Fundamentals of Environmental Pollution and Control
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Lecture No. # 20
Introduction to Soil

Well, I mean today we start with soil I mean as I have said you know is in the last class we concluded about water, water pollutants and things like that we have worked in detailed about water pollutants. Here, today we'll discuss about soil.

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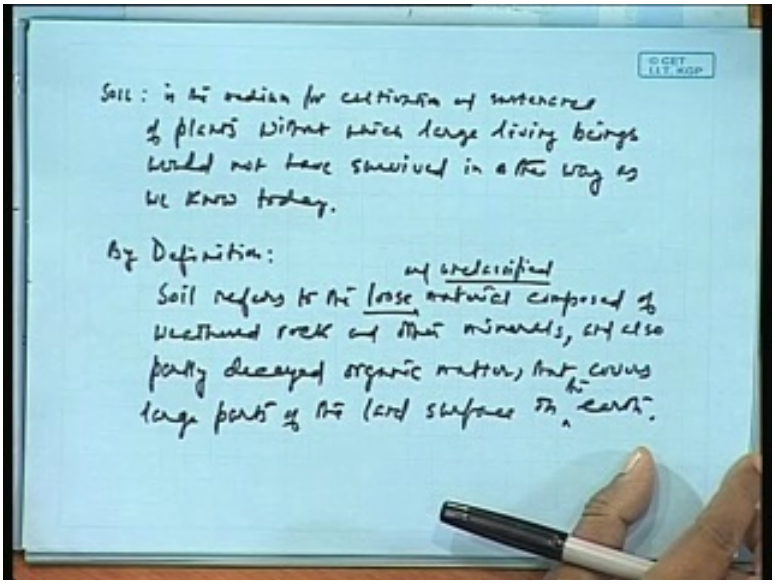

Soil is you know soil, soil as you know soil, soil is the medium, medium for, is a medium for cultivation, cultivation and sustenance, sustenance of plants without which, without which large living beings would not have survived in the way as we know today is a medium for cultivation, medium for cultivation and sustenance that is a medium for cultivation and sustenance of plants without which large living beings would not have survived in the way as we know today.

So, this soil remains you know is a most important productive medium by which, on which the human culture has developed, human culture has developed. Remember one thing that you know you say is today's population of 6 billion people throughout the world if that can be fed, if that can be fed that the single largest medium on which the food resources can be generated is basically soil. We have different other mediums like you know we have some water medium also where plants grow but that would not have been sufficient to feed at this large mass of people, large population of people not only that apart from man, apart from humans you know there are other animal, other animal beings that we know of they also survive on plants. So, soil remains a very important area of environmental science and engineering because it's as you will see that an understanding of soil and understanding of soil in terms of a medium for vegetative growth that

is very important for us, vegetative growth is absolutely important for human survival. So, soil as you can know by definition if we just see soil by definition, by definition, by definition soil refers to, this refers to very very generalized definition of the soil the loose, loose material, loose you can say loose and unclassified material, unclassified material composed of, composed of weathered rock, weathered rock and other minerals, other minerals and also another important thing that we have already known also and also partly decayed, partly decayed organic matter, partly decayed an organic matter that covers, that covers large part of, large parts of land surface on earth.

Soil refers to the loose and unclassified material composed of weathered rock and other minerals and also partly decayed organic matter that covers large part of the land surface on earth. So, this is you know this is on the large process on the earth okay, on the earth right. So, here you can see this is you know I, what we have say this is a very general definition I am, I am just going you know in a very simple way as to about to identify soil. As we go further we would, the thing is this loose and unclassified need not have to be so generalized, it does not evoke a sense how soil is but as you can see you can physically if you do not know as if you are a blind person, if you are handling soil if you are handling soil, the soil would come to be something like this where it is very loose and it will have weathered rock and minerals and also partly decayed organic matter that covers large part of the land surface. So, large part of the land surface, this is where you know this is the basic definition of soil will mostly discuss other things about soil but let us go further on this we would say you know why, why it is soil is so very important I mean you know again a general study we will again work on details of this.

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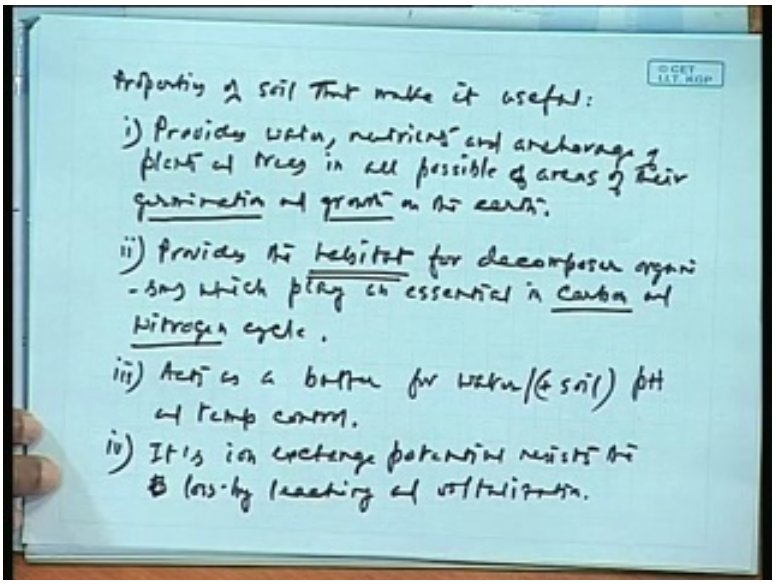

Properties of soil, properties of soil that make it useful, properties of soil that makes it useful. Now what are the properties? The first of all the most important property is provides, provides water, nutrients, nutrients and anchorage, anchorage of plants and trees in all possible areas, areas of their germination and growth on the earth, right provides water, nutrients, anchorage. Anchorage is anchorage of plant and trees in all possible areas of their germination and growth,

on the earth on all possible areas of their germination, the germination of the plants and trees, germination of the plants and trees germination and growth on the earth not only germination it should also support growth both of them are important, both of them are important provides anchorage. Anchorage is by which the plants remains stuck to the soil by which the plants can stand on the soil by which the trees can stand on the soil that is the anchorage it provides. There is the water it provides is as you have known this is the water through the root system mostly more than 95% of the water that a plant needs goes through its root system, about 5% it might observe from the atmosphere.

So, here the nutrients most of the nutrients, the soil nutrients as you know this, all this metallic nutrients will come back to them again. All this nutrients are gone through or generally driven through the soil say essential exchange of soil from the soil to water exchange takes place in the liquid medium. Remember as we know like we can take solid food, the plants cannot take solid food. Plant has to be, everything has to be found in the form of a dissolved state that is you know in the form of a, in the form of a certain vaporized state or in the liquid phase. So, unless they are soluble, they cannot be drafted drawn into the plant root system. So, this is what is important about this, about these plants provides this is another very important thing, provides habitat, provides a habitat for decomposer, decomposer organisms, decomposer organisms and essential role, play an essential role which play an essential role in carbon and nitrogen cycle. This apart, I mean this essential role apart, I mean you know this role I mean the essential in carbon and nitrogen cycle, apart from this provides you know habitat is another very important thing.

We will observe this you know is a very important if we just try to see this a habitat in the soil speaks of its quality. A soil which is good I mean you know which is you know good for the growth of the plants would also encourage lot of microorganisms, would also encourage insects, would also encourage warms, would also encourage lot of fungus, it would also encourage the larger say living beings, creatures like you know rats, rodents then any kind of other insects that they follow snakes and the foxes all that are basically drafted by the soil quality itself. You would observe I mean this is for us to even if you do not know much about the soil, if you just try to observe the one way, one best way to find that you know if the soil is good or not you just to observe how many organisms I mean how many living beings actually reside in them. The worms are very important earth worms that you know they are extremely important for the soil, extremely important soil does not, soil is not a, soil is a continuously a highly active body of activities. This hollow is, this is always pregnant with lot of activities, soil is not a, the weight is not a static material. Its say a lot of dynamic reactions, lot of dynamic changes take place in the soil within the real time. So, you know is very important for the soil to be a habitat where you know it would allow the other, other plants, creatures, small insects to reside in them.

So, here it say you'll know, you'll always find that you know this is what is particularly a very damaging side today. In all places you will see that you know people I mean without knowing that you know they cut trees, they disturb the soil and as a result of which you know it is generally say you know trying to understand you know they form the lower part of the pyramid in the food chain. The food chain that we know of you know lower animal say shorter, shorter and lower animals and creatures being used as a food for the higher animals and brings and that is how the pyramid takes place, you know it's from the lowers you know from this fungi say there is a you know the insects feeding on the fungi this you know the warms or you know other

larger insects feeding on the smaller insects then larger insects are being fed by the toads, the toads being eaten by the snake, the snake is being you know eaten by the birds and that is how this the birds are eaten by the humans beings.

So, you know you can see the food chain taking place, this food chain and the food pyramid the basic part, the bottom of the food pyramid is essentially where in the soil, most of the animals and plants live. So, they remain as the central point of any development of human culture, development of the culture that we know of. Agriculture is, agriculture, farming all this remains the basic things of economy. Economy depends on that you know economy does not on depend on the services that you see economy does not depend on this the education system, it depends but you know the primarily depends on the agriculture unless the first part of the economy, first chain of the economy doesn't work. The next, the forwarding things that takes place would not exist.

So, suppose you know you would find you know in many cases like this you know when whenever there is a bad crop or bad monsoon or you know heavy drought taking place, you will find that you know also that you know the people spending power becomes less and the whole other things take place. So, you know the demand is less, demand becoming less, the other sectors begin to be affected. If agriculture is doing well, if the farming community is doing well in any country, its economy also gets supported by that and for the farming community one very important aspect is soil, without soil, without its regenerative capacity, without its use of its capacity no economy would stand on its own, okay. This is the first and foremost things so you know here this is where it becomes extremely important.

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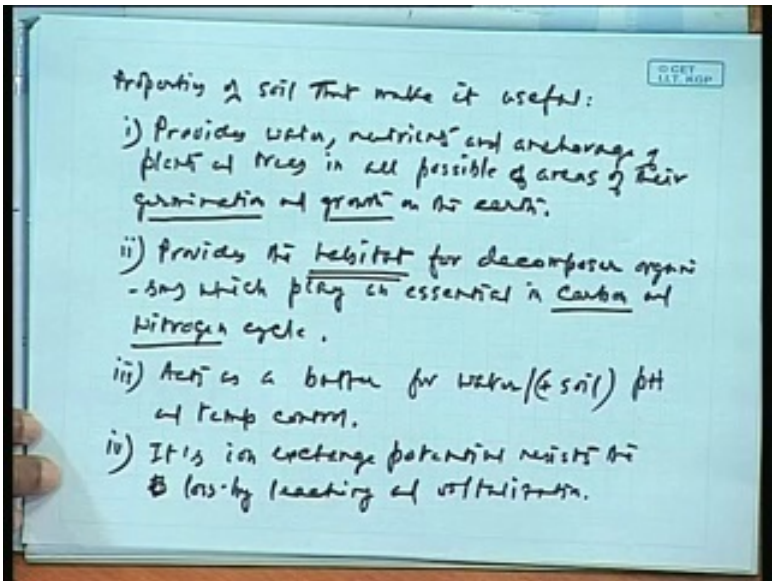

Another very important thing is acts as a buffer, acts as a buffer for, acts as a buffer for say the buffer for water, also water and water plus soil, water and water plus soil pH buffer and temperature and temperature control, temperature control. Particularly you know in a particularly in the time of the year, when the temperature is very high, when the temperature is very high the

soil, soil I mean by means of its moisture that is contained within it and the structure by the structure by itself, it can support a certain buffer for cooling the temperature of the roots, temperature at the roots, so that the root functioning remains all right, root functioning remains good. The root what is supposed to do is in a position to do that temperature change and so you know this is buffer for temperature, is a temperature control.

It works as then it is its ion exchange potential, its ion exchange potential resists, resist the loss, resists the loss by leaching and volatilization, volatilization that the understandable thing is this, this is a particular property you would always understand. You see this, you would, you would find you know in most of the cases like you know what is, what I am trying to mean here is this say there are organics substances you have also measured soil organic matter right. What happens to the soil organic matter, what happens to the soil organic matter? The soil organic matter how it helps? The most important thing that it helps is it works as a pH buffer that is very important is a most of this soil, soil pH you know most of this soil you know either being in the, mostly in the remaining at neutral you know time to time changing you know working as an acidic buffer, if there is a higher alkalinity working as an alkaline buffer, if it there is higher acidity they try to balance. And what is most important here is this, to retain this, the retain thing is because of this otherwise the organic matter if the soil does not, if the soil does not protect it from the contact with the atmosphere what essentially happens is the organic matter would finally be converted into, would be oxidized would be and finally reforming carbon dioxide and water and would leave the soil, leaving the soil.

So, if they leave continuously that is what happens in a disturbed soil. If they continuously leave, the soil becomes inhabitable for large number of insects and worms and other species. So, for the soil to remain it's, the soil to remains its productive potential it is important that you know it resists it resists any formation of an environment where higher oxidation takes place. The soil by its own composition itself can resist higher oxidation due to the contact with the atmosphere and as a result of which you know the property of the soil remains maintained. That is why you know this if the organic substances are more, the soil would be in a better position to control the pH. So, that is you know that does not that the loss by leaching, loss by leaching and volatilization. Volatilization is that the same thing of carbon dioxide going out of the soil then any other substances H 2 S, nitrogen going out at places like this. So, this also is the properties of soil that make it extremely useful for our purpose. Apart from that you know this is if you just observe trying to say the soil as such you can see that you know in most cases how we find soil, how we find soil is the soil examination you know this an examination by, an examination, examination by eye of a spadeful of soil.

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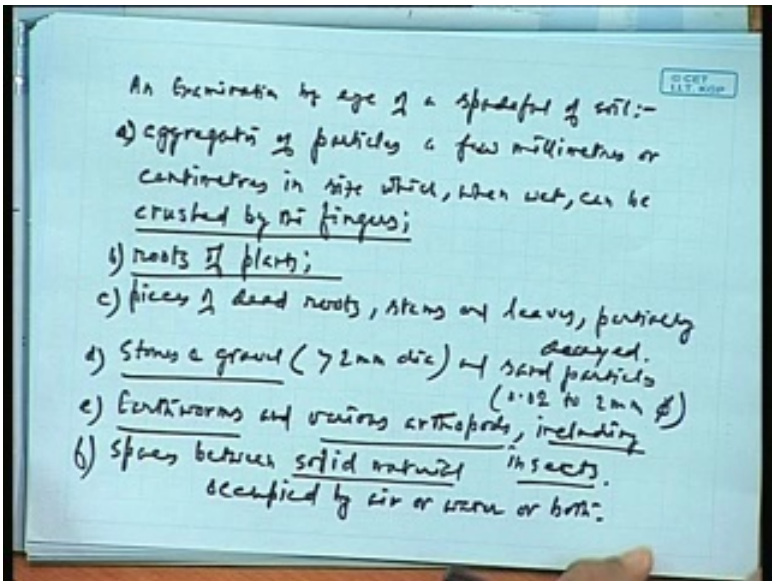

What is you know this the physically, now suppose as I have said you know in the earlier case if you keep the eye closed that is how the soil looks like, you know it's looks like an aggregate, it looks like you know particles you know of different aggregate particles but without knowing much about that. But in an eye examination how it looks like? If the, what we would find in a mostly in the soil aggregates of particles, aggregates of particles, aggregates of particles, a few millimeters or in size which can which when wet can be crushed by, can be crushed by, crushed by the fingers. Roots of plants, pieces of dead roots, stems and leaves partially decayed, partially decayed, stones and gravel, stones and gravel greater than 2 mm diameter that you already know and sand particles, sand particles 0.02 to 2 mm dia, earth worms, earth worms, earth worms and arthropods, including arthropods you know having a number of pods fit you know the particularly the kind of insects and the higher worms that we generally find arthropods and spaces, spaces between solid material, solid material occupied air, air, water or both, air, water or both.

So, what it has? This is number one a, that you can see a, b, c, d, e and f. So, this is how you know this is what you know in a casual examination of, casual examination of the soil, casual examination of the soil would provide you the kind of information, the kind of things that you are going to you expect of the soil. If you just take a soil, block of soil in your hand this, this is what you would observe in the soil, say this the aggregates of particles say which can wet crushed by the fingers, roots of plants, pieces of dead roots, stems, leaves, partially decayed, stones and gravel, earth worms and various arthropods that you even observe in the insects, spaces of solid material occupied by air or water or both, air water or both. I would tell you know not to just you know, not to know by the lecture itself, please try to see it, take a block of soil is say as any kind of that we call it single small unit of soil, try to see yourself what you can see in the soil. These are the things that you can observe in the soil in a very live and active soil, in a soil which is live and active, we would find them in this order right.

Now having come to this you know this is about the soil part, this is about the soil that is you know the introduction to soil that we can see of, we can think of the introduction of the soil and having to say you know it having to see soil, having to see soil as being polluted or being degraded is another thing what we expect of the soil.

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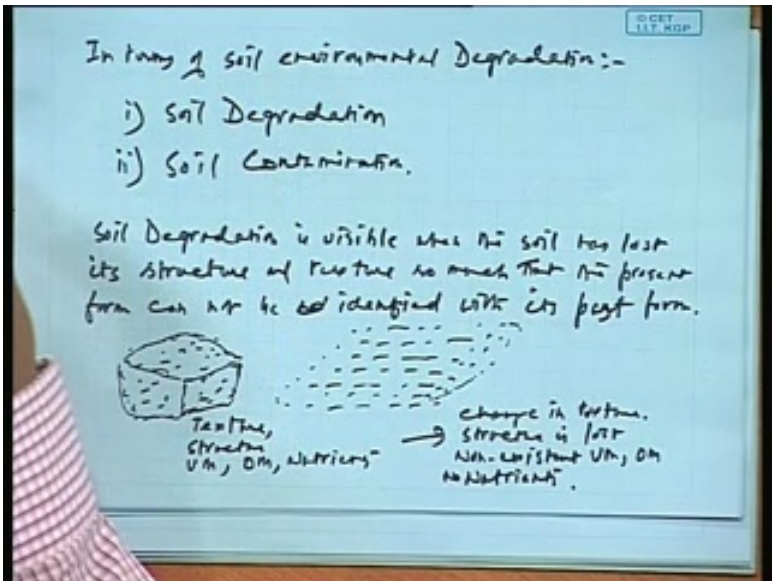

Now here the soil when we are in terms of, in terms of, in terms of soil environment, in terms of soil environment, in terms of soil environment, soil environmental degradation or pollution, degradation soil environmental degradation. We deal with two terms specifically one is soil degradation, one is soil degradation, another is soil contamination, soil contamination both of these are two different things, both of them are two different things. A degraded soil is not necessarily contaminated soil, a degraded soil is not necessarily a contaminated soil but a contaminated soil may be degraded as well.

Let me explain you how. See, what happens you know a soil degradation you just write you know the soil degradation, the soil degradation, soil degradation is visible, soil degradation is visible when the soil has lost its structure, structure and texture so the, so much that the present form, the present form cannot be, cannot be identified with its past form with it, with its past form say like this I will come back to this, this structure part a little bit but just try to understand this is a say you know if you are trying to say a soil particle, if you just trying to observe a soil particle what happens you know you should all see this thing. Mostly suppose this is what is you know a loose, a particularly a block of soil, if you just observe this as a block of soil okay. when this block of soil gets degenerated what we see the, what we see is the soil immediately instantaneously losing its structure instead of, instead of having a, instead of having a blocky kind of structure, instead of having a blocky stripe of structure having three dimension the soil almost to confines itself into a two dimensional structure say you would find this particularly if you just try to observe say you know particularly where there the buildings are being made.

Suppose you know in places in IIT where the new buildings are coming up you just observe the soil after the rain. You will see that a large part of the soil being you know being drained off, large part of the soil being drained off and it is coming you know the initial block of soil is spreading into the roads, spreading into the walk ways and places like that, that is the, that is where the soil is actually getting degraded, the soil structure is getting destroyed. So, it is any kind of engineering excavations, engineering excavation like related subjects like mining then say dam construction, civil construction say and then say a many cases you know like any kind of say home construction, all these kind of industries, the typical what happens is soil degradation, the degradation of the characteristics of the soil, degradation of the characteristics of the soil.

So, here what we will find is say the texture, texture, I'll come back to this texture, structure say the say volatile matter then say organic matter, organic matter, volatile matter, organic matter say then say a nutrients, the typical a metallic ions the nutrients that you know this nutrients, this would lead to, this would to lead to different texture, change in texture, change in texture. There would be a texture but the texture would be changed that is you know you would have seen that the fine particles would be missing. One good way of seeing the soil degradation you will see is that you will find that if you find in the soil after the rain, the soil, the finer particles of the soil has left it and then you know soil has been degraded because that soil is not desirable soil, that soil is not a productive soil. We have to have a, if we are going to have productive soil we have to have a good structure, we should have a consistent texture, consistent texture, we should have a reasonably good volatile matter in that, reasonably good the volatile matter means you know there is a vapour in that, reasonable amount of organic matter in that and say other nutrients.

The nutrients and the dissolvables in the soil that remain or the salts that remain would immediately go out of the body of the water okay. So, this is the changing in the texture, the structure getting you know structure is lost, structure is lost, volatile matter is, volatile matter is non-consequential you know the volatile matter does not exist or you know it is too much weight, organic matter nonexistent, nutrients lost say nonexistent volatile matter, organic matter and nutrients and nutrients say you know you can find this an nutrients. So, here no nutrients, so this is you know degradation, this is what is called degradation you know it is not this is something to do, something to consider differently than contamination. Contamination is altogether and new aspect but it is a different aspect. The contamination can take place without the soil being degraded, without the soil typical characteristics of the soil has remained but it has undergone a degradation. I'll talk about this in you know following to this. So, you know you can find out this is soil degradation when there is no foreign material has been included in the soil yet the soils inherent properties have been completely changed. This is what is known as soil degradation okay whereas you know when you when we discussing about contamination.

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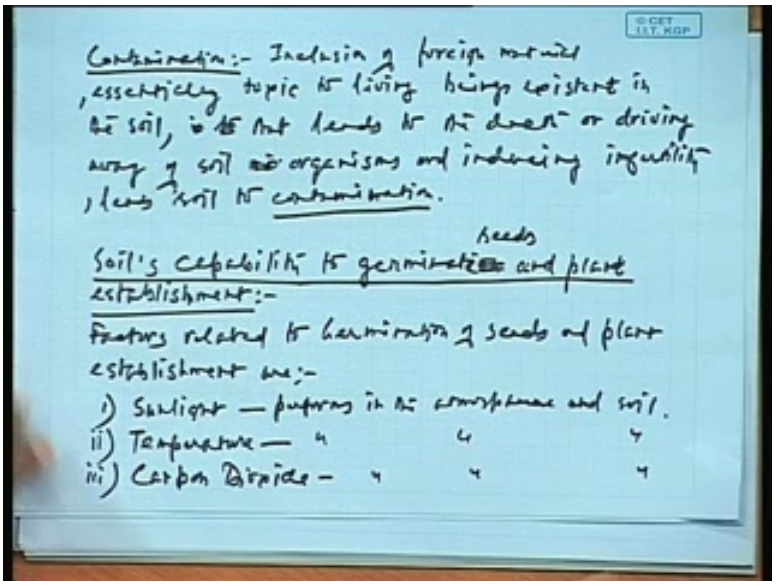

The contamination is, contamination, contamination, contamination is a say inclusion of foreign material essentially toxic to living beings existent in the soil, existent in the soil. Inclusion of foreign materials, inclusion of foreign material, I'll discuss about this foreign material part as well. This essentially toxic to living beings existing in the soil to inclusion of foreign material that leads to the death or driving away of death or driving away of soil organisms, soil organisms, driving away of soil organisms and death or driving away of soil and inducing infertility leads soil to, leads soil to contamination.

So, let me again start with this, let us discuss about this again. Inclusion of foreign material essentially toxic to living beings existent in the soil that leads to the death or driving away of soil microorganisms and inducing infertility leads soil to contamination, leads soil to contamination. So, this particularly say what is a contaminated soil around us, what is a contaminated soil around us? Have you see a contaminated soil around us? We see it every day let me know it, let me tell you this. This is you know if you go to a petrol pump or if you go to a repair shop you will see the, find that the soil has been completely blackened, the soil the discoloration of the soil has taken place, complete discoloration of the soil particularly in the repair shop. If you just see the typically the material they discharge on the soil, as a result of that the soils, the coloration has completely changed, the soil has been completely blackened or is looking like heavily grey that is what is the soil, contaminate soil.

See, here the soil has not degraded. The degraded in the sense that you know its texture has not changed, its structure might not have changed, it might still have volatile matter, it might still have organic matter but since the inclusion of certain foreign materials, inclusion of certain materials which are toxic in nature like mostly say, mostly say they mostly the toxic things are like you know the volatile organic material, organic carbon BOCs inclusion of say the liquids containing high doses of nickel, cadmium, chromium right and then say lead all these can lead to heavy contamination of the soil.

So, a soil or also you know if you particularly if you are relating to an agricultural field containing high, very high DDT or any other organic substances you know that can lead to the contamination of the soil. So, in a contaminated soil even if the nutrients are there, even if the other structure of the soil is intact you will not find any living organism in that soil. You just try for your case, you just take those soil you know in the repair shop, take it out and you know when you are going there you know you also take out soil from an ordinary field, soil from the repair work shop and things like that, you will see that soil there would look very infertile you will not find a grass of, grass also growing on that soil that is what is the soil contaminated.

So, here in cases like this you know we will not be finding opportunity to discuss contamination in a large measure. Contamination is an extremely important aspect of soil pollution, soil degradation today but we will not find much time to discuss soil because you know it itself is a great subject but try to understand these two things because in engineering terms these two things have a very important connotations, two very important differences. The differences is this that not all industries, not all industries or all kind of industrial activities lead to soil contamination that might lead to soil degradation but not contamination but in the other kind they are, in the other cases you know the discharges wherever there are very serious discharges like taking place something like you know in a PCV manufacturing unit. There may be that the toxic discharge may be so heavy that it can, it is able contaminates say land field contaminated land field, if it is, if say something like nuclear waste is being dumped on the soil.

You know the various parts of the world are completely charred with the soil has been so much damage that you know there would not be any plant or there would not be any kind of farming in 100 years to come. The soil takes a lot of time to regenerate itself, they giving to giving soil it structure, back its structure where it will be able to drive growth of its own where it would be able to generate plants, small seeds plants, trees it would remain you know it takes tremendously long time if its left alone, it would take a 100 years, 200 years before it can be recultivated before it can be used for any kind of purpose, not necessarily for human use you know but say for to grow a jungle there, to grow a forest there it would be extremely difficult in those areas.

So, here in cases soil remains a very important area and particularly one we are discussing what we would be discussing here. Our perspective here would be in terms of the soil, in terms of soil, in terms of soils capability, capability to germinate, this is what you know our discussion would revolve on. Whatever I will discuss on soil would centrally deal with soils capability to germination and plant establishment, plant, soils capability to germination and plant establishments. So, you know this is the, this is what is the main area of our discussion regarding soil, regarding soil. We will not be disusing about soil contamination as I have said because you know this would be different, this would be completely out of our scope but we would discuss mostly the soil capability to germination, capability to germinate and plant establishment. Say capability to germinate, to germinate you write to germinate okay this, the soils capability to germinate seeds and plant establishment, so we would discuss this in greater detail.

Now, there are not necessarily you know the soil is only contributed to this plant growth. There are many other things you know that also deal with, that also of extremely important for this. The factors you know this particularly, particularly related to the factors related to germination of seeds, factors related to germination of seeds, seeds and plant establishment are, number one is

sunlight, sunlight which works in the, performs function where it performs, sunlight, performs in, performs in the atmosphere, atmosphere and atmosphere and soil. As I have said you know sunlight is a, sunlight plays a great role. The important, most important role of sunlight is to provide energy for all the, all kind of atmospheric or atmospheric or you know this soil atmosphere and also soil atmosphere I mean soil atmosphere, soil environment. So, the sunlight performs the mostly it provides the energy for all the environmental reactions all the physical, all the chemical reactions that take place in the body of the soil as well as in the atmosphere. You say temperature as you can see temperature is very important as you know that in all temperatures, temperatures where it perform is performs in the atmosphere and soil say there is carbon dioxide another third one is, third one is say is carbon dioxide, third one is carbon dioxide, dioxide where it performs carbon dioxide you know it also performs in the atmosphere and soil.

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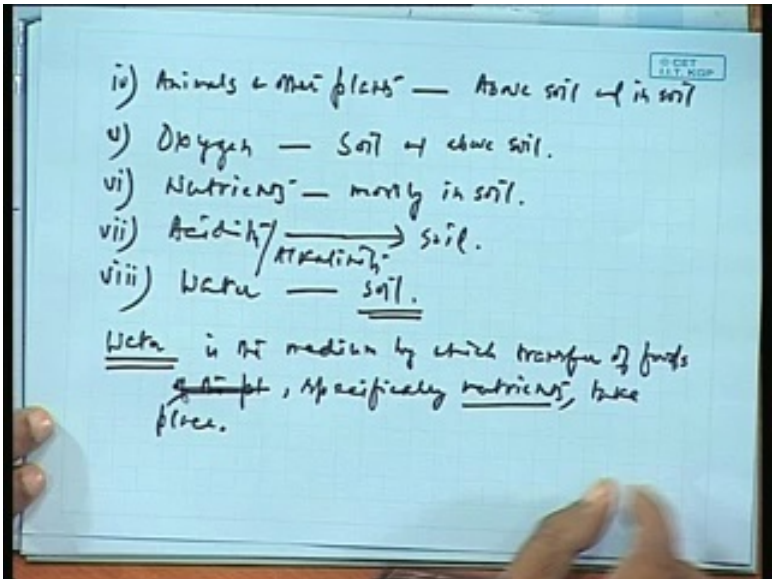

Animals to, you know animals to, animals and other plants to play their role, animals and other plants do play their role above soil and in soil and in soil where they perform above soil and in soil. This the fifth one is that you know the one another important thing is oxygen, oxygen or as you would know as air or in works in the soil. Nutrients mostly as I have said in soil, mostly in soil, mostly in soil, mostly in soil but some of the nutrients can be also absorbed through the, through the this, through the, through the plant leaves, plant body as well. And the finally is another important parameter is acidity, the acidity or alkalinity I mean instead is not just to say an acidity and alkalinity, so you can say alkalinity .

So, this would you know this would make the change in the potential so that you know the osmotic pressure would develop. So, this is you know mostly in the soil, mostly in the soil this is where these are the places where it performs, these are the places where it performs. So, you can find out this you know the acidity this the mostly the parts that you can see you know would not discuss much about this sunlight, temperature, carbon dioxide and all other things because you must be knowing by now you know because all these things are essentially you know typical

things that are generally discussed you know even in this high school also. We will go into some of the different things you know some of the more important parts like you know the other things that we would mostly discuss about is say the nutrients will come back to that again acidity alkalinity of the soil also will come back, the soil water the first of all you know another important thing that would be the soil, soil, animals and other plants you know this, did we discuss water anywhere. Water is this, water is there, sorry, I am sorry this is one, this is last part is water in soil, in soil, mostly in soil, the mostly in soil, water performing in soil.

So, we start with water, will start with water. Water has a great role to play, so water as I have said water is the medium, water is the medium by which, by which transfer of food, transfer of foods, transfer of foods and foods specifically nutrients, specifically nutrients and specifically nutrients takes place, nutrients takes place. You know in many cases there are some kind of plants which will be having very little chlorophyll and they would be mostly draw their most of their foods through the water, most of their of foods into specifically including, specifically including the nutrients, the nutrients that you have already known the water nutrients say you know all those kind of anions and cations that are necessary for the growth of the plants would be drafted, would be drawn into the plant by, through water in which water would play as a medium, in which water would play as a medium. So, here in case that you can observe now if you can observe is water as is the role of water. Let me explain you know few things about water you know how water remains in this.

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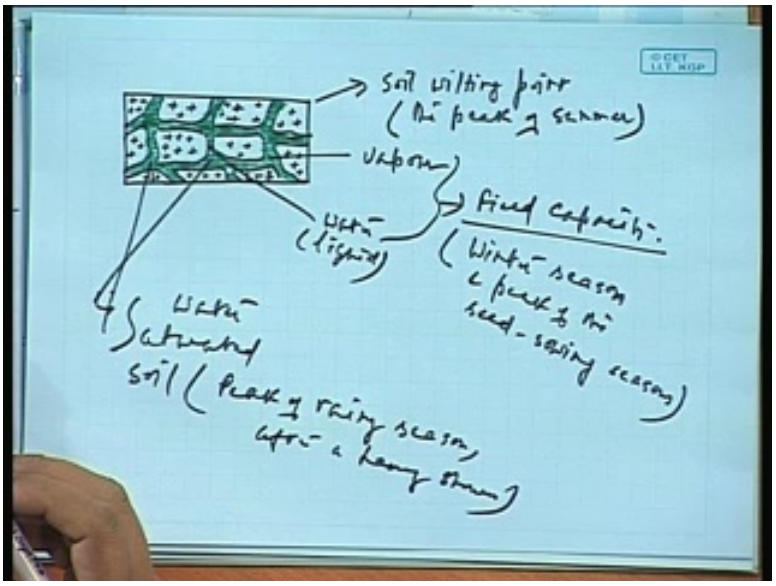

If you just observe you know if you just make a structural examination, an examination of the soil structure as such you know instead of the soil structure as such you will find that in this is the mostly the particles that we observe here is you know this particles should be, this is how the soil looks like I mean if you remember something that we discussed in terms of porosity you know this is where these are the things, these are the things you know this is how the soil particles look like, this is how the soil particles remember the same drawing that we have done this is how it would look like.

So, all these cases if you see this particles here, this particles, this particles here, this particles the things that we can see is you know this is how it is looking like, how it is looking like so these are the particles that you can see here okay. To observe this in a different type you know in a typically you know soil if we just observe that you know in a fully you know when this is, there is completely devoid of water, completely devoid of water. Suppose as you can see there is as if to suggest is you know this places, the inter intergranular spaces, intergranular spaces are without water, without any moisture this is called, this is called is wilting point, soil wilting point. Soil wilting point takes place fixes mostly in the, in the peak of summer, in the peak of summer, peak of summer, soil wilting point take place you know in the peak of summer, in the peak of summer you know this is where you know the soil is completely devoid of water, completely devoid of water. This is where you know you will find the soil is beginning to break, the surface is you know is beginning to break because all the moisture that binds them together has being by that time evaporated and so the soil is completely without water, in the wilting the word wilting is you know where the plants begin to you know begin to dry of so much that they cannot stand on their own, they cannot stand their own, they generally try to begin to bend that is the called the wilting point, that is called the wilting point. So this is soil wilting point.

Now having to say that in most cases, in most cases in the soil, in most cases in the soil there would be this where ever there is there in the soil if we find out this soil basically the water remains like this, the water remains mostly, mostly as a combination of vapour and liquid right. You will find some area this is filled up with some area, filled up with say water, some area filled up with water and this some area would be the water is mostly say the water this is what is vapour, this is what is vapour and this one is, this one is water, water as such. So, this is when this water the soil remains in this two states, in the soil water remains in these two, two states in a liquid that is water or liquid vapour or you can say liquid here, this is known as the field capacity, this is known as the field capacity.

This is particularly you know in all kind of agricultural activities, we generally try to remain the soil in a particular state like this when there would be sufficient water as well as sufficient vapour so that the root can breathe, root can also take sufficient water for its own consumption. This is what is called the field capacity, this particularly you know this field capacity you will observe during the winter season, winter season when there would be, water would be, water is generally given is not excess amount of water is given, sufficient water amount of water is given or you know the peak of the, peak of the harvesting say a peak of the seed sowing season, when the seed is generally planted in the soil. This is where the soil the, this is how the soil should look like. This is how the soil should be, so should have sufficient moisture, should have sufficient vapour, should have sufficient water as liquid. Here again so you know if we just see this particularly as the rainy season approaches after a number of, good number of showers, after a good number of showers this the, all these vapour would be driven away, all these vapour would be driven away and all these force, all these intergranular spaces would be filled up by, would be filled up by water. This is what is known as the saturated, the saturated condition of, the saturated condition of, this called the saturated condition of this, particular state is called, this the saturated, saturated water saturated soil, water saturated soil, this is water saturated soil. This is on a peak of, peak of rainy season or after a heavy shower, after a heavy shower, right. So, this is what it would take place after a heavy shower. So, we can observe, we can observe that you

know will take this up later on, see in the next class. So, this is what is the three situations by which the water can remain. Thank you will take it up again.