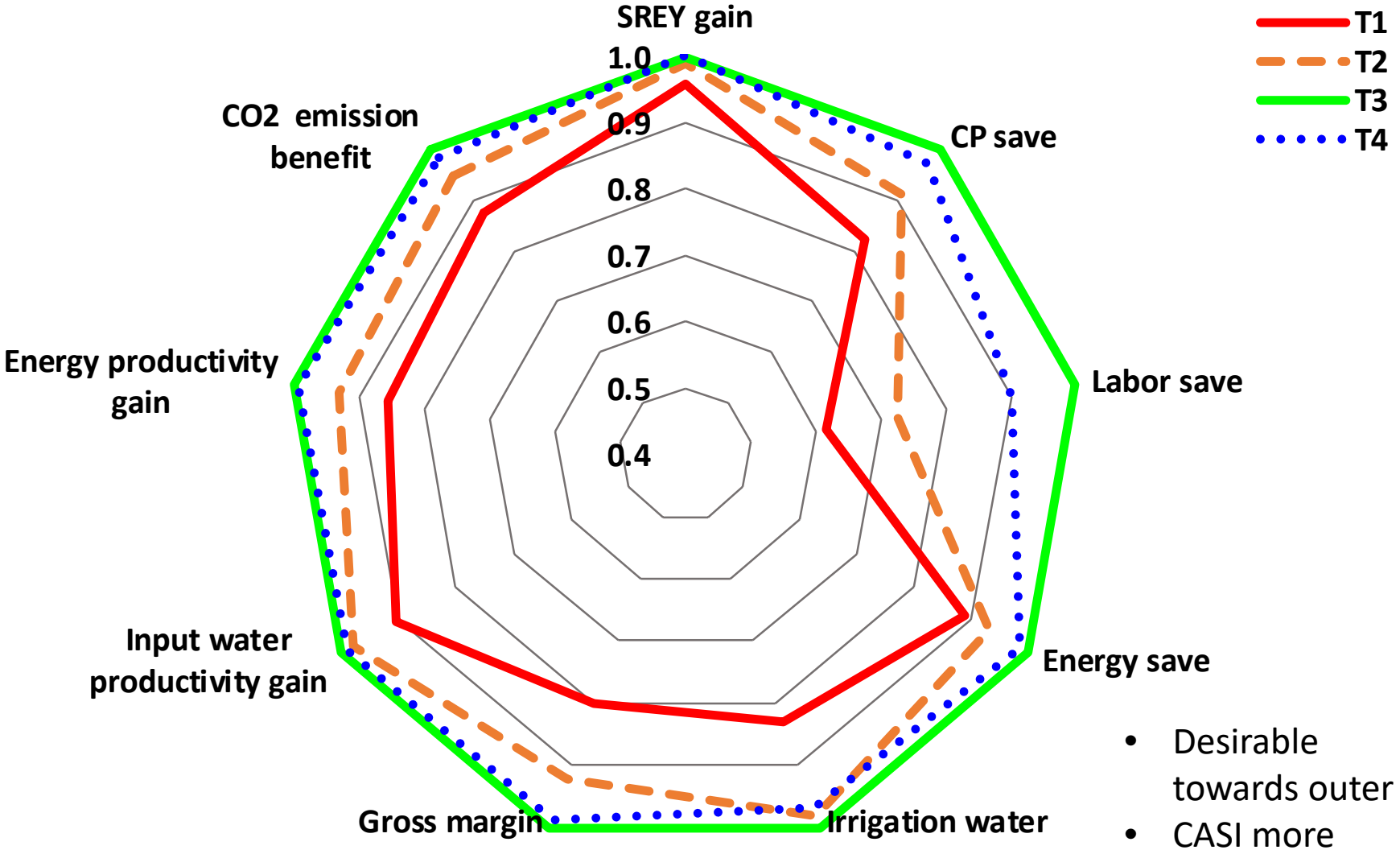
Comparative Advantages

- Reduction in tillage passes number from 5-10 to 1
- Advance the crop planting by 15-20 days
- Time saving atleast 70 % in crop establishment
- Fuel saving 30-45 litre ha-1
- Labor saving by 15-40 person days ha-1
- Reduce production cost by 4000-5000 INR ha-1
- Reduce irrigation water application by 5-10%
- Reduce weed population of particular species (P. minor)
- Increase crop yield by 5-10 %
- Increase in farm income by 20-40%
- Increase water productivity 10-15%

W05L02: Economic Advantages of CASI

Dr. Ram Datt
Assistant Professor Dept. of Extension Education,
BAU, Sabour

Integrated assessment of system performance indicators across tillage options for the smallholders of the EGP



- Desirable towards outer
- CASI more desirable in all parameters

Source: Gathala et al., 2019

Economic Advantages

✓Up to 80% of fuel used to establish a crop is conserved through CASI

✓Up to 60% fewer person-hours are used per hectare compared with tillage.

✓we have demonstrated that CASI management practices reduce both labor use and total 587 production costs by around -40% and increase gross margins by up to 25%, compared to traditional 588 CT practices.

✓Net profit gain 2.5-3.0 thousands/Acre

W05L03: Soil Health

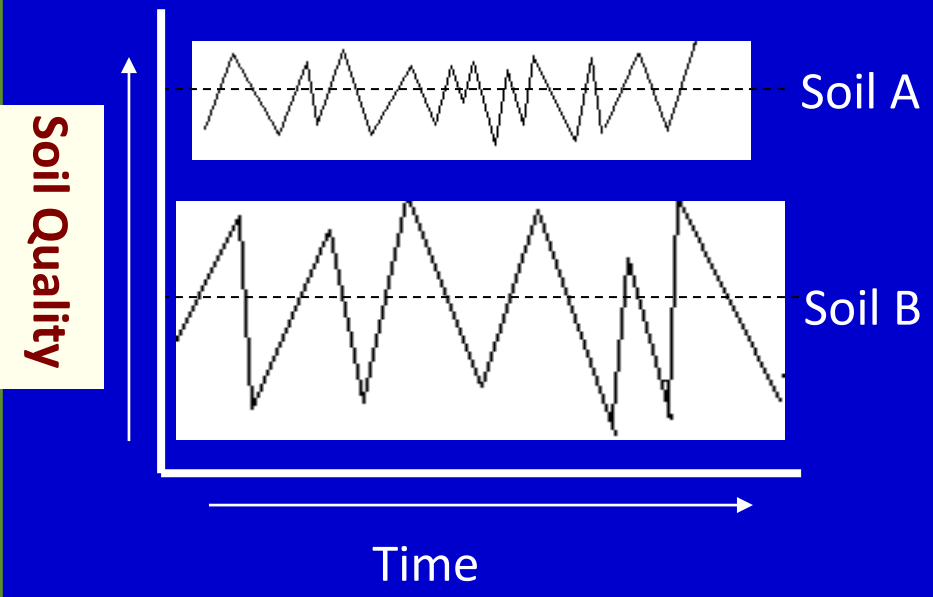
Dr. Mahesh K. Gathala
Sr. Systems Agronomist, CIMMYT, Bangladesh

CIMMYT

Soil Health

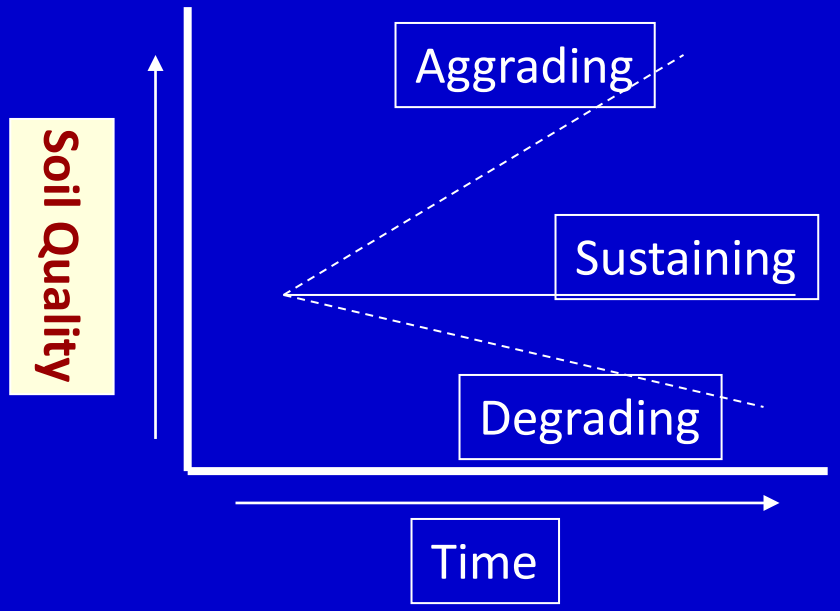
- Basic and simple – we understand and feel but difficult to define
- It is like human health but assessment is more complex
- We have vast knowledge but need to distil/integrate in a simple and usable form
- Soil quality not directly measurable but Infer from measurable soil properties
- Best indicator of soil quality in crop production: Ability to produce good yields
- Therefore, soil properties that relates to yield: Indicators of soil quality

Inherent Soil Quality



- **Inherent - reflects basic soil forming factors**
- **Climate, parent material, time,**
- **Topography, and vegetation (Reflected in Land Capability Classifications)**

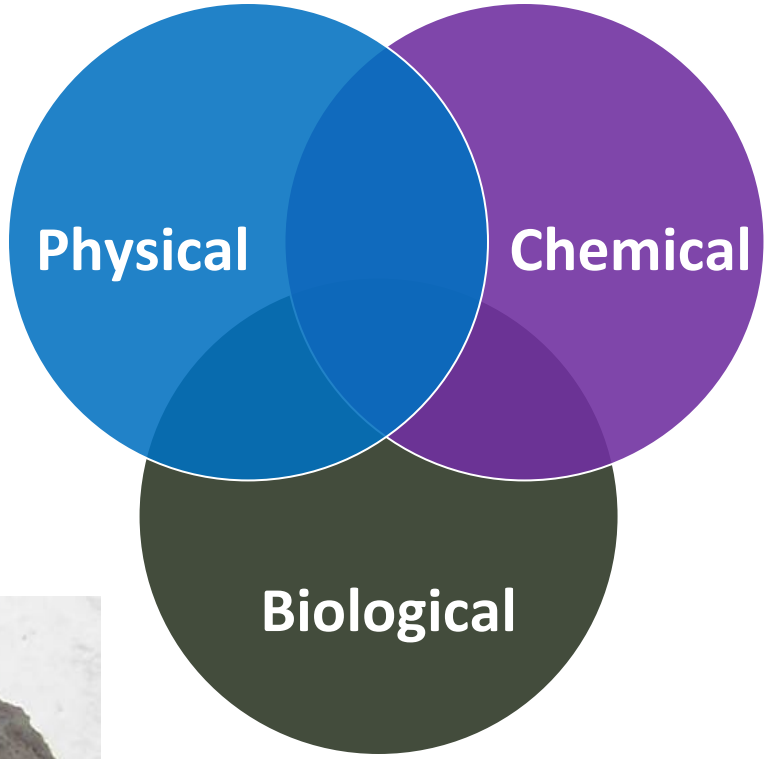
Dynamic Soil Quality



- **Dynamic - describes soil status or condition**
- **Reflects management decisions**
- **Current or past land uses (Reflects sustainability & conservation goals)**

Soil quality in relation to soil process

- Physical support for plants
- Soil water retention and movement
- Soil erosion
- Soil Hardness



- Nutrient retention and release
- Soil reaction
- Energy (C) storage

- Weed & Pest suppression
- Microbial biomass
- N mineralization
- OM decomposition

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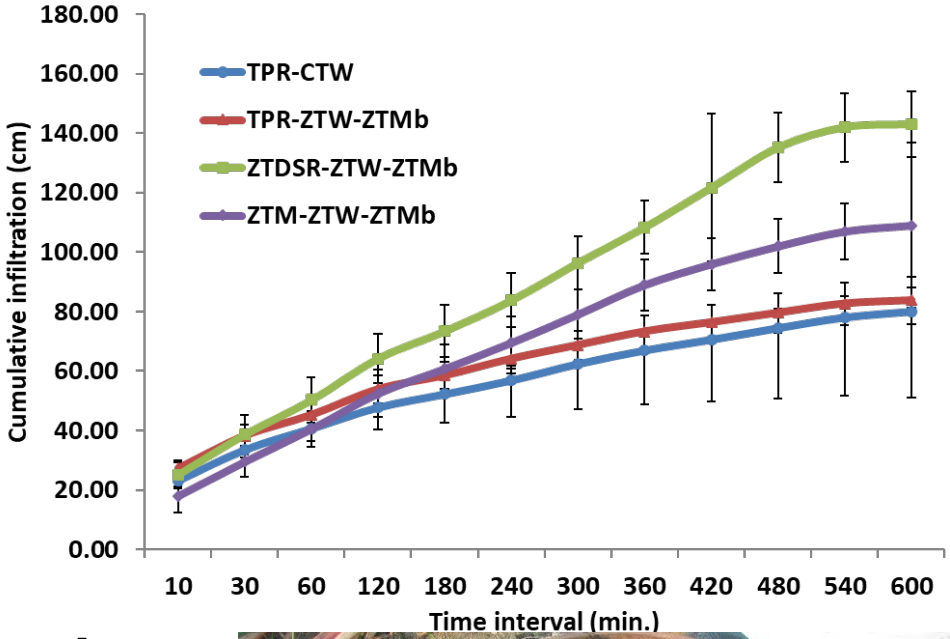
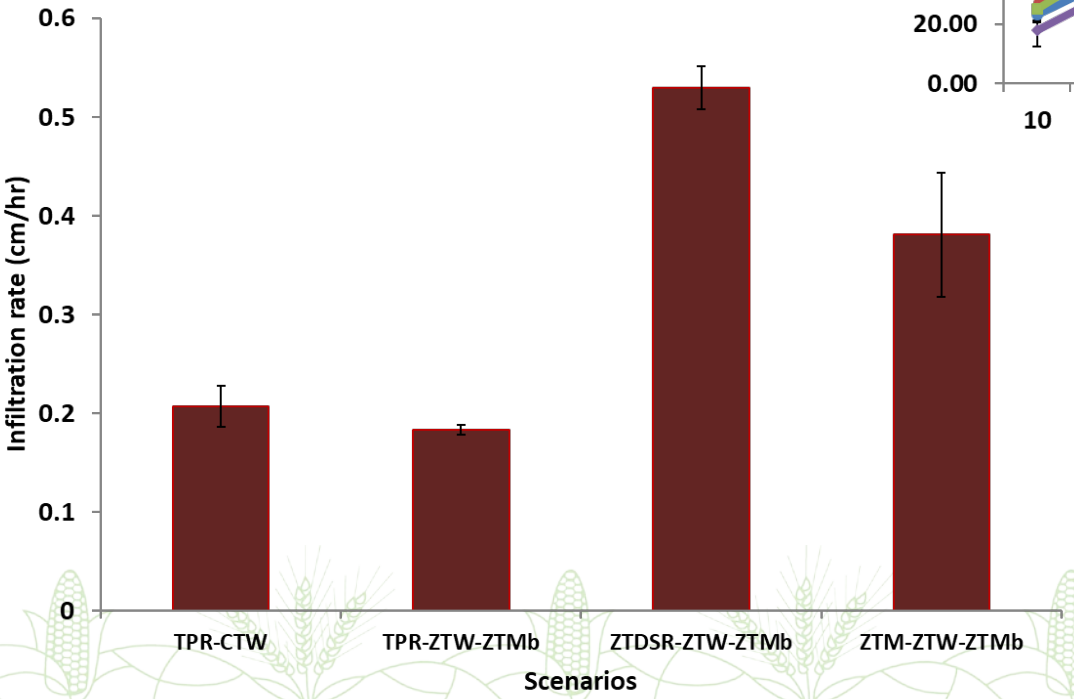
Soil physical properties under CA

Infiltration under CA after 8yrs

Increase soil infiltration and rate which helps for waterlogging sensitive crops and recharge aquifers

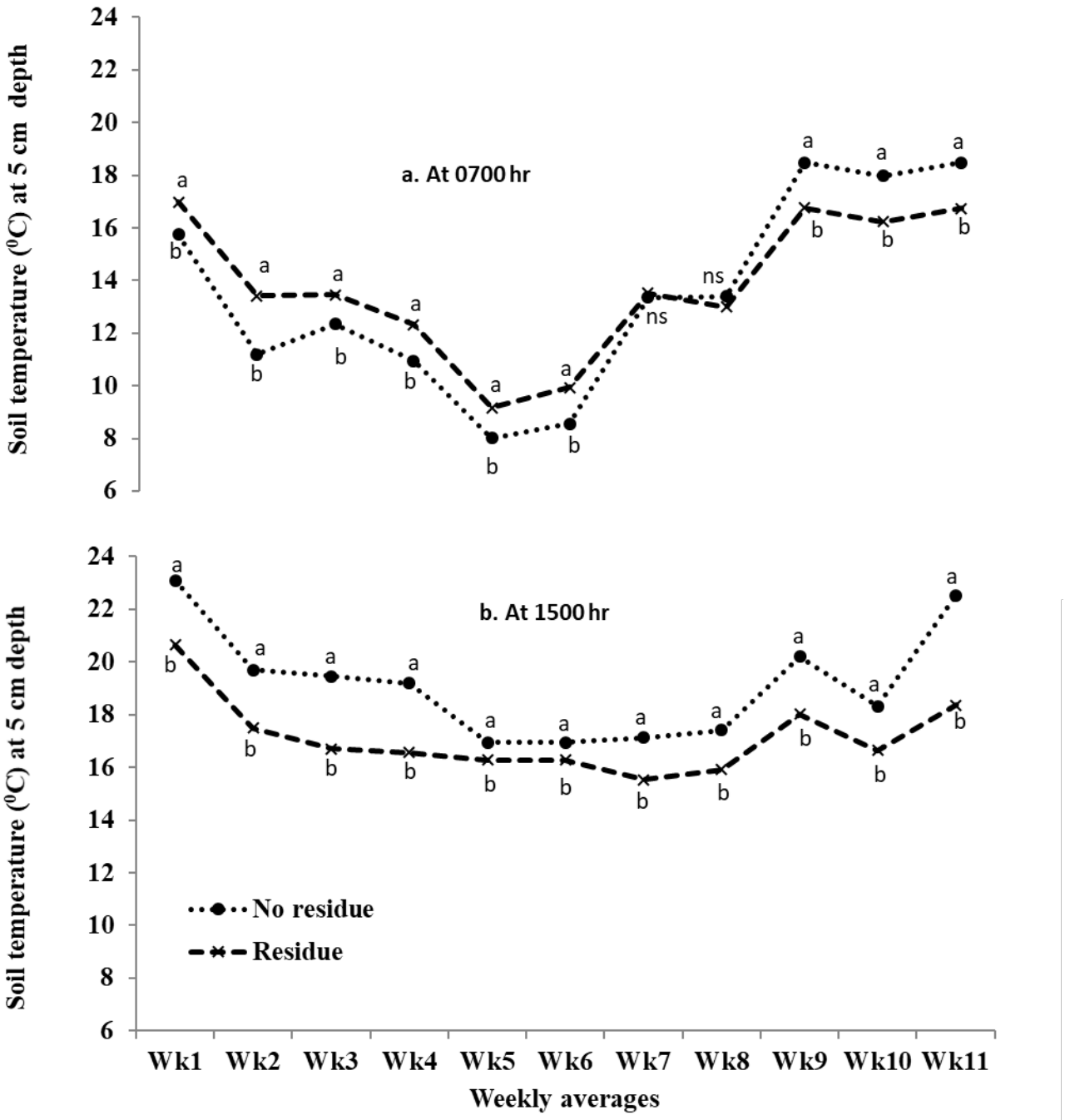




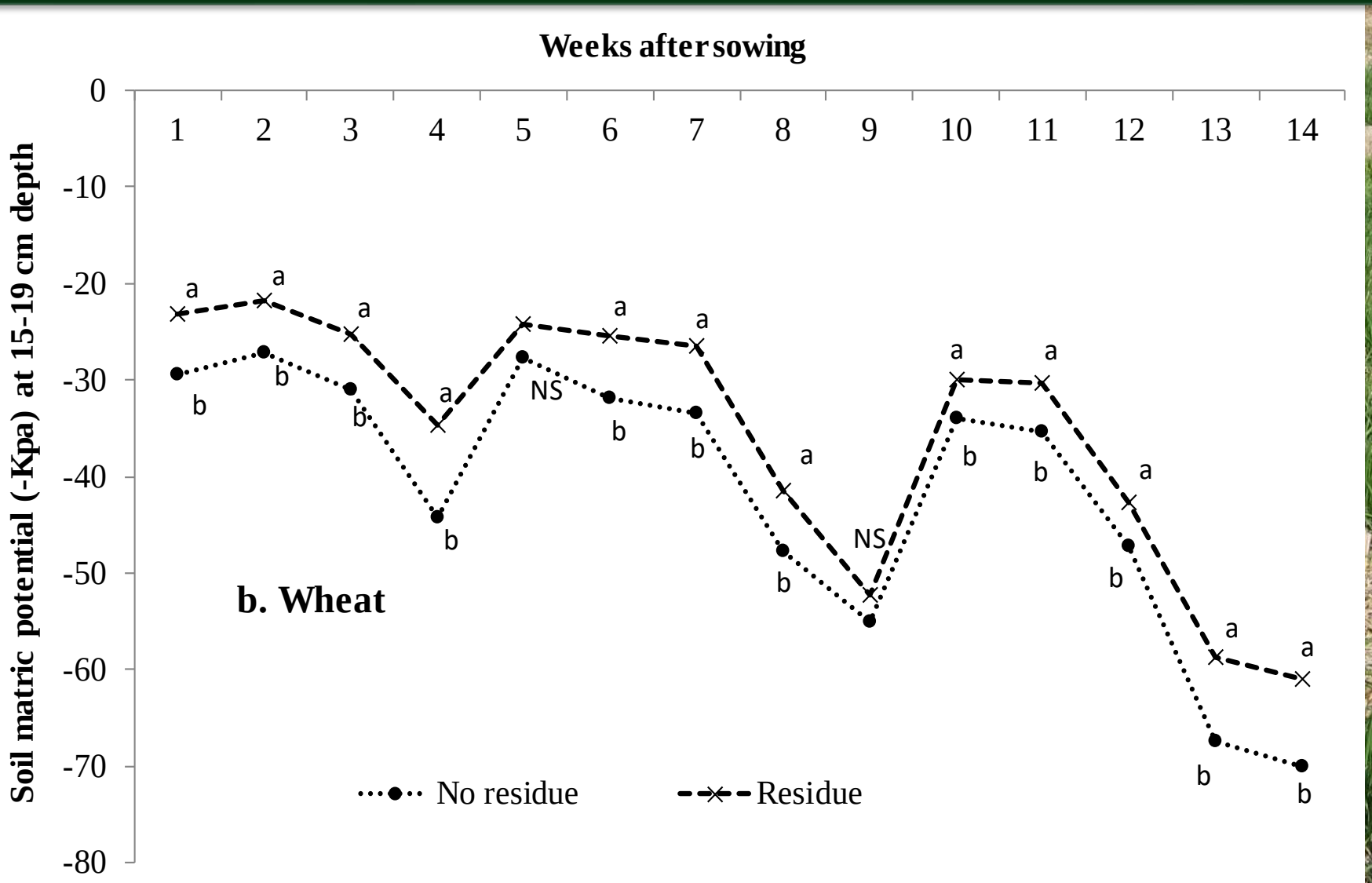
Moderation of surface soil temperature by surface mulching

Moderate soil temperature in extreme weather conditions by 4-5 ^{0}C

Gathala et al., 2017



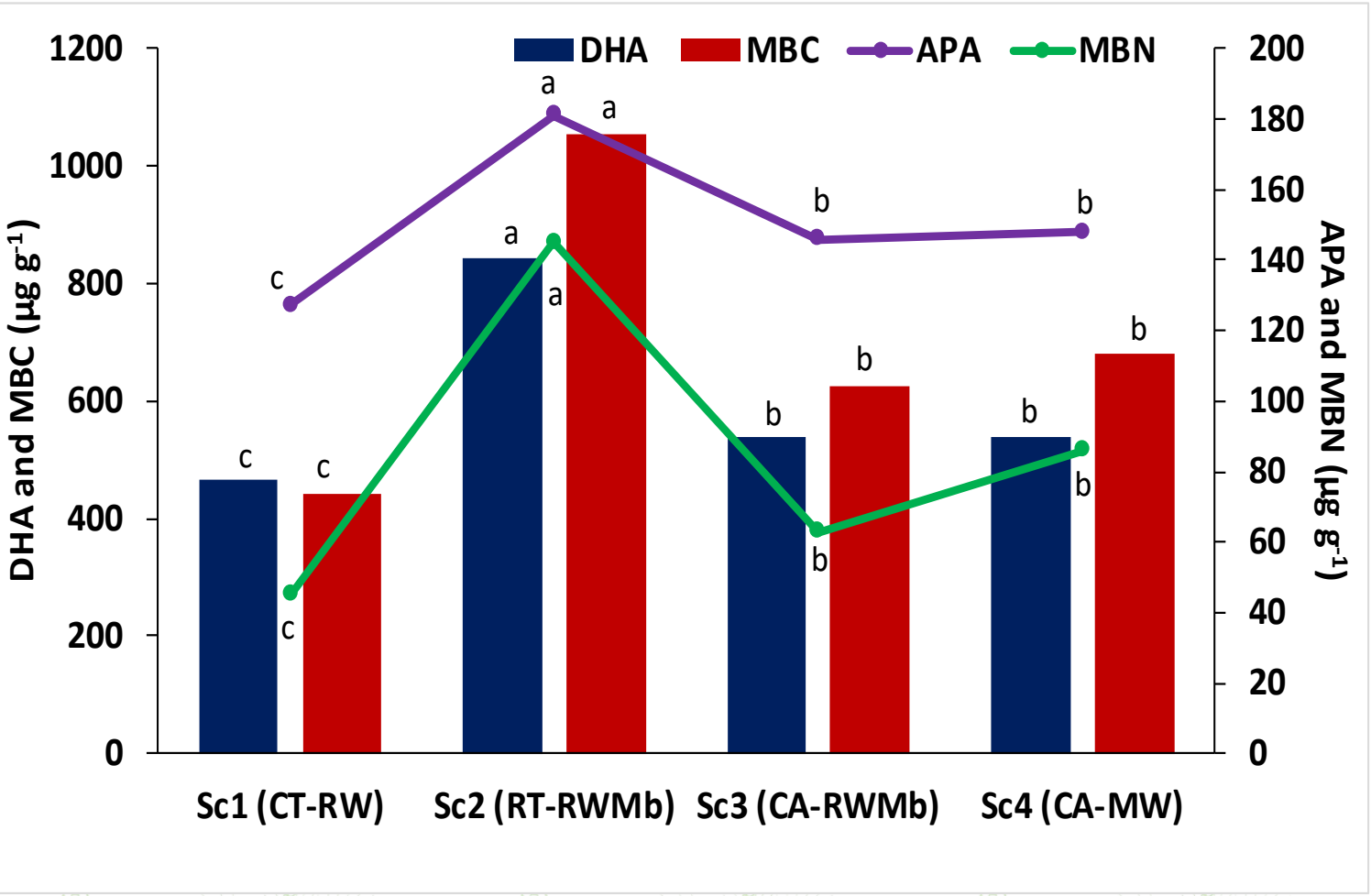
Soil matric potential with and without crop residue



Gathala et al., 2017

Soil biological properties under CA

Effect on soil enzymatic and soil microbial biomass



Increase in soil DHA, APA and soil microbial biomass of carbon and nitrogen **Biologically active fractions -sensitive indicators,** predict direction and rate of change of soil quality earlier and better.

Source: Jat et al., 2019

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Effect of CA practices on Soil microbial populations

Sustainable intensification of		
Microbial population	**Rice based systems**	**Maize based systems**
Bacteria	**+26%**	**+28%,**
Fungi	**+61%**	**+68%**
Actinomycetes	**+92%**	**+98%**

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Sustainable intensification influences soil quality, biota, and productivity in cereal-based agroecosystems

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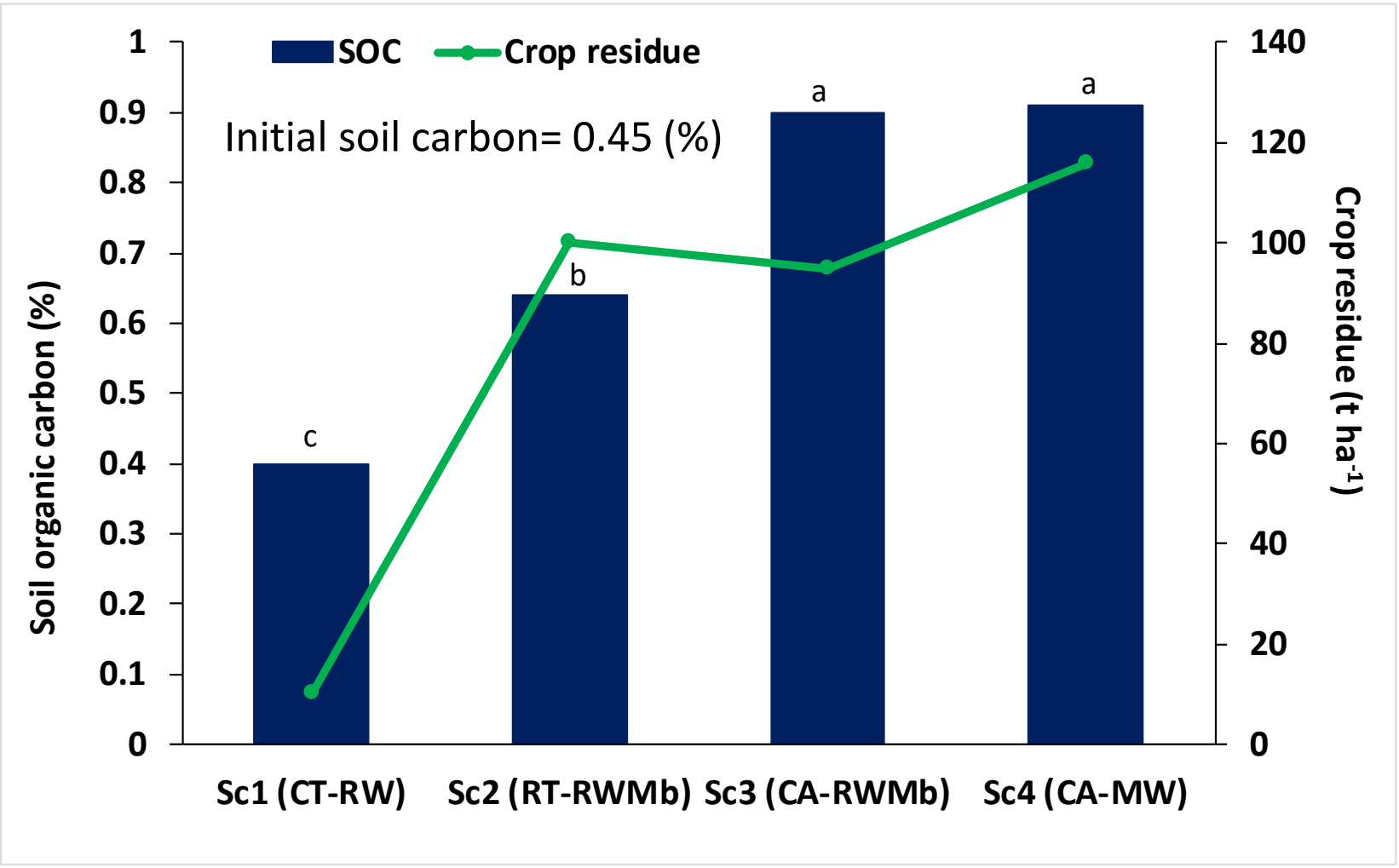
[d] ICAR-Indian Institute of Wheat and Barley Research (IIWBR), Karnal, India

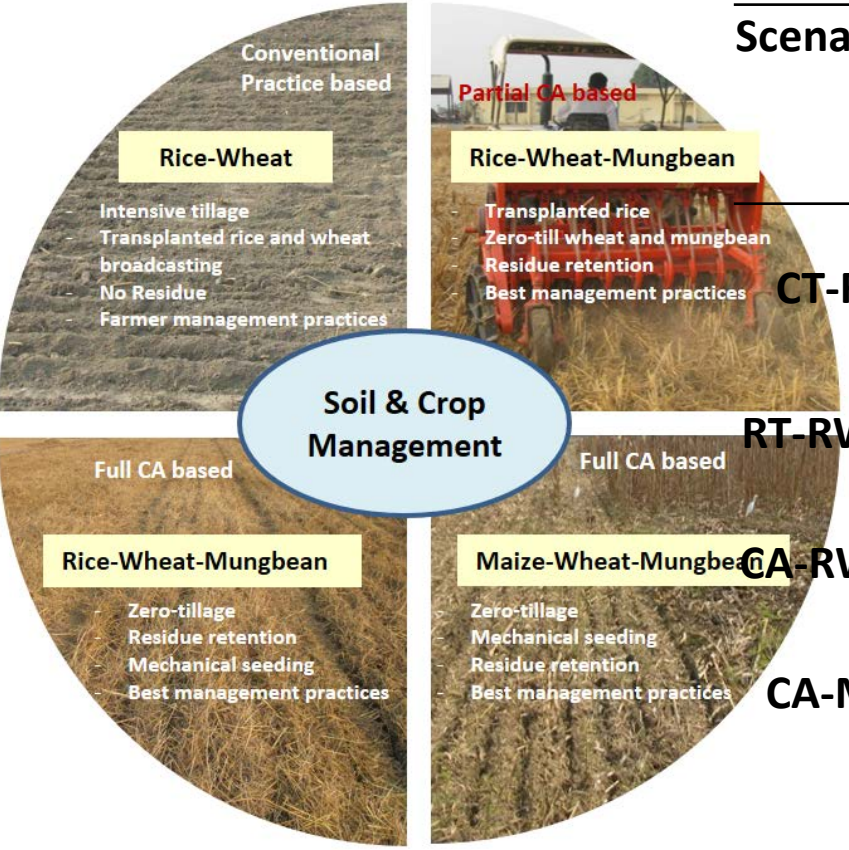
Change in soil organic carbon after 8 years crop residue management



SOC strongly associated with crop residue recycled and soil disturbance

Source: Jat et al., 2019

Changes in Nutrient Content in surface soil (0-15 cm) after 6 years



Scenario	SOC (%)	N	P	K	pH	SQI
		Kg ha^{-1}				
CT-RW	0.49c	186.9c	28.1b	164.5b	7.68	0.30c
RT-RWMb	0.68b	224.8b	21.3b	173.6b	7.37	1.00b
CA-RWMb	0.89a	301.1a	39.5a	224.6a	7.55	1.79a
CA-MW	0.82a	250.0ab	34.5a	268.8a	7.56	1.51a
	(0.45)	(131.0)	(12.6)	(130.0)	(8.20)	

Choudhary et al., 2018

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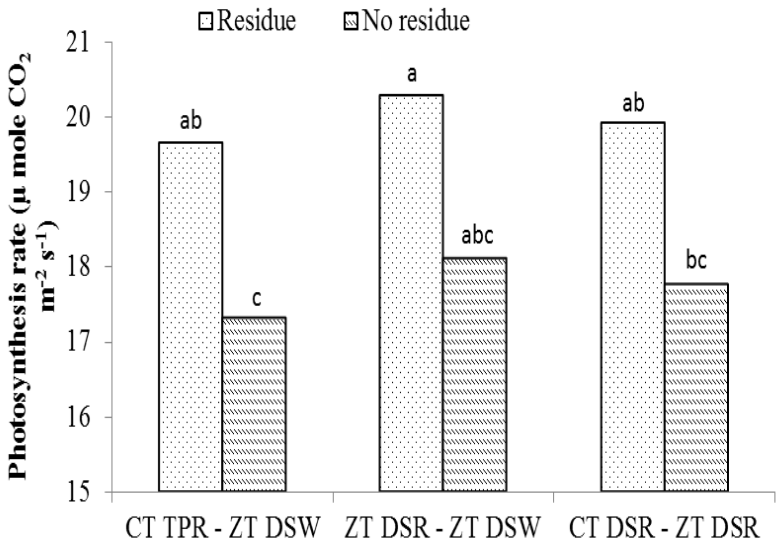
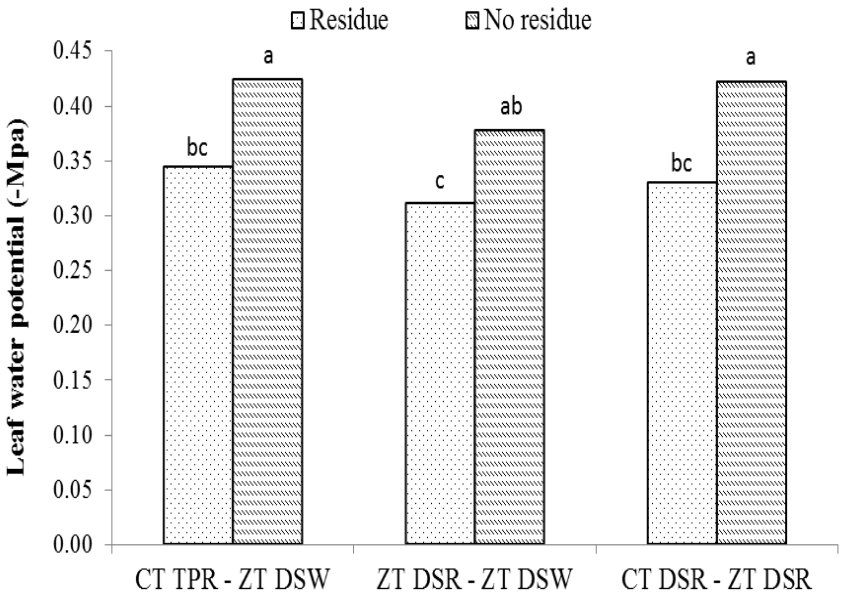
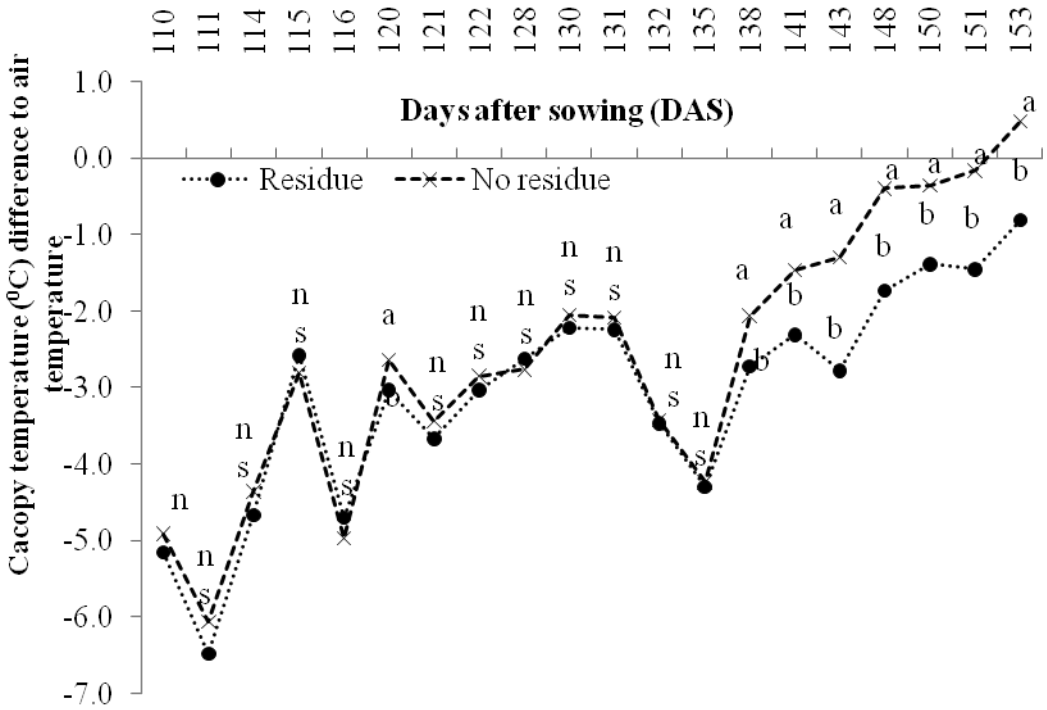
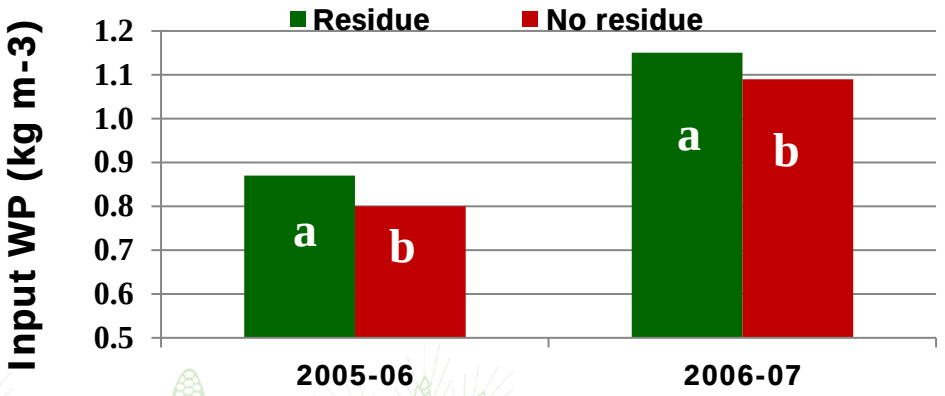
Residues: Physiological processes, water use efficiency and resilience









Source: Jat et al (2009, 2012) and Gathala et al., 2017

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Conclusions

- Chemical, physical and biological properties are all important for soil health
- CA practice improve soil health compared to CT practice
- Healthier soils produce higher yields
- Soil health quick to degrade but takes time to improve
- Healthier soils increase resilience to climate variability and change and facilitates better human health

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W05L04:Climate Resilient and environmental benefits

Dr. Ram Datt
Assistant Professor Dept. of Extension Education,
BAU, Sabour

Environmental benefits are spokes that emanate from the Carbon hub of the **"Environmental Sustainability Wheel"**

- ✓ Increased water holding capacity and use efficiency
- ✓ Increased cation exchange capacity
- ✓ Reduced soil erosion
- ✓ Improved water quality
- ✓ Improved infiltration, less runoff
- ✓ Decreased soil compaction
- ✓ Improved soil tilth and structure
- ✓ Reduced air pollution

Carbon

Central hub of environmental quality

- ✓ Reduced fertilizer inputs
- ✓ Increased soil buffer capacity
- ✓ Increased biological activity
- ✓ Increased nutrient cycling and storage
- ✓ Increased diversity of microflora
- ✓ Increased adsorption of pesticides

Source: Reicosky, 2003

W05L05: Social Benefits

Dr. Ram Datt
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BAU, Sabour

Social Benefits

- Alternative income generating activities
- Reduce drudgery
- Freeze women labour
- Change role/responsibilities vis-à-vis gender
- Enhanced nutritional security
- Diverse farm activities

Course Name: Conservation Agriculture based Sustainable Intensification
Week 05-Lecture-1: Productivity Benefits
Course Instructor: Dr. Sanjay Kumar, Chairman, Dept. of Agronomy, BAU, Sabour

Hello friends. We are now into the fifth week of our course in CASI. This is the first lesson of this week and we would learn about the system benefits of CASI.

We know that CASI increases the benefits of our system in four different ways. These are benefits in system productivity, increase in water productivity, increase in energy productivity and input use efficiency. Also, conservation agriculture is based on three main principles i.e. minimum tillage, crop cover and diversified farming system.

We will first discuss the enhancement of system productivity. There is an increase in system productivity if there is an increase in crop yield of kharif, rabi and zaid season crop compared to the conventional system of growing these crops. So to increase system productivity, we have to increase the productivity of various factors that are important to crop productivity.

Now, soil cover, mulching, crop residue retention and minimum tillage are important requirements in conservation agriculture. These things improve the physical character of the soil and help improve the water holding capacity of the soil which makes sufficient moisture available to crops.

If we talk about the rice-wheat farming system, then if we do DSR under CASI, then we save around 10 to 15 days between the seed to seed period in our rice crop. These 10 to 15-day period is very important for the next wheat crop and as the wheat crop gets more time and our yield also increases.

Now, when we talk about conservation agriculture as system based, we know that we increase our yield by 5 to 10 % when compared to the traditional farming system.

Also, if we improve the water use efficiency of our farming then our system productivity will also improve. In order to increase the use efficiency of water, we have to see that the consumptive use of water is more. To do this, we have to ensure that there is sufficient moisture in the soil.

Also, if we do residue retention in our farm, which is an important part of conservation agriculture then our water holding capacity of soil increases. This improves the water infiltration rate of the soil and reduces the runoff of rainwater and subsequently reduces soil erosion. This means that the top layer of the soil which is the most fertile remains in the farm and this increases our productivity. Usually under CASI, we see the benefits of any activity in the long run.

Now, we will discuss ways to increase nutrients in our farm. Nutrients are more effective in soil where there is sufficient and balanced water or moisture. If there is a lot of water, then the nutrients are washed away with water and this can reduce our fertilizer use efficiency. This is

commonly found in traditional methods of farming. Under CASI, we can use different instruments through which we can manage nutrients and increase the efficiency of nutrients.

Now, we discuss water productivity. As we know by increasing water productivity, we mean less loss of water. We have seen that compared to conventional agriculture, there is about 10 to 15% less loss of water in conservation agriculture and this improves our water productivity by 10 to 15%. Water productivity depends on the residue retention in our farm. With residue retention, we have seen that the water infiltration rate increases and there is a decrease in loss of water through runoff. Also, in conservation agriculture, we use mulch on our farm so there is less evaporation compared to the traditional system of farming. So water productivity is more in conservation agriculture.

Now, we discuss energy productivity. In today's time, we are more and more exploiting our agriculture resources and products though our population is ever increasing and we have limited quantity of land available for farming. But under CASI, our management practice is such that compared to traditional ways of farming, we minimize the use of agriculture products like herbicide, pesticides, fertilizer or use them in optimal quantities. So our energy requirements are more in the traditional way of farming than under CASI.

When we calculate our energy input, we take into consideration that under traditional farming, we till our farm 5 to 10 times whereas in zero tillage we only till it once. Labour requirement is also more in conventional farming and we depend more on machines in conservation agriculture. In conservation agriculture, we save labour during sowing, harvesting and even during post-harvest. As we are saving labour, we require less energy input. But, in traditional agriculture, we see that farmers do a lot of tilling and in the process consume more fuel whereas there is less requirement of fuel in conservation agriculture. In the same way fertilizer is extensively used in traditional farming. For the process of weeding, a lot of labour is used in traditional farming but under CASI, we prefer the use of herbicide. So overall, we use more quantity of products in traditional farming when compared to conservation agriculture and as a result we spend more energy in traditional farming. On the other hand, in conservation agriculture, we optimally use these products and because of which our input energy is less.

In conservation agriculture, we say that there is 5 to 10% increase in system productivity. So if output energy of both traditional farming system and conservation agriculture is same, then as input energy is required less in conservation agriculture, we can safely say that we produce more energy by investing less energy in conservation agriculture.

Now in terms of input efficiency as we are using many different products in traditional farming, the effectiveness and utilization of these products cannot happen fully. But in conservation agriculture, say if we are using nutrients then there are many techniques and instruments to assist us like leaf color chart or green seeker. If we use all these things, then we prevent ourselves from using more nitrogen. So our input use efficiency and its productivity increases as we are using less amount of nitrogen and our productivity remains the same.

Now, why do we get these productivity benefits? If we talk about the entire CASI system, we notice that there is a 5 to 10 % increase in our yield. There is also 10 to 15% increase in water

productivity, 20 to 40% increase in farm income. The main reason for increase in income and profit is that we are saving around 4000 to 5000 rupees per hectare from not tilling. In a year, we save around 40 to 45 labor man days per hectare. So from all the savings what eventually happens is that we save our cost of cultivation and even if the return is same when compared to the traditional way of farming, we are able to profit more. In other words, our benefit cost ratio increases.

So from CASI, we are able to profit more in every parameter be it productivity or water productivity or energy saving or energy productivity or input efficiency.

Course Name: Conservation Agriculture based Sustainable Intensification
Week 05-Lecture-2: Economic Advantages of CASI
Course Instructor: Dr. Ram Datt, Assistant Professor-cum-Jr. Scientist (Extension Education), BAU, Sabour

Hello friends. This has been fully proven that conservation agriculture is a very beneficial technique of farming. But the most important thing for farmers is the economic advantage of a farming technique. Today we will discuss this aspect and look into the various cost savings that come with the adoption of conservation agriculture when compared to traditional way of farming.

Various research studies have been conducted in different locations on conservation agriculture. There will be minor variations in the findings of these studies but all of them show that conservation agriculture is beneficial. We conducted research in the Eastern gangetic plains of India, Nepal and Bangladesh for all types of cropping systems like rice-wheat system, rice-maize system, rice-lentil system or rice-jute system. We found various advantages of conservation agriculture. The overall result of our findings was that CASI is more beneficial than conventional tilling.

To understand it better we look at this graph. There are four treatments. T1 represents conventional tillage meaning puddled transplanted rice after which rabi crops like wheat, maize or red lentil are sown on tilled plot. T2 represents puddled transplanted rice but the rabi crop is done through zero tillage. T3 represents DSR and then zero tillage for rabi crop. So this is a full CASI technique adapter. T4 represents UPTR meaning unpuddled transplanted rice and then rabi crop is grown with zero tillage.

These four categories were analyzed in nine different dimensions and it was found that CASI which is represented by T3 is the most beneficial in all dimensions. This was true for all the 9 dimensions of comparison like the system rice equivalent yield, cost of production savings,laboursavings, energy saving, irrigation water saving, gross margin, input water productivity, energy productivity and CO2 emission benefits. In all of these categories, you can see that T3 is the most beneficial. We have kept them in an index of values from 0 to 1. We can see that the most valuable is represented by the value 1 and least valuable are going towards the value 0.

The second best system after T3 is T4 i.e. unpuddled transplanted rice and zero tillage for rabi crop. It has the same benefits when it comes to water saving with other systems but in all the other parameters this system is more beneficial.

Then comes the T2 system where we did puddled transplanted rice followed by zero tillage for rabi crop.

In the end is conventional tillage system i.e. T1 and it is shown that the other three systems are more beneficial than the conventional T1 system.

Another study done by FAO has shown that we can from the time of land preparation to the time of crop establishment, save around 80% consumption of fuel if we are doing conservation agriculture. We save around 60% labour compared to conventional tillage in conservation agriculture. In our study of the 3 countries of Nepal, India and Bangladesh, we found that 40% cost can be reduced and 25% gross margin gain in conservation agriculture compared to conventional tillage.

Overall, farmers can save approximately a minimum of 2500 to 3000 rupees in conservation agriculture when compared to conventional tillage.

So friends, conservation agriculture is very beneficial for farmers. In times of climate change, conservation agriculture comes forward as a very good solution and it is also very beneficial for the farmer.

Course Name: Conservation Agriculture based Sustainable Intensification
Week 05-Lecture-3: Soil Health
Course Instructor: Dr. Mahesh K. Gathala, Sr. Systems Agronomist, CIMMYT, Bangladesh

Hello friends. Today, we will talk about soil health. We will discuss what is soil health and what is its relationship with soil quality. We will also look at the main components of soil health.

Soil health is something basic that we can feel and understand but it is difficult to measure. Soil health is just like human health but doing an assessment of soil health is very difficult. Soil health depends on soil quality. We cannot directly measure soil quality so we do an indirect assessment of it through soil properties. We do have vast knowledge about soil health but we cannot just summarize it into a simple formulae or indicators like we do for human health.

The best indicator of our soil health and soil quality is our crop yield. As we cannot directly measure the soil quality indicators, we measure the soil properties to get an idea about the soil health. So a straight forward measurement of soil health is not possible that could give us a clear result if the soil is healthy or not.

Soil health works on two important properties: inherent soil properties and dynamic soil properties.

Inherent soil properties include things like with which rock the soil is made of, the time of soil formation and its parent material. It also includes things like the topography of soil, what was the vegetation and how long did it take to be formed.

Now, major soil classifications are described and divided under inherent soil properties. We can check the different types of soil like its parent material and if the soil is acidic or alkaline, productive or unproductive.

Soil health also depends on soil dynamics which includes things like the land use, what was the cropping system, how was cultivation and management done and the decisions. Soil quality depends on the above and they are influenced by soil health, management, cropping system, farming system, temperature, seasonal crops. So their overall management governs to soil health

So the dynamic and inherent properties are the factors that govern soil health. Soil health depends on three properties: physical properties, chemical properties and biological properties.

All these three properties indicate soil quality. Soil's physical properties function is to support the plant so that it can stand upright and grow. It also controls soil erosion. If the physical condition of soil is good, then soil erosion will be less and if it is bad then the soil will erode with water. The hardness of soil also depends on soil physical properties like if the soil is hard or soft. Soil physical properties also help with water retention and the movement of water within soil profile.

Soil chemical properties function is to retain the nutrients and also how to release them. It also controls soil reactions like EC and pH**.** Carbon energy storage also depends on soil chemical properties.

Soil biological properties affect weed, pests and diseases and their suppression. The growth of microbial population in the soil like micro-roots and micro root zone depends on biological properties. Organic matter decomposition rate and the N mineralization of soil i.e. nitrification and denitrification is also governed by biological properties.

Now we look at soil physical properties. It includes soil temperature called also soil thermodynamics, soil moisture, **bulk density**, hardness of soil, soil permeability and soil composition and aggregation.

The soil chemical properties include EC and pH, available nutrients, total nutrients, total organic carbon and available carbon etc.

The biological properties include the growth and population reactions of bacteria, fungi and actinomycetes. It also includes insects and pest related disease and their growth and seeds.

The organic matter decomposition depends on microbial population and bacteria. It will also be according to soil biological properties. It includes the rate of organic matter decomposition if there are more bacteria or actinomycetes or fungi in the soil.

So these were the three soil properties and now we will discuss them further in detail and how management affects them.

We had discussed earlier the relation between residue retention and soil physical properties. We will also talk about soil health under CASI and how soil physical properties are governed.

We will first talk about soil permeability or infiltration. If we practice residue retention and conservation agriculture for a long time, then the soil permeability or infiltration or water soaking capacity increases. This recharges the aquifer and also prevents water logging and crop burn out.

If we do zero tillage and conservation agriculture continuously then the soil aggregation i.e. there is improvement in small lumps of soil. This helps with overall soil composition and structure.

If we retain residue, then our moisture is conserved and that regulates our temperature. This can moderate temperature by 5 to 6 degrees which is very beneficial during extreme high and low temperatures.

If we practice CASI and retain residue and do zero tillage and crop diversification, then it conserves water as the capacity to retain moisture increases. This is possible because the soil physical properties like soil structure temperature and**bulk density** improves and as a result the water retention capacity increases. Also the mulch helps prevent water evaporation.

Now we look into soil biological properties and the enzymes like bacteria, fungi and actinomycetes. If you look at the graph, the population of dehydrogenize activities and enzymes increase. The total microbial carbon and actinomycetes increases. So we can see in the graph that all the three enzymes population increases where residue retention is practiced. But their population falls where there was no residue retention and tilling was practiced. We have 28% growth of bacteria, 68% growth of fungi and 98% growth of actinomycetes where we do zero tillage and residue retention and mulch.

This was all for micro fauna. But the macro fauna population also increases like soil and seed predators and many other beneficial insects. The population of earthworms also increases. So the overall biological properties of soil increases and there is self-tillage in the soil like if the population of earthworm increases then they till the soil on their own and release nutrients.

Now, we discuss soil chemical properties, especially soil organic carbon. This is directly associated with how much organic matter we are providing to the soil like farmyard manure, crop residue or any other plant biomass. So in the graph, we can see that after 5 years of CASI, if we are continuously providing residue of all the three crops then the value increases from 0.45 to 0.9. So the soil surface values doubles.

The benefits of it in soil profile will be less and will only be found in the long run. So this is over all an improvement in soil carbon.

Another thing we notice in the graph is that the amount of available macro nutrients like nitrogen, phosphorus, potassium and Sulphur increases and they are easily available to the plants. Now the availability of micro nutrients like iron, zinc, manganese, boron and other non-essential but important nutrients like silicon also increases and so there is good plant growth.

So if there is overall improvement in physical, biological and chemical properties then we can see in the graph the photosynthesis rate of plants increases. The canopy temperature which is very important in the later stage of plant, if at that time our temperature is maintained then there is good grain filling and grain weight as a result of which we get good production.

Overall if our soil health is good, our soil quality indicators like physical, biological and chemical properties are good then our overall soil and plant and water relation improves and as a result we get good crop and yield.

Now, we will look at the advantages. The soil's physical, chemical and biological properties are very important for soil health. If we have a problem in one of the properties, then we won't have good soil.

The soil health improves under CASI as compared to traditional farming as the three chemical, biological and physical properties of soil improves.

If our soil is healthier then we will get good quality yield and we become healthier by eating good quality food.

The soil health and soil quality takes years to improve but if we want to destroy it then we can do that in just one year by adopting wrong practices. It is just like human health where it takes years to keep good health but in just one month we can get any diseases or anything by eating unhealthy things.

If our soil is healthy then our plant will be healthy and it would have better resilience against climatic shocks. This can improve our income and the quality of food we eat and the quality of soil for our future generation will be better.

It is very important to maintain the soil health.

Thank you and hope you enjoyed this chapter.

Course Name: Conservation Agriculture based Sustainable Intensification
Week 05-Lecture-4: Climate Resilient and Environmental Benefits
Course Instructor: Dr. Ram Datt, Assistant Professor-cum-Jr. Scientist (Extension Education), BAU, Sabour

Hello friends. We know that agriculture provides us with our basic needs like food, fuel and fodder but it also contributes to the emission of greenhouse gases. These gases are released through soil organic matter decomposition or the use of fossil fuel or through residue burning.

In the last 30 - 40 years, we extensively practiced tilling soil and this released 30 to 50 % carbon from our soil into the environment resulting in the deterioration of our air quality.

Now, conservation agriculture is being looked at as a potential solution. We had looked at the three main principles of conservation agriculture: minimum tillage, soil cover and crop rotation. If we do minimum tillage and permanently or semi cover the soil, then there will be reduced emission of carbon in the environment and our soil will be healthy. We can understand it better by looking at the Reicosky, 2003 'C wheel'.

We can understand carbon in two parts. First, if our soil is fertile then there would be more organic matter in the soil and we would get good production and this will improve our economic condition. Second, if we stop carbon emissions then CO2 sequestration will stop and our air quality will improve. If we have more organic matter in the soil, then the water holding capacity and the use efficiency will increase. According to a study by Hudson, if we increase the organic matter by 1% then the water holding capacity of soil increases by 3.7 %. Also more organic matter in the soil means that water will seep into the soil slowly and reach the plant. The rain water will also infiltrate and go down.

The Cation exchange capacity(CEC) will increase and this will increase the availability of nutrients. One study has shown that if we increase the organic matter in the soil then it increases the CEC by 20% to 70% provided they are clay minerals or metal oxides.

Conservation agriculture also stops soil erosion by almost hundred percent as the crop residue decays slowly and a layer of organic matter develops. In fact, conservation agriculture had started as a response to the problem of soil erosion.

This also improves the water quality. When there is an increase in organic matter then there is also increase in biological, physical and chemical activities and this decreases soil compactness. This leads to an improvement of soil structure and tilth and there is aeration for the plant. All this slowly reduces the release of CO2 in the environment as the carbon is being trapped in the soil and less of it is released.

One benefit of this is that as there is more organic matter in the soil so we require less fertilizers. Also due to tilling, the availability of nitrogen increases in the short term due to mineralization but in the long run the availability of nitrogen decreases.

There is an increase in soil buffer capacity and in biological activities. As we are not disturbing the soil structure, there is an increase in the different types of biota in the soil. They get an ideal environment and their numbers and variation increases. Also there is no run off when we use pesticide or herbicide in our farm as there is a layer of organic matter that absorbs and increases the efficiency of pesticides.

So we can say that carbon is at the center and plays an important role. Conservation agriculture increases the availability of organic matter. In a research conducted for Eastern gangetic plains, it was found that if we do conservation agriculture then almost 10% CO_2 equivalent emission decreases and this figure was between 10 to 20% in other studies.

Besides this, conservation agriculture mainly zero tillage and DSR, there is increased resilience against climatic shocks like floods and drought. I would like to share an example with you. We had organized a DSR demonstration in Kathaili village. Now there was an unexpected flood during the month of September in that village and we found that farmers who had done DSR in lowland, their crop was saved while the transplanted paddy crop of farmers next to the DSR plots did not survive the flooding.

Like I said earlier, with conservation agriculture, the water holding capacity increases as there is an increase in organic matter and water slowly is released for plants. So even in drought like situations, the plant gets water.

We had also looked earlier at how crop residue retention maintains the balance of temperature between 5 to 6 degree Celsius. So due to climate change, if there are any variations in temperature then our yield does not get affected by such things. Therefore, we can say that conservation agriculture is climate resilient and it has many benefits.

So friends today we looked at the various environment related benefits of conservation agriculture. Conservation agriculture increases our production and improves our economic condition.

Thank you.

Course Name: Conservation Agriculture based Sustainable Intensification
Week 05-Lecture-5: Social benefits
Course Instructor: Dr. Ram Datt, Assistant Professor-cum-Jr. Scientist (Extension Education), BAU, Sabour

Hello friends. This week we learnt about the various advantages of conservation agriculture like how we can increase system productivity and the economic advantages it has. We also looked at the environmental benefits of conservation agriculture. There is one more important aspect that we have to look at. Agriculture is a system with a family approach. This is even more true for developing countries like most of south Asian countries. As agriculture is family based both male and female members of the family work in the farm. These days'feminization of agriculture is a very talked about subject. Also, when we talk about Eastern Gangetic Plains then the migration rate is also very high. So, keeping these things in mind, today we will discuss the social benefits of adopting conservation agriculture.

First, if we adopt conservation agriculture then we can also do some alternate income generating activities. For example, we were in Katheli village and a women farmer by the name of Rekha had done CASI farming in half acre. Keeping in line with our goal of intensification, she also grew some vegetables in her Maize farm. She was able to earn 5000 to 6000 by selling these vegetables. After this, she also got maize crop from her farm. So in this way, if we adopt the principles and technologies of CASI, then we can also engage in alternate activities. This is especially true for women as most farmers are small cultivators and there is a lot of migration because of which women have to take care of the farm.

The second benefit conservation agriculture has is that it is a labour saving way of doing farming. If we do DSR, then we don't have to do puddling and transplanting. Now mostly, I would say around 90% of the transplanting work is done by women. So it requires a lot of drudgery and we can avoid all this by adopting conservation agriculture. Women then can spend their time in other income generating activities. In Bihar, there are many self-help groups for women and these groups also work on women entrepreneurship. So if women are able to spare time from agriculture then they can spend that time on their family or on any other entrepreneurial activities.

This also works as an empowerment. When we started our work through a self-help group, then some women came forward and told us that they will adopt conservation agriculture. These ladies worked as our ambassador and told other women about it. So in this way, these ladies got recognition and also a source of some additional income. Such social benefits come out of conservation agriculture. Basically, male and female farmers who are able to save time from this can use that time in other activities.

The benefit that farmers derive from conservation agriculture, they can spend that in education and food. So their nutritional security also improves.

One of the principles of CASI is intensification and it brings diversification to our farm and this leads to more income generating activities.

One of the social benefits of conservation agriculture is that women do extremely laborious work like transplanting or weeding. They can save time from these and instead spend that time on other activities. Overall, there will be an improvement in the household activities.

We would also have to design machines that come under CASI to be gender specific. Like the machines are very heavy and it is very difficult to transport them from one place to another. So we have to work on how to make these machines accessible to women and how to make small machines so that women are able to operate it.

So friends besides other advantages of CASI, one benefit that we see coming out is the social benefit. If everyone works together then there will be scaling out of conservation agriculture and the business will increase and other people in the society will get employment. Service providers can buy more machines and expand their employment. So, conservation agriculture has a lot of advantages.