Farm Machinery
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Lecture - 11
Laser Guided Land Leveler

Well students, we have talked of the different active passive implements. Now we will talk of another machine which is economizing on the use of irrigation water. It is very essential, because so far the farmers have been using irrigation water by flooding the field, or check basin. There are various ways and methods by which they irrigate the field, but then they it has been found that at many locations the amount of water which goes into the field is much more than what actually is required.

Many places you will find that the pool of water is more, somewhere it is less and so on and so forth that way the locations where lot of water is ponding those locations the seed germination will not take place. Or even there is a germination it will be very poor and the field crop will not be that healthy as expected.

So, very recently well if I say about last 7 8 years, this laser guided land leveler is an equipment which has been used very extensively by the farmers. Well many farmers are not in a position to own this equipment, because this is only meant for levelling the land, but then some of the this has been used on custom hiring basis by the farmers in a very, very big way because of the advantages that it will give. So, we will discuss about this laser guided land leveler in this class today.

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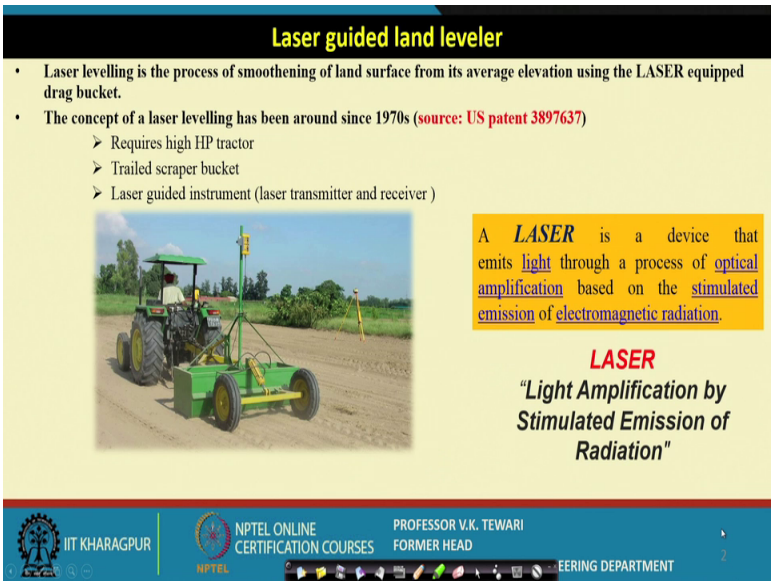

What is a laser guided land leveler? Well we see that when we want to know the topography of a particular field, we have the civil engineering methods by which we do we use the del p level and all that, and we find out what is the elevation and depression of the different locations in the field.

If we know that, the only way is that we go there and fill up those locations or cover the land or cut the soil and make the land as level as possible. So, that we used water economized water use and the same depth of water could be there in the whole of the field.

So, if we know the topography of this, we would then require the cutting of this soil extract from one location to other location and so on and so forth. And even these scrappers are used tractor drawn scrapers are there which go in the front and the operator can move this soil and level the land this has been going on, but with the advent of this laser guided land leveler, there are many advantages which has come here.

Now, let us see what is laser? Laser you must have learnt in your other electrical engineering classes, laser is a light amplification by stimulated emission of radiation, laser. So, light amplification by stimulated emission of radiation. So, this concept is being used for guiding a particular equipment which will know which location it has to cut the soil and which location it has to fill the soil during the course of its action.

Well laser is a device that emits light, through a process of optical amplification based on the stimulated emission of electromagnetic radiation, which I explained here. Now the concept of laser leveler, laser levelling has been around from 1970 although a patent is US patent is given here. It requires high horsepower tractors yes this is one big important thing apart from the cost. In fact, when it came to the country initially, the cost was about 9 to 12 lakh rupees. And it was therefore, very difficult to use by small farmers. Then over the years with the government intervention, ministry of agriculture and then manufacturers were contacted and asked to manufacture this particular equipment at lower cost. And hence in the market now you will find even cheaper or within the range of about 3 to 4 lakhs, such equipment are available for operation.

But then the requirement is slightly higher hotspot. It is a trailed type of scraper bucket has a trailed type of scraper bucket. These are generally as a trailed equipment, it is used as a trailed equipment, you can also have a mounted implement, but some work is going on which may we may talk of that later, but it is generally a trailed type equipment. It has a laser guided instrument, laser transmitter and receiver. So, these are some of the brief of what the concept of laser levelling is. Now, let us go ahead.

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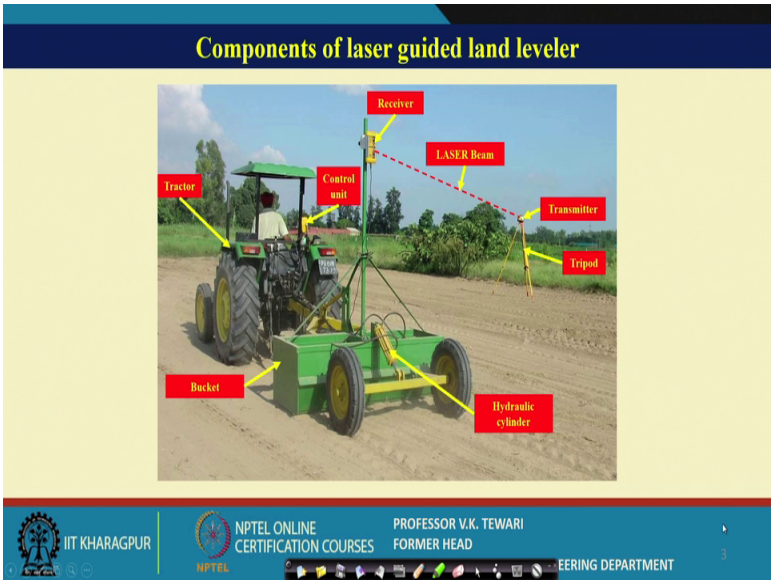

What are the different components, what are the of this laser guided land leveler? First is the tractor of course, we have the tractor here.

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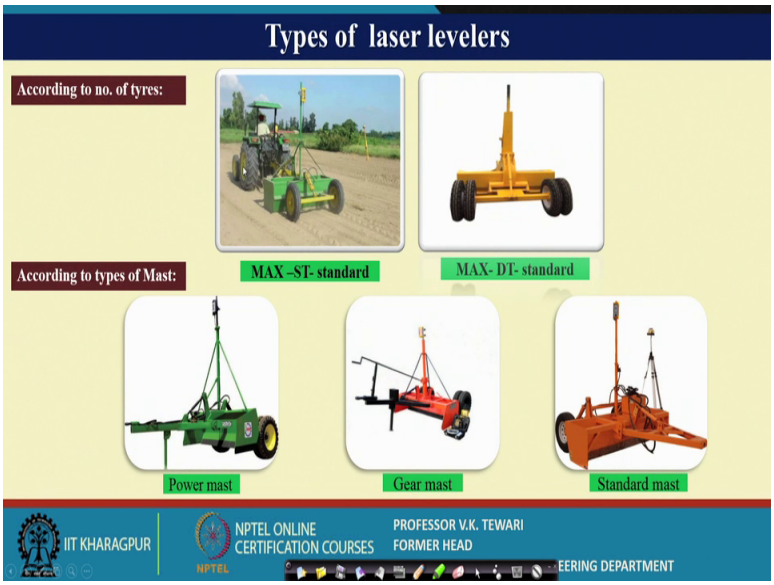

The tractor, the power source, the control unit of this system is kept over here. The receiver is on this mast here. Then the laser beam, laser beam is coming from here receiver and this is the transmitter here. It is on a tripod, hydraulic cylinder well there is a hydraulic cylinder, I will talk of this hydraulic system slightly later in this course, but hydraulic cylinder is here which will allow the bucket to be oriented for scrapping. And this is the bucket here which will be employed. So, these are the main components. And of course, the connection with the 3-point linkage of this particular it is a trailed type implement, in fact, but there is a connection of the frame which is there with of the tractor.

Now, let us go to the other details of this. Types of laser levelers; there are various types in the market as I said that this equipment has been now produced in the market in the country, in India in other countries and there are several types available. According to number of tires, now you see here, number of tires there is only 2. So, this is a 2 tire one. There this is a 2 plus 2, 4 there are 2 double tires on both sides of this.

Then according to type of mast, what is the type of mast here? This type one is the power mast the by automatically by power we can change the position of this. Then gear mast using gear, we can change the position of this mast here. Then standard one which is a standard mast which has been generally used by all and it is connected through the hydraulic system again, of this particular equipment. So, these are some of the variations

in the levelers which are available. Main purpose of all of them is to do the field levelling.

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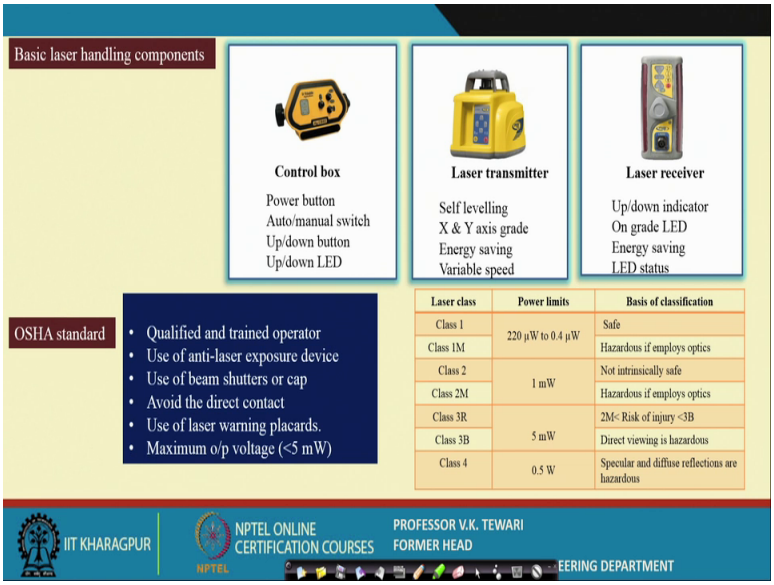

Levelling, laser land handling components; detailed components which we saw there; the control box, the laser emitter transmitter, the laser receiver. So, transmitter receiver and the control box very important one. Because one transmits the other receives and then gets back to the control box which will do the various operations.

Some other safety point of view which are also indicated here because it is a laser beam and it may hurt the person if one is not careful about that. So, those are also indicated here and it is worth mentioning at this point of time. OSHA, the OSHA occupational safety and health administration of USA has defined standards. So, qualified and trained operators should be used for operation. This is very important.

Use of anti-laser exposure devices; these are very important because when it is in operation when the people are there could be some problem because of these laser. Use of beam shutters or caps, yes it is important you must have the shutters or caps made when it is not in operation because otherwise it may heard the human being or the operator. Then avoid the direct contact, yes, you should not have any direct contact with this. Use laser warning placards yes, there should be placards or there should be locations written properly on that, that avoid looking at this or some other sorts of instructions or warnings, we should be given on the equipment. And it should be

operated within a maximum operating voltage output voltage of less than 5 milli watt. And these are some of the classes and the power limits which are given here. The basic classifications with respect to the laser classes are given here.

So, if between this 220 micro watt 2.4 micro watt it is safe. A hazardous if employs optics one m now not intrinsically safe, if you are using one milli watt. Hazardous if employs optics now these are some of the terms which need to be looked into from an users point of view. What we are more interested is that these maximum output voltage must be within this. So and direct viewing is hazardous which we should take care of that.

Here a some information about the details of this particular laser line levelling equipment, and it is important points important components and what are the safety features which ones must observe these are indicated here.

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How does the laser guided land leveler work? How does it work? Well as I said that generally if common sense says that wherever there is lot of soil you try to scrub that and where there is less you try and dump over there. This is a general concept which we understand or you understand.

But then what is the purpose that it does, it does not handle so much of soil. Because we have already taken the topography and the topography is already there in the system. And

now the tractor and grading implement the laser, the laser guided systems can be mounted on tractor, bulldozers, scrapers, road graders and even terraces, wherever you can you can put them together.

Laser transmitters; what is the job of the transmitter? The transmitter or emitter sends continuous self leveled laser beam. Signal with 360-degree laser reference up to a command radius of 300 to 400 meters. So, this is this transmitter he doing this job 360-degree within a radius about radius about 300 400 meters and each and always it is doing that. So, depending upon the for auto guidance of the receiving unit.

So, since it is 360 degree, wherever the implement goes when in the operation during the operation it will always keep on informing this, as to what is the location of that place. And what is the job need to be done at that place.

Laser emitter is mounted on a type tripod, as I showed earlier. And stand placed just outside the field to be laser levelled and high enough to have unobstructed laser beam travel very simple, because this must be at a slightly higher location. And it should be unobstructed position outside the field which is being leveled. So, this transmitter must be kept at that location on a tripod.

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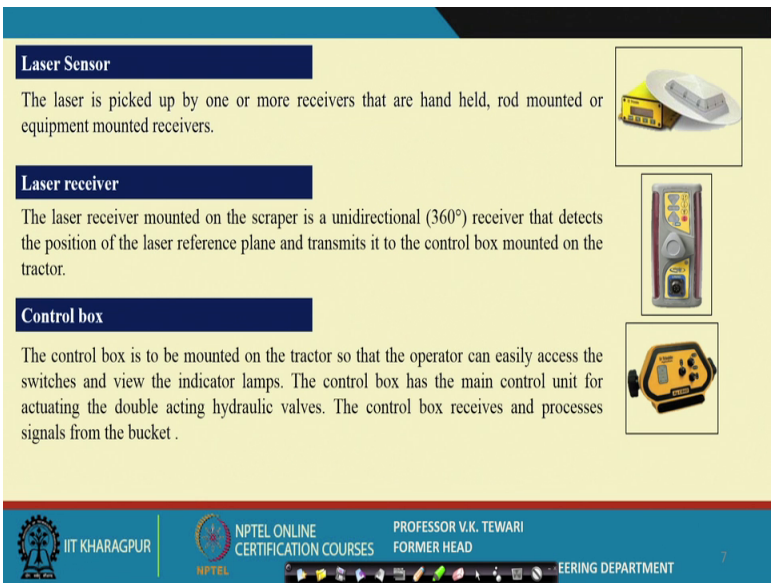

The laser sensor;tThe well the laser is picked up by one or more receivers, that are handheld rod mounted or equipment mounted receivers. Now this laser receiver is

mounted on this scraper is a unidirectional 360 degrees receiver that detects the position of the laser reference plane and transmitted the control box mounted on the tractor.

As I said earlier that the job of the transmitter the laser receiver is that it will be giving it will be receiving this; that means, the scrapper is a unidirectional 360-degree receiver, that detects the position of the laser reference plane it always detects the position of the reference plane. With respect to what it comes what comes to it and then that transmits to the control box on mounted on the tractor.

So, the job the control box will then start and it will then instruct the bucket to do the job further. So, this has come to the control box. The control box is also mounted on the tractor. And this control box has the main control unit for actuating the double acting hydraulic valve. There is a hydraulic system because this whole amount of soil which will be there on the bucket it is not possible to be mechanically.

So, that is why hydraulic system has been used a double acting cylinder has been used for this I will also show, what is this double acting cylinder and how it actually operates? What I will just lead to tell you about the hydraulic system you might not have learned about hydraulic system, but something I will tell you here as a brief you can say that compatibility of what I am going to say here.

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Yes, here is the hydraulic valve assembly here. The valve assembly regulates the flow of tractor hydraulic oil. Now generally in a hydraulic system what is there. In a hydraulic system we had certain components. For example, there will be a location where there is hydraulic oil.

Now, this hydraulic oil is lifted through a pump. So, it is lifted through a pump now this pump then put the oil and then it goes to a particular directional control valve. So, if we have a directional control valve here. So, this is the directional control valve here. Now these are the lines and here is the load. So, the oil is here. Hydraulic oil is kept over here this hydraulic oil is pumped through the pump here. And this pump is given by another prime over, which could be a electrical motor or an engine.

So, this prime over gives power to the pump. And then this pump will pressurized oil will go to this directional control valve here. This directional control valve has one which comes to this the other may come to the tank. And it goes to the double acting actuator which has been said earlier here.

So, the and the load is now pushed or taken back. That this if this is the direction which is talking of extend then this will be retract direction for this particular double acting actuator. So, this is the one which has been shown here. This is one which has been shown here.

The hydraulic valve assembly; now this is connected where, it is connected to the drag bucket. The levelling bucket can either be 3 point mounted or pulled by the tractors drawbar. The bucket dimensions and capacity will vary according to the available power source. And the field conditions this is very important to know how much is the power of the tractor that we have taken, and what is the total volume that we are likely to handle, what is the topography of the field therefore, we must have a look at the dimensions of this bucket or the bucket must be chosen in these taking into consideration these parameters.

Generally, for a 60 horsepower tractor, we get a 2-meter-wide and one-meter-deep bucket, in most soil types. For most soil types we get for a 60 horsepower tractor for 2-meter-wide and one-meter-deep bucket is used.

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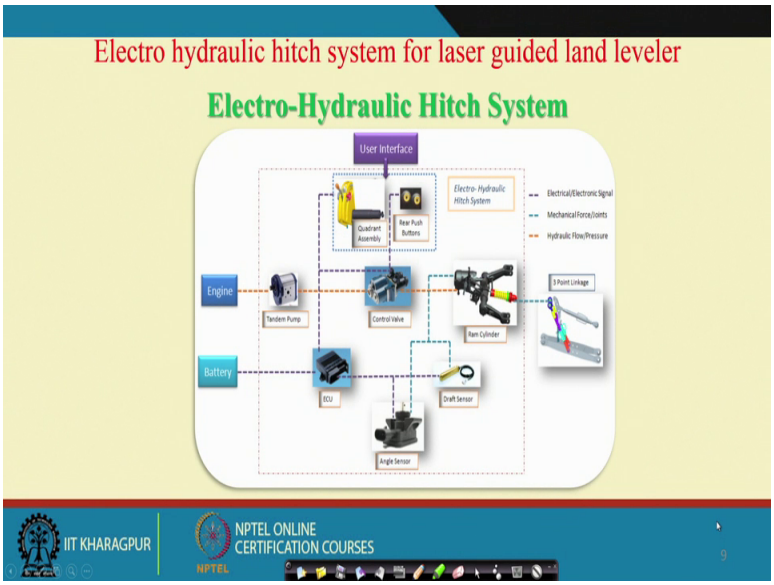

Now, today in all the tractor companies and the manufacturers also thinking of using the electro hydraulic system because the hydraulic system has been in use for a long time and the moment we use a electrical system for operating this electro hydraulic system, it becomes electro hydraulic system. Wherein, we can very precisely do the job with the minimum power requirement of the hydraulic system and with accuracy, your high level of accuracy. Here, it is just shown here that there is a control valve there is a control valve over here.

Now, this control valve, see we have this control valve here. The engine is here, the battery is there and the ECU is this. Now this control valve gets information. Actually where does it get information from the sensor right. So, from the sensor it will get information. It will go to the control valve the control valve will mix. So, that this is operated. And the push rear push buttons and quadrant this is the quadrant which generally we operate manually when we are operating. So, this has to be operated through the system here which we were initially when we were operating this quadrant, we were getting the changes in these. Now this is the connector to the 3-point linkage here to which the implement is connected

So, the control valve which is now a solenoid operated control valve. So, this solenoid valve and the whole system is in the ECU, the electronic computing unit or.

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Electronic control unit ECU sorry electronic control unit this electronic control unit, and we have the angle sensors which will also talk of the angle, the draft sensor which would talk of the draft, and these are now in consonants with this ECU, the control valve will be in a position to operate this ram cylinder, which will talk of or which will operate the 3-point linkage here. These are the some more details of whether is electrical electronic signal or a mechanical force joints, hydraulic flow or pressure these details are given in this particular diagram here, in the electro hydraulic heat system.

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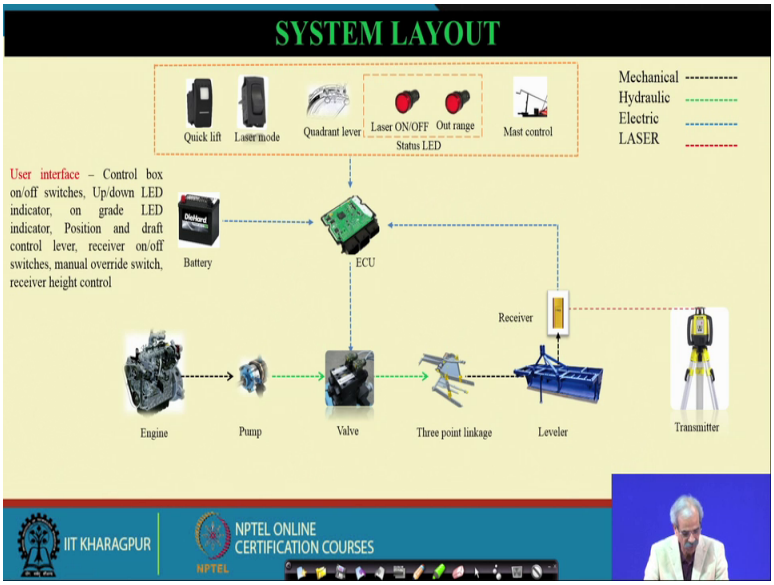

The system layout a greater, system layout is shown here you can see that the user interface the control box on off, switch up down led indicator or grade led indicator position, and draft control lever receiver on and off switches, manual override switches receiver height control.

Now, all these are indicated in this figure here. See these three point linkage. Here the transmitter is sending the information to the receiver then go to the ECU then goes to the valve here and valve is operated by the power from the engine and pump here, this batteries for this and the details of the quick lift, laser mode, quadrant operation, on and off etcetera must control etcetera are done by the system. This is the layout of the system which does this operation.

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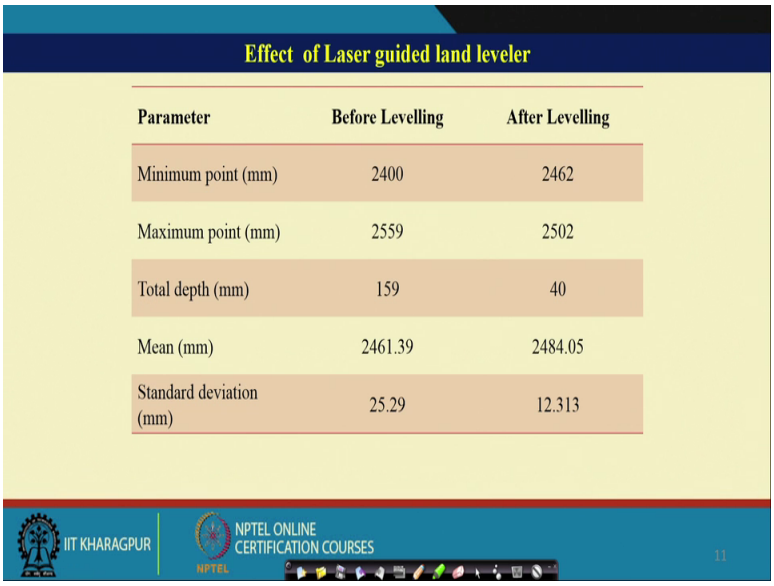

What is the effect of this laser guided land leveler? And an experiment has been done in one of the industries and I have in front of me here which I want to show you. The results of what happens. So, before levelling the minimum point was minimum point was this. After levelling it has come to this the maximum point was about 2559 millimeter, after levelling it has come to this total depth 159. It after levelling it has come to this. Mean value or before levelling in the whole field if you consider it is this much and this much after levelling.

So, if you take the standard deviation of all this data with respect to minimum maximum and total depth, we find that the elevation is 25.29 millimeter which has the standard deviation of these elevations locations is 25.29. And then this comes to 12.3 313, after levelling. So, virtually you see that because of the laser land leveler there is a tremendous difference in the grid of the field which has been prepared. And that will help you in giving in economizing on the use of water, which will be actually pumped for this. So, this is the biggest advantage of this and it saves lot of energy. We will see in the next slide what are the other benefits of this?

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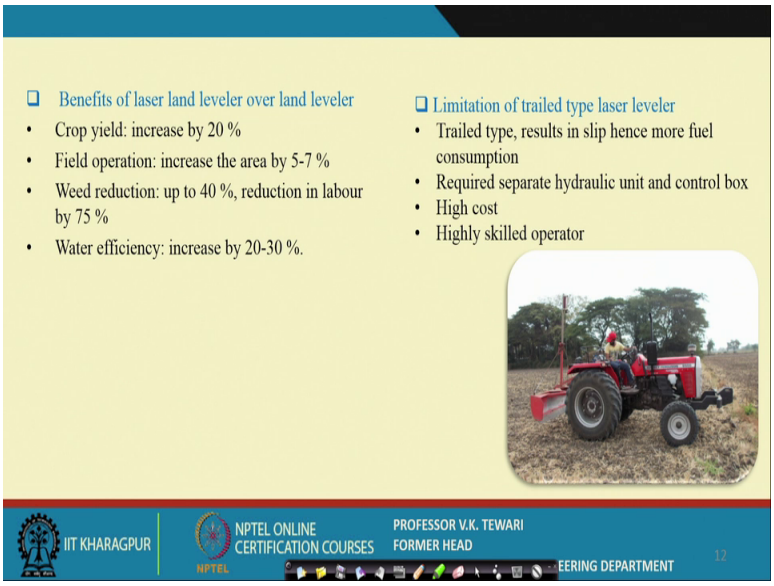

The different benefits of laser land leveler, crop yield it has been also seen that there is a crop yield increase in crop yield by 20 percent. Why so? Because if the use of water is judicious, definitely there will not be loss of the field crop at various locations in the field. And hence the growth will be uniform the flowering will be better, and then you will get crop from each and every corner of the land. And hence the total yield will definitely increase, and it has been found by the experiments and people have done. This is out of the past research that I am quoting this data. So, people have found that about 20 percent increase in crop yield has been seen.

Field operation; increased the area by 5 to 7 percent yes. Now the field operation in case since you are in a position to save the energy of the tractor, whether it is for plowing or for levelling or for creating the proper soil tilt. You see certain energy and that energy can be utilized. So, in other way you can say that it can increase the area 5 to 7 percent more area can be covered, if you have the machine energy saved because of this particular equipment which you have used here.

Further, weed reduction 40 percent reduction in the labour. Sure labour requirement the moment we have any mechanization or any equipment being used, we are we say that we do not require that much of human labour. Although we do not say that we displace labour altogether, but definitely we want that the labour requirement should be decreased. Not because we want to displace the labour here, because the labour not

available for these operations in the field. And particularly when there is a peak demand of the tasks, whether it is a field preparation or weeding harvesting tracing whatever is the situations we do not find that in these peak hours we get enough people.

So, definitely we are talking of reduction in labour; that means, we will not require this and still we will have a better crop yield. It written so, the moment we have uniform better field proper levelling off the field, actually smothering of the unwanted weeds etcetera then you will find that the crop which comes will have minimum weed in infestation in this minimum weed infestation.

So, about 40 percent we will have weed reduction, weed growth reduction that will come up and finally, the water efficiency sure, because water is a scarce commodity. We know that if you do not have any idea you will simply pump and start flooding the field. That is not correct, because when you want to flood the field you have no idea and you just keep your watch and say that within 2 hours my field will be filled up and I switch off the pump and go away.

See what you have lost you have lost the energy and you have the electrical energy the pump, the total water a time may come when you will not have water. So, we will have to economize on this water. And this particular equipment is helping us in saving water to the to the extent such that the efficiency of water increases about 30 percent. So, we are saving this water which can be used for some other operations. So, saving the water here will increase the total amount of water globally. And then hence you can take up another crop.

Now, there are some limitations of this unit are also there, which we must know while every unit has lot of advantages, there are some disadvantages also. Which go hand in hand and we have to be careful about this. For example, trailed type results in slippage, and hence more fuel consumption yeah. When we talk of the trailed type implements there could be slippage. Because we do not have the control of this equipment with the tractor.

Because if it is mounted one we have a complete control on the equipment and the moment load is high, we can change the position and then go ahead, but when this is a trailed one, we cannot have control on this and then many places it will slip and then the

total area covered will also come down. And therefore, this slip will occur and hence more fuel consumption will take place.

Separate hydraulic unit and control box, yes it will definitely require because the hydraulic system of the tractor is not designed for taking these outputs, because a requirement of this particular bucket is very high. If you are taking a bigger bucket it will handle a very high volume of soil. And then if you think of the wave density of the soil then total weight which is to be handled by this bucket is very high.

So, you need to have a separate hydraulic system yes. You can call this to be limitation, but then when you think of the advantages several advantages, I think this will offset and then we must have a separate system as compared to the system, which is available for tractor in the tractor for lifting and lowering and maintaining the position of the implement with respect to the tractor.

So, we need to have a separate system, we may call it limitation, but I would say that is not a limitation it is a requirement. Which then if you say that additional implement where one can say it is a limitation not limitation, but adding to the cost. So, a high cost here. Well at the same time you require a skilled operator. Sure we must have skilled operator or a skilled people. It is essential that for all the equipment which are automated equipment which are sensor based equipment, which are micro controller based or sensor, which are ultrasonic controller based or several other electronic devices which are being used in the equipment nowadays, you need to train your operator with respect to several things.

For example, with respect to operation with respect to it is a safety with reference to it is limitations or the things you must have. And therefore, a skilled operator will give you a better output of the system rather than the operator who is not trained. Even your total or work output will come down; the down time of the implement will be more if the person is not skilled. So, a skilled operator, a trained operator has to be there. It is not a limitation I would say it is not a limitation, but then one can say that yes, it requires because in a tractor even a person who can drive and then he can operate the controls.

Thank you.