V Organic Farming for Sustainable Agricultural Production

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Lecture – 10
Organic Farming and Climate Change (Contd.)

So, Lecture 10; so Organic Farming and Climate Change as a continuing. So, here we will discussing the organic farming as a key role in climate change mitigations or how we can mitigate the climate change through organic farming. So, we will first we will learn about the adaptations and mitigations in agricultural productions, then we will move smoothly to organic farming as climate change mitigations.

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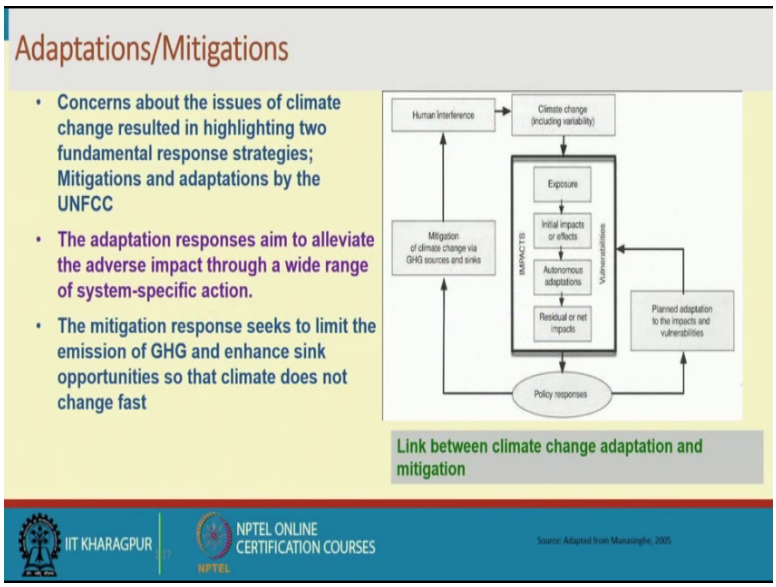

If you talk about the adaptations and mitigations as you say the climate change that has impact; that means, if the climate change this including the climate variability. So, so this has a exposure then initial impacts or the facts when we see the agricultural productions. So, there is impact of climate change then every crops it has a autonomous adaptations. So, the crops also try to adapt to the rising temperatures. And sometimes the farmers during the practice agricultural practice; so, they also be become adaptive to the usual clime climate change; that is a autonomous adaptations then there is a residual or the net impact of climate change.

So, one is the other side the impacts then there is a vulnerability; vulnerability if you go for the economic assessment; that means, so if there is a impact is a adverse effect on the agricultural productions. Then how vulnerable is your the food production to climate change.

So, it depends upon like examples of a in a particular locations. So, the farmers are growing mainly rice crops. So, more area under rice and also the for some farmers grow wheat crops and wheat is very less. Suppose 90 percent area is a diverted for rice crops and 10 percent for wheat crops. The effect is much more on wheat as compared to rice; if you talk then you talk of vulnerability, then that area maybe even though the impact is less and rice. But there is a impact adverse effect, but the high area under rice a rice secure is higher as compared to wheat.

So, the farmers will be highly vulnerable to climate change. So, their vulnerability assessments to climate change; once we have then policy makers make the plant adaptations to through plant adaptations the impact can be nullified can be reduced by the adverse impact of climate change on the rice production or the food and production can be reduced through the plant adaptations.

So, in addition to the adaptations, so there is mitigations; mitigation means so, our activity the management practices should be such that so, there should be less emission of greenhouse gases to the atmosphere. So, that is known as the mitigations. So, the adaptations and mitigations; they should go hand on hand. There should be adopting mechanisms so that it should minimize the impact of climate change.

At the same time there should be mitigation strategy. So, that the so, that we do not allow the climate to change at a faster rate. So that means we concerns about the issues of climate change result a in highlighting the two fundamental response strategies that is mitigations and adaptations by the UNFCC; Unit Nations Framework Convention Climate Change. So, the adaptation responses aim to alleviate the adverse impact through a wide range of system specific actions and the mitigation process seeks to limit the emission of greenhouse gases and enhance sink opportunities, so that the climate does not change fast.

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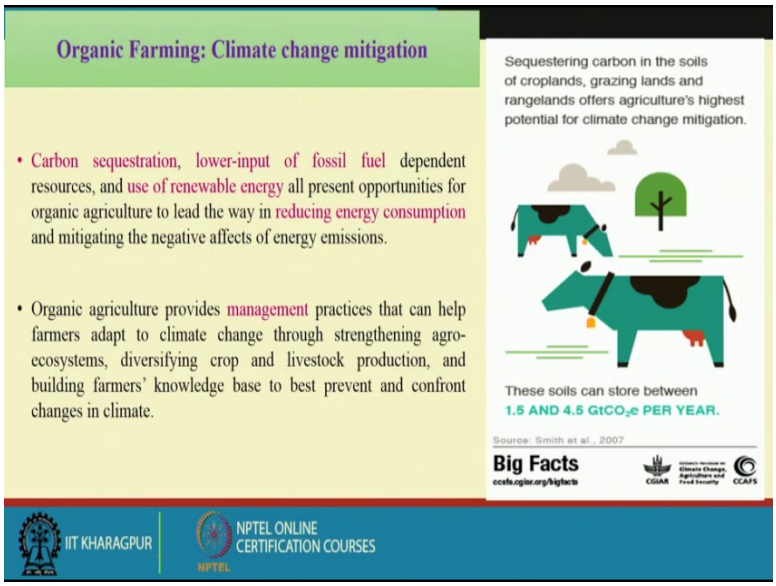

So, looking at this adaptations and mitigations, if you see organic farming, the role of organic farming and the potential of organic farming as a climate change mitigations. So, in general sequestering carbon in the soil or the a croplands, grazing lands, graze lands and other agriculture's are the highest potential for the climate change mitigations. So, if you want if you can increase the carbon sequestration soil; soil can be sink of the carbon dioxide.

So, we can minimize the emission of greenhouse gases atmosphere and so the climate change. That means a carbon sequestration lower input of a fossil fuels dependent resources and use of renewable energy; all present opportunities for organic agriculture to lead the way in reducing energy consumption and mitigating the negative effects of energy emission.

Second organic agriculture provides management practices that can help farmers adapt to climate change through strengthening agro-echosystems, diversity of crops and diversifying crops and livestock productions and building farmers knowledge base to best improvement- prevent and confront changes in climate change. So, we have discussed this also in detail in previous classes as organic farming is an integrated farming system concepts where we have the more number of crops crop diversifications and the livestock is an integral part of organic farming.

So in these integrated farming systems, so the output or the byproduct of one component that becomes the input of other components that is a zero emission concept or we can say no emissions. So, there is no waste, all the unfarmed biological resources are utilized and it needs less ah off farm resources or a less energy for this products organic productions that way it can have a less emissions or for the greenhouse gases to the atmosphere and that can that can we can say organic farming as a key for the mini for mitigating the climate change by reducing the a greenhouse gas emission to the atmosphere.

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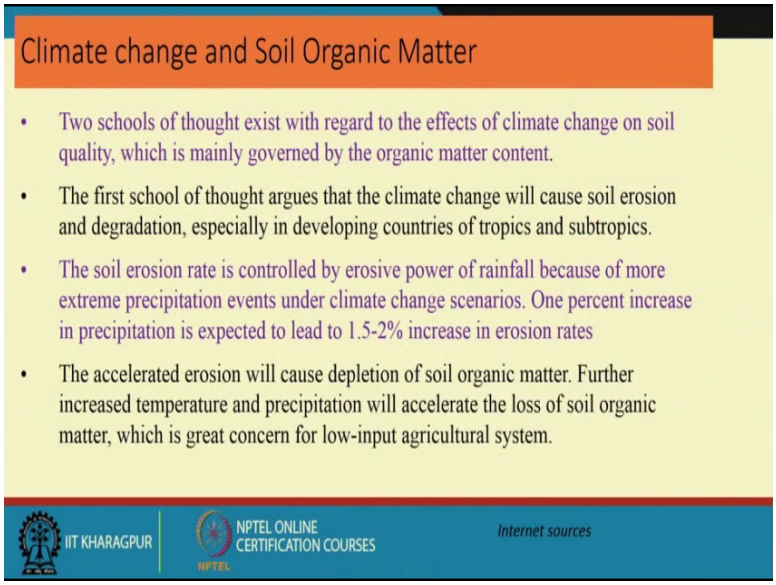

If you see the soil organic matter the sequestration of the soil organic matter, the climate change and this soil organic matter; if you see there is a two schools of thoughts whether with the changing temperature and the variable in precipitations what will happen to soil organic matter it may decrease or increase. One school of thought that says argues that climate change will cause soil erosion and degradations especially in developing countries of tropics and subtropics.

That means, so as we are discussing now with climate change so there is increasing number of high precipitation events. So, because of a high intensity precipitation events increasing so that causes splitting of soil particles and erosion of the top soil layers; that means, degradation of the soil because top soils are a fertile and top soils are rich in carbon. If there is a loss of top soil layers erosion of soil through the water because of

high intensity precipitation events, so that cases loss of soil quality and loss of soil organic matter.

So, the soil erosion rate is a controlled by erosive power of a rainfall because of a more ah extreme precipitation events under climate change scenarios. So, 1 percent increase in precipitation is a expected to lead to 1.5 to 2 percent increase in erosion rates. So, that is why the accelerated erosions will cause depletion of soil organic matter, further increase temperature and precipitation will accelerate this loss of soil organic matter which is a great concern for low input agricultural systems.

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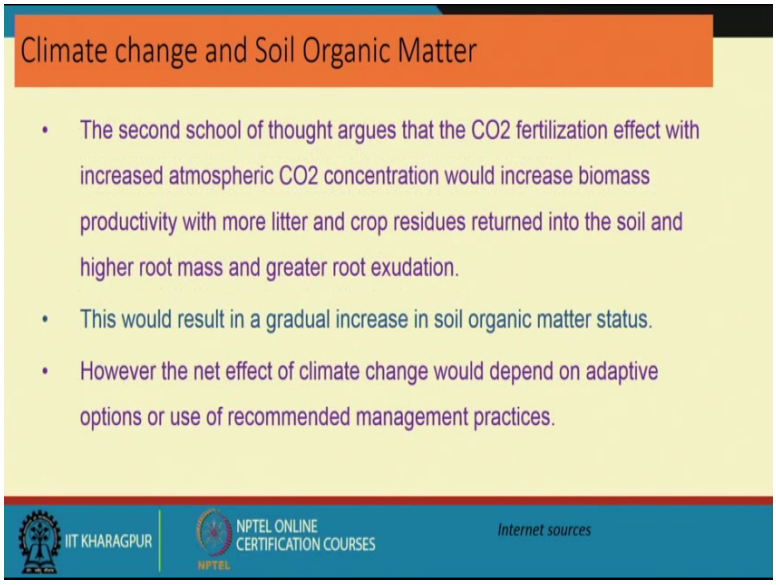

So, this is a one school of thought. The other school of thought this says that the second school of thought we can say that argues that CO 2 fertilization effect with increased atmospheric CO 2 concentration would increase biomass productivity with more litter and the crop residues returned into the soil and higher root mass and greater root exudations. So, because of the increasing root biomass and increasing the soil rhizosphere activity, so this should result in gradual increase in soil organic matter.

So, this is a contradictory. One says there will be a decrease in soil organic matter and the other school of thought there maybe increase in soil organic matter in future climate. So, however the net effect of climate change would depend on adaptive options or use of the recommended management practices.

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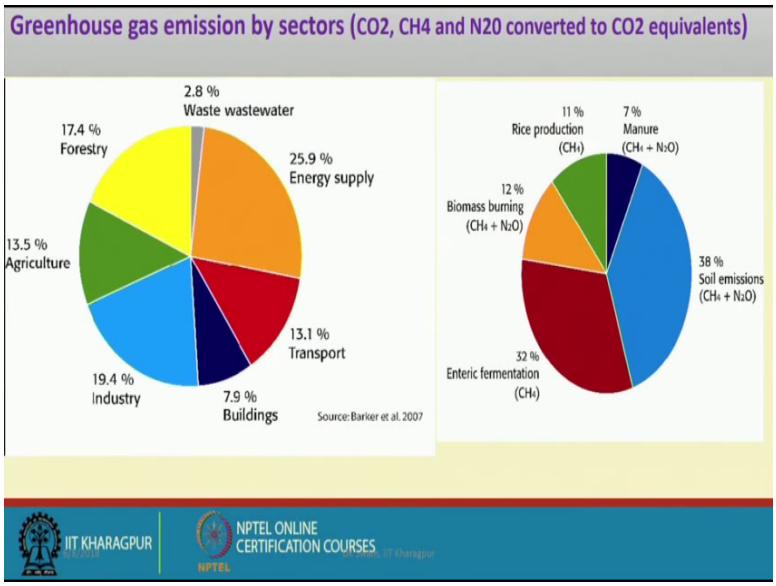

So, I have to see the greenhouse gas emission from by different sectors maximum being in energy supply sector that is a 25.9 percent. So, this includes your carbon dioxide, methane and nitrous oxide and agricultural sector also we discussed last class it contributes around 13.5 percent of the total greenhouse gas emissions.

So, if you see the among the agricultural sector, the greenhouse gas emission maximum is from soil that is around 38 percent followed by enteric fermentations from the livestocks, the ruminants say a 32 percent, followed by biomass burning is around 12 percent, rice production contributes around 11 percent of the total greenhouse gas emission from the agricultural sector and finally, the manures handling around 7 percent. So, these are the scenario of the greenhouse gas emissions from different sectors and in the agricultural sector from different components the greenhouse gas emission.

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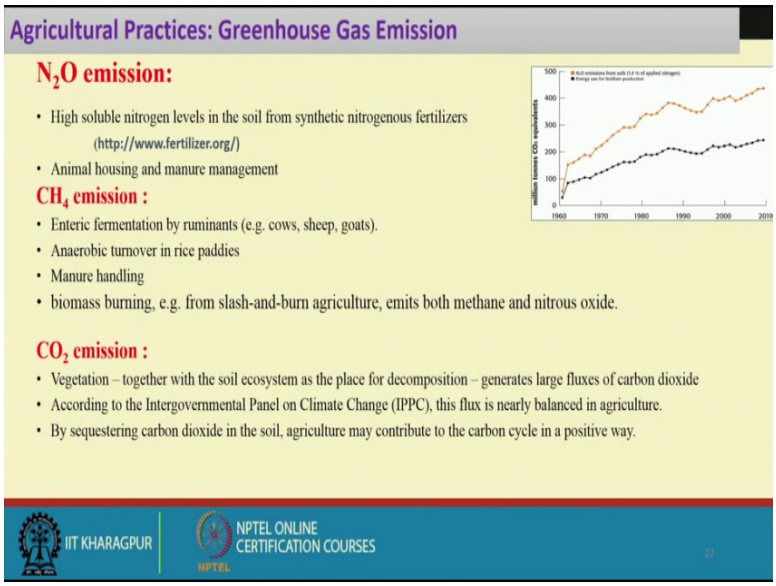

So, if you see the agricultural practice or the greenhouse gas emissions, so nitrous oxide emission that is a high soluble nitrogen level in soil from synthetic nitrogen fertilizers. So, use of the through chemical fertilizers and as we discussed the earlier class because the yield management improper management unscientific management of this chemical a fertilizers specially nitrogenous fertilizers that lead to emission of greenhouse gas nitrous oxide.

And we can see from the figure the red line shows nitrous oxide emissions in million tons of carbon dioxide equivalent after application of the fertilizers. So, that is increasing over the years as we progress because there is a increasing use of chemical fertilizers with increasing use. So, there is increasing emission of nitrous oxides to atmosphere from these fertilizer applications. Moreover, when you are using fertilizer because production of the fertilizer black line shows energy used for fertilizer productions this much of CO 2 equivalent energy used for the fertilizer production; that means, that is increasing use of energy for the production of fertilizer that also causes the global warming emission of the greenhouse gas gases to atmosphere.

So, this is the ah nitrous oxide emissions. Similarly, you can see the methane emissions. So, either the entering fermentations from a ruminants like cow, ships and goats, then anaerobic turn over in rice pad is because rice is grown under the flooded conditions standing a water. So, form the from this standing a water rice field so there is a emission

of the methane emission methane emission is a higher as compared to the saturated conditions and the manure handling that also causes some methane emissions in a manure productions and the management and biomass burning that is a slash and burn agriculture we have the zoom agriculture in that case that emits both methane and nitrous oxides to the atmosphere.

And if you see the carbon dioxide emissions, vegetations and together with the soil eco systems as a place for decomposition so generate large fluxes of carbon dioxide. According to IPCC, that is intergovernmental panel on climate change this flux is nearly balanced agriculture because know the crop or the perennial trees they also absorb carbon di oxide for a photosynthesis though there is a release they also absorb. So, in that case this is the balanced the flux the of CO 2 from the vegetations is balanced in agriculture by moreover by a sequestering carbon dioxide in soil agriculture may contribute to the carbon cycle in a positive way.

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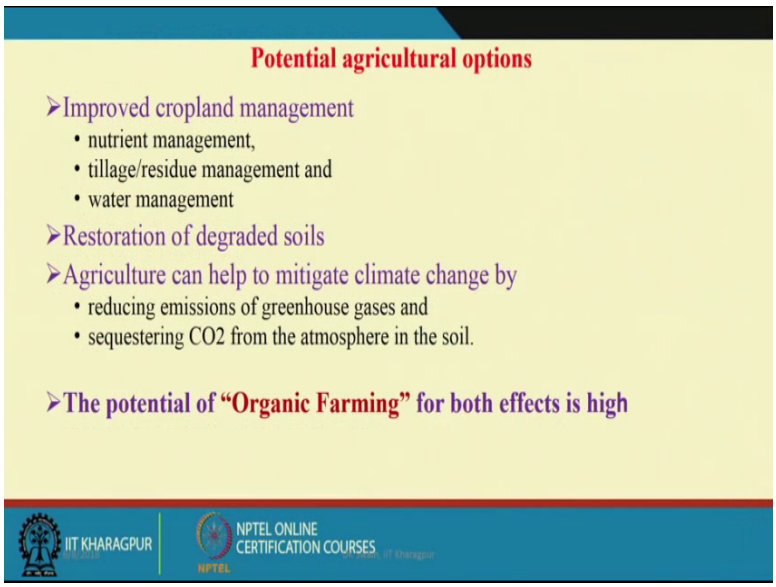

And the potential agricultural options you can see for minimizing the greenhouse gas options green greenhouse gas emissions those are the improved crop land management. You have this as scientific nutrient management that can minimize the greenhouse gas emission. These we have discussed in previous classes tillage and residue management conservation tillage minimum tillage and the incorporation of crop residue and the soil that can minimize the emission of greenhouse gas of the atmosphere then water

management as we discussing. So, if you maintain the minimum water or the economic use of water efficient use of water that can minimize the emission of greenhouse gases if you go for a flooding like rice field if you go for the flooded rice that causes anaerobic decompositions and more release of methane from the rice field.

Rice does not require a standing water for a higher productions, only saturation is enough to maintain a good level of productions and under a saturate conditions there will be less emission of methane as compared to flooded rice. So, that is a new rice production technology that is a system of rice intensifications where no standing water is maintained only saturations or field capacity saturation is maintained to have a better productions with a less emission of greenhouse gases to the atmosphere. Then restoration of a degraded soils then agriculture can help to mitigate the climate change by reducing emission of greenhouse gases.

And at the same time by a sequestering carbon dioxide from the atmosphere in soil and for this the potential of a organic farming for both means reducing emission of greenhouse gases and for sequestering carbon dioxide and soil is very high.

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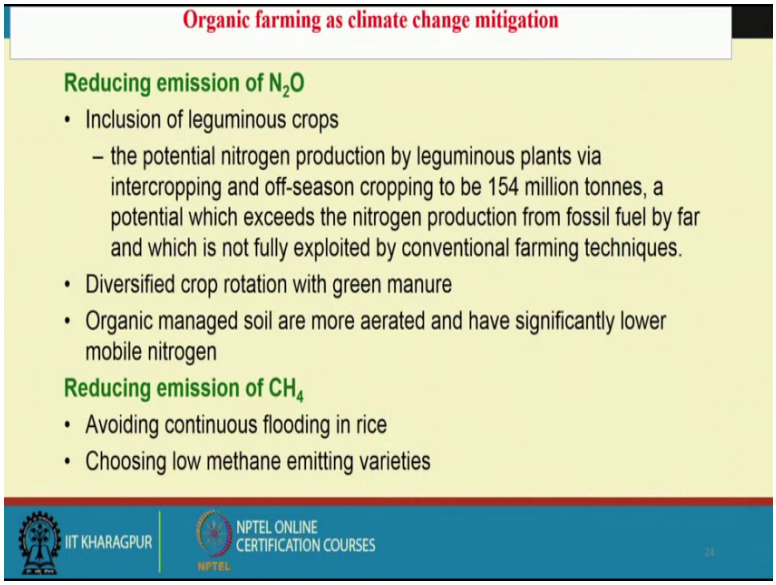

See organic farming as climate change mitigations because reducing the emission of nitrous oxide inclusion of a leguminous crops. By adding leguminous crops or by putting crops in a crop rotations, we can minimize we can reduce the use of synthetic nitrogenous fertilizers. So, up to this the information a potential nitrogen production by a

leguminous plant by a intercropping and half season cropping to be 154 million tons a potential which exceeds the nitrogen production from fossil fuel by far and we and which is not fully exploited by a conventional farming technique. So, there is a great scope great opportunity we can include leguminous crops in the crop rotations are the cropping system, so that we can minimize the use of a synthetic nitrogenous fertilizers.

Then diversified crop rotations with a green manure crops, then organic manure soils are the aerated high aerated as compared to the conventional fertilizer managements or the chemical fertilizer and the because of the more erosions they have the significantly lower mobile nitrogen. Then after So, I reducing methane emissions we discussed avoid continuous flooding there should be only saturation in the rice feed, we do not need to flooding water to have a higher productions saturations well managed water can give a good production, high productions with less emission of greenhouse gases to the atmosphere. And also the variety also there is some varieties we can have a less emitting of the greenhouse gases.

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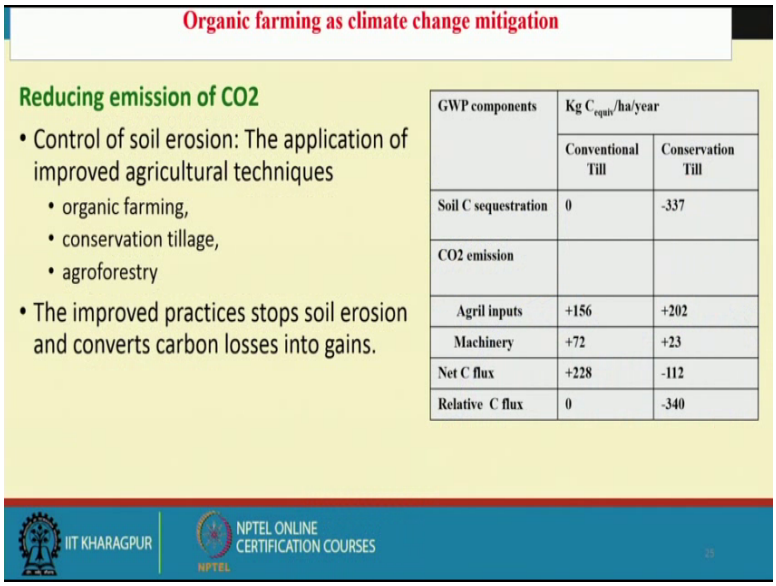

So, reducing carbon dioxide emission, so different options we can use for how we can minimize the emission of carbon dioxide, organic farming as we have discussed the way of reducing the CO 2 emissions and conservation tillage agroforestry. So, this we the table shows how the tillage practices that can minimize the emission of greenhouse gases

if you see the compare the conventional tillage versus conservation tillage kg carbon equivalent per hectare per years and these are the global warming potential components.

So, a soil carbon sequestration for the conventional tillage if you reference has a 0, in conservation that is a minus 337 kg carbon per hectare, per year means this much carbon is a last to atmosphere through conventional tillage. And if you go for the conservations this carbon is a protected in the soil that is restored in the soil that is sequestration soils if you go for the conservation tillage; that is for the soil carbon sequestration say and if you go for the CO 2 emissions through a agricultural inputs. So, this is the carbon emission is a higher in case of the conservation tillage as compared to conventional tillage.

In conservation is to around 202 kg per hectare per year, in conventional 156 kg carbon per hectare per year this is because in agricultural inputs application in conservation tillage are specially for the fertilizers that is not well managed mainly spread on the surface soil that causes more emission of nitrous oxide and also if you go for the conservation tillage as a less tillage we go for the more application of the herbicides to control the wheat in conservation tillage, so in that way there is a more emission of the greenhouse gases to atmosphere. And if you if you have to look at the machinery in case of the higher emissions only conventional tillage because more use of the farm machinery in conventional tillage.

So, if you see the net flux, in case of the conventional tillage plus 228 kg carbon per hectare per year, if you go for the conservation tillage it is a minus 112 and if you see the relative carbon flux looking at the 228 plus 112; that means, 340 kg carbon equivalent per hectare per year that is sequestered in the soil in conservation tillage as compared to the conventional tillage.

So, that is what the tillage practices also one of the options and organic farming the we are discuss also we go for the conservation tillage or the stubble mulch tillage, so that it can minimize the emission of greenhouse gases in the atmosphere.

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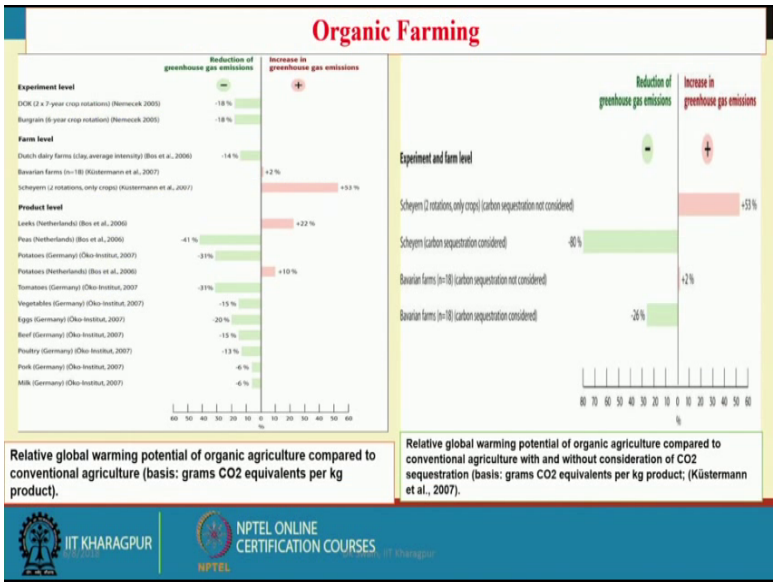

And if we give example how organic farming as a global warming reducing global warming potential the relative global warming potential of a organic agriculture compared to conventional agriculture. So, one levels in European country, they have studied at the farm levels, at the experimental levels and also product levels.

If you see the reduction in greenhouse gas emissions, so, that is most of the cases. So, there is a decreasing greenhouse gas emission or there is a reduction greenhouse gas emission in a organic farming as compared to conventional farming. So, if you see here for the farm levels to the two farms there is 18 percent reduction in greenhouse gas emissions, similar ah there is experimental levels in farm levels here the two farm shows there is a increasing emission of a greenhouse gases.

One farm shows plus 2 percent the other farm shows plus 53 percent emission of greenhouse gases at atmosphere, but in the in crop level you can see the many crops that shows that is a decreasing emission of greenhouse gases to atmosphere in a organic farming as compared to conventional farming. If you take the example of those farms where there is a higher emission of greenhouse gases the atmosphere in a organic farming.

Suppose these two farms you will take example in one case 2 2 percent the other case 53 percent. So, this is without considering carbon sequestration; that means, the amount of

organic matter are added to soil that is not considered. All the cases it is not considered, the carbon sequestration.

For those farms if you see the carbon sequestration in the soil in this case again the emission becomes negative. If you see the right hand side this graph, for those farms the suppose 53 percent higher emission of greenhouse gas at atmosphere in organic farming as compared to chemical farming carbon sequestration is not considered; that means, amount of organic matter added to the soil in organic farming that is not taken to account.

If you take those into account, then it becomes negative minus 80 percent; that means, while considering carbon sequestration the organics ah farming system that makes a huge reduction greenhouse gas emission of the atmosphere as compared to chemical farming. Same in case of the other farm; in this case if there is 2 percent increase in greenhouse gas emissions if you don't consider the carbon sequestration, but if you consider the carbon sequestration, there is 26 percent reduction in emission of greenhouse gases.

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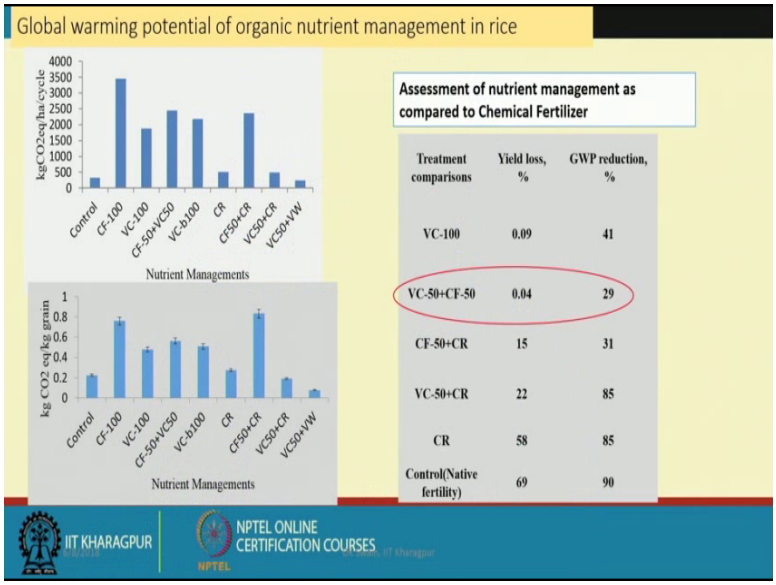

So, we have got from our Indian experiment, from our group also we have seen the global warning potential of organic nutrient management in rice. We have seen here we have different nutrient management treatments; we have been control means no fertilizer is used and CF 100 where using chemical fertilizer at the 100 percent recommendation, VC 100 means we are using vermicompost, at a 100 percent n recommendation and CF

50 VC 50 means the chemical fertilizer are 50 percent and vermicompost are 50 percent, VC b 100 is the vermicompost 100 percent, but the whole vermicompost applied at the time of showing of the crop and this VC is the vermicompost whole is splitted in two bases; one at the time of showing the other time a other a time of paniculnisations and the other treatments the crop residue, now things added at the crop residue at the previous crop and this treatment is chemical fertilizer 50 percent with crop residue, here vermicompost 50 percent crop residue, here vermicompost and also vermi (Refer Time: 23:56)..

So, with this treatments we wanted to know what is the carbon dioxide emission from this soil? That is kg carbon dioxide equivalent per hectare per a crop cycle of around 5 months. So, if you see the different treatments here chemical fertilizer shows the huge emission as compared to other organic fertilizers. So, the emission from chemical fertilizer in around 5 to 6 months, around 3500 kg carbon dioxide equivalent per hectare.

If you see the vermicompost the emission is around 2000 kg carbon dioxide equivalent per hectare and also we calculated the kg carbon dioxide released per kg of rice grain. The bottom figure if you see this one the kg CO 2 release per kg of rice grain. In this case also chemical fertilizer shows higher that is 0.8 kg around 0.8 kg carbon dioxide released per 1 kg of rice production. But if you see the vermicompost at the same time it shows 0.4 or maximum of 0.4 to 0.5 kg carbon dioxide released per 1 kg of rice production in case of the organic treated plots.

And at the same time we are using 0.8 kg of carbon dioxide per 1 kg of rice production in case of the chemical fertilizer plot. And also we compare this one assessment of nutrient management as compared to chemical fertilizer for a different treatments we in comparison with the chemical fertilizer as a normal usually farmers use chemical fertilizer. If you compare different organic treatments, so, there is a yield loss if you see if you apply vermicompost at 100 percent n equivalent bases the yield loss is 9 percent as compared to chemical fertilizer.

However, the global warming potential reduction is around 41 percent. Though there is a 9 percent yield loss, so we reduce the greenhouse gas emission. So, we reduce the global warming potential 41 percent using organic nutrients and if you go for the integrations

organic and chemical together, in this case the yield loss is a 4 percent and the global warming potential reduction is around 30 percent.

So, either when you go for the management practices, especially for rice crop, either you have to advice for the full vermicompost or a integrated nutrient managements. So, that the yield loss is 4 to 9 percent and there is a substantial reduction. In the global warming potential in case of the other treatments, so there is a huge yield loss a 15 percent or a higher; we do not want to go for the other treatments there is yield loss is more than 15 percent.

And when between the VC or the vermicompost 100 percent or the integrations, so for my advice we can go for the integrations because it will be to meet the vermicompost 100 percent you required around 6 tons of vermicompost per hectare. In this case we need 3 tons. So, depending upon the resource if the resource is limited we can go for the integrated nutrient management. So, that we can have the same yield as of the chemical fertilizers and there is a around 30 percent reduction in global warming potential.

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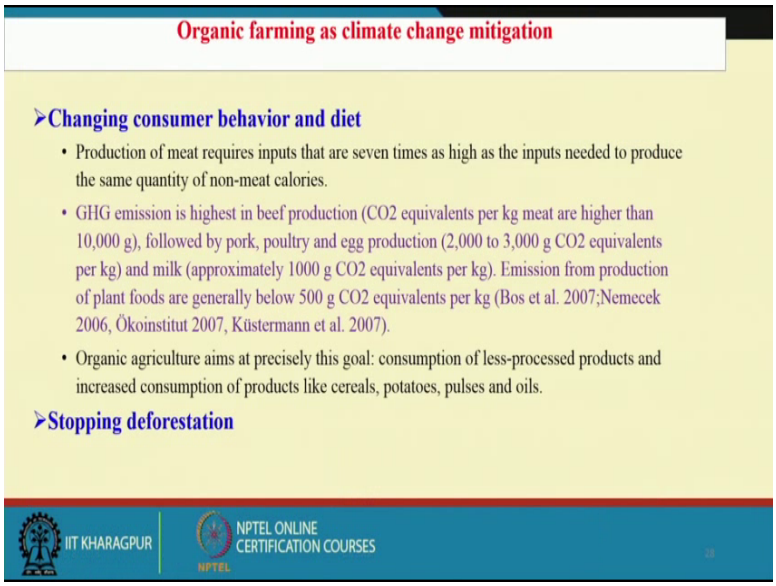

So, other way organic farming as climate change mitigation; so, changing consumer behavior and diet production of meat require inputs that are 7 times as high as the inputs needed to produce same quantity of non meat calories. That means, the greenhouse gas emission is a highest in bit production that is a around 10 kg per kg of the bit; 10 ten thousand gram of greenhouse gas is emitted per 1 kg of beef production followed by

pork, poultry and egg that is a around 2 to 3 kg of CO 2 equivalent per kg and followed by a milk exactly 1 kg carbon dioxide per 1 kg of milk productions.

But if for the vegetables emission from the plant foods generally below 500 gram carbon dioxide equivalent per kg of the plant based products; so, in this case you can see, so plant based products they do a emit less carbon dioxides and whereas, the beeps or this the meat the meat based products they do produce the huge amount of greenhouse gas emissions to the atmosphere.

So, the other one the organic agriculture aims at precisely this goal consumption of less processed products and increased consumption of products like cereals potatoes pulses and oils. That means, if you are consuming more of the processed products in that case, there is a more we are contributing the emission of greenhouse gases face products are better from the organic point of view; then the finally, stop deforestations, so that you can minimize greenhouse gas emissions.

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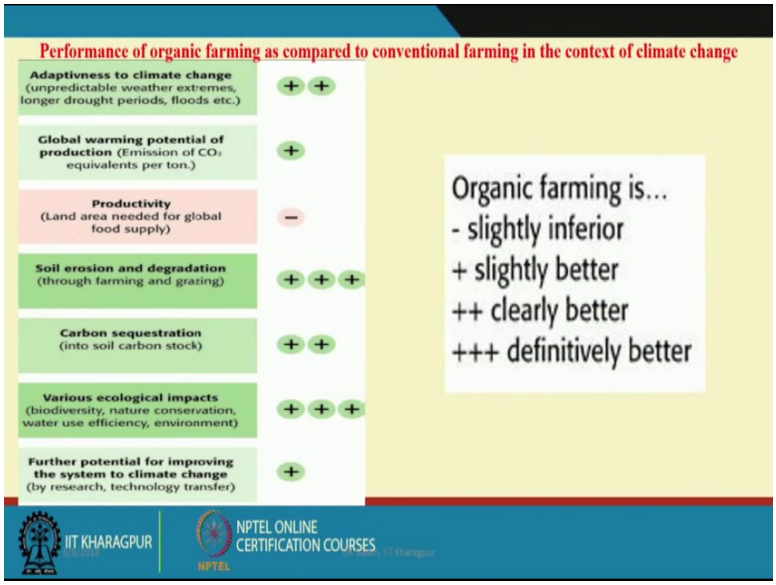

So, in the final slide the performance of organic farming as compared to conventional farming in context of a climate change; so, wherever there is a negative one negative sign that is a slightly inferior. So, that is a yield level or the productivity as we consider the production or the productivity the organic farming slightly infer the slightly inferiors. So, there are the two sign two positive they are the a single positive they slightly better;

that means, global warming potential of productions organic farming is better and further potential for improving the systems to climate change organic farming is better.

So, the plus or to a plus the signal and the symbol of plus and plus two plus they clearly better; that means, the adaptiveness to climate change, organic farming is clearly betters and also carbon sequestration in the soil carbon in the increasing the soil carbon stock organic farming is a better options and definitely better that is a soil erosion and degradation. So, through organic farming we can minimize soil erosions and degradations ah. So, various ecological impact ecological diversity in nature conservations water use efficiency and environments.

So, that can be protected through a through organic farming is a definitely better; that means, in brief focus a organic farming as there is a climate change is certain. There is a rise in temperature, there is a decreasing water availability for agricultural productions and that increasing carbon dioxide concentration and in view of that we have in this environments in this adverse conditions, we have to go on increasing productions at the same time we have to see a better quality productions at the same time we have to see a better environment.

For this organic farming is as a key role is a key candidate we can say for mitigating the climate change or for a better adopting to climate change because organic farming that can minimize the water consumptions at this is same time, it can adapt well to climate change conditions and through organic forming we can minimize a greenhouse gas emission to atmospheres, we can maintain a better environments, we can make a we can have a good food productions with a better quality ok.

Thank you.