Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning(NPTEL)

Course Title
Bioenergy

Lecture -18
Biomass Production System and their Categorization

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Welcome back to the lecture series in bioenergy so from today's lecture we will be shifting gears so if you just recall back where we started we started with the basics of the energy then we talked about the fundamental concept of bioenergy where we highlighted that biomass play a significant role next from there we went ahead and outline the biomass production system in the form of photosynthesis the most fundamental reaction on the floor of earth which is driven by the incoming solar radiation or sunlight or as a matter of fact any form of light it is a light driven process and there we talked about the complete photo system and how the start and sugar molecules are being formed.

So today what we will do from the basic mechanism now we will see the output of it and from there what are the strategies which are being followed, so just in every lecture as I generally do in the beginning I kind of giving you an overall capsule or kind of you know what you are expecting from this lecture on the subsequent lecture, so today also start like this so we have already seen incoming solar radiation leads to photosynthesis. So on the floor of earth as well as on the ocean land ocean water bodies everywhere there are formation of biomass.

So what we will do first we will classify the biomass depending on their origin are they from growing in the water are they going on the land in the land what kind of forms they are, are they in the form of forest or they are in the form of cultivation of grasses from there we will narrow down like you cannot use every crop for bioenergy or for biomass production okay then we will

talk about what are the features what we look forward among this wide area of biomass which are formed and along with I just missed out one thing we will also talk about in the first fragment what are the bio waste in the form of crop residues manuals and everything which could also be utilized which are byproduct of biological systems which also could be utilized for bioenergy production, from there we will enumerate all the features what are essential for after selected for example, say a to z this is the total type of biomass which are form on the floor of earth.

Now that does not essentially mean from a to z everything could be used with choose certain of them some part of them some fragment of it based on what is the fundamental basic what we have already studied in terms of the photosynthetic efficiency in terms of their carbon capture potentials and there is one thing which we have discussed in terms of their cellos content in the form of starch contents of what is, so again that is directly related to the photosynthetic, okay.

Now what will be those features which will govern that and from those features we will narrow down to what are the critical points, what we are looking forward in order to use them for harvesting fuels okay, so this is in subsequent lectures this is what we are going to talk before we enter and enumerate all the different route thermo chemical, chemical biochemical the different routes of conversion okay too. So let us start today by enumerated the different forms okay, so coming back to the slide now.

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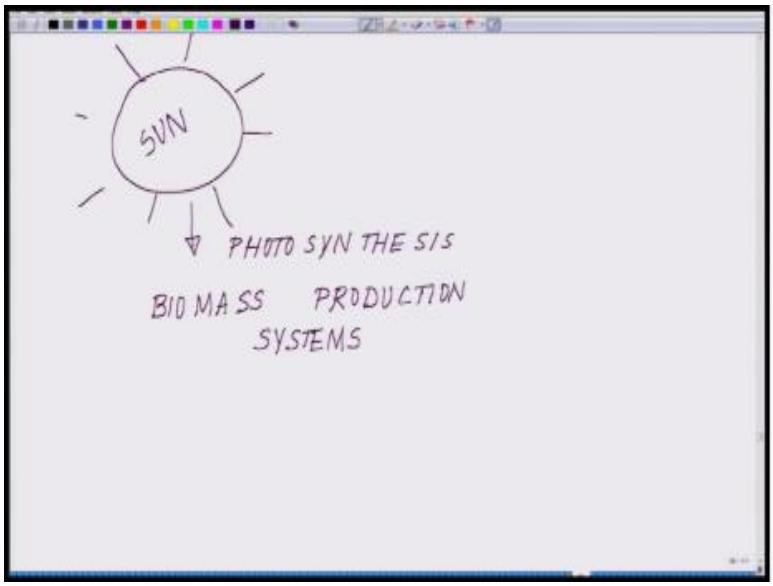

So if we talk like this is our solar is Sun which is the ultimate source of our energy, so through photosynthesis process what we are generating we have a wide range of biomass production system, so these biomass now let us first of all do the classification of them biomass production system okay, and so let us classify the biomass production system so biomass production system could be classified as.

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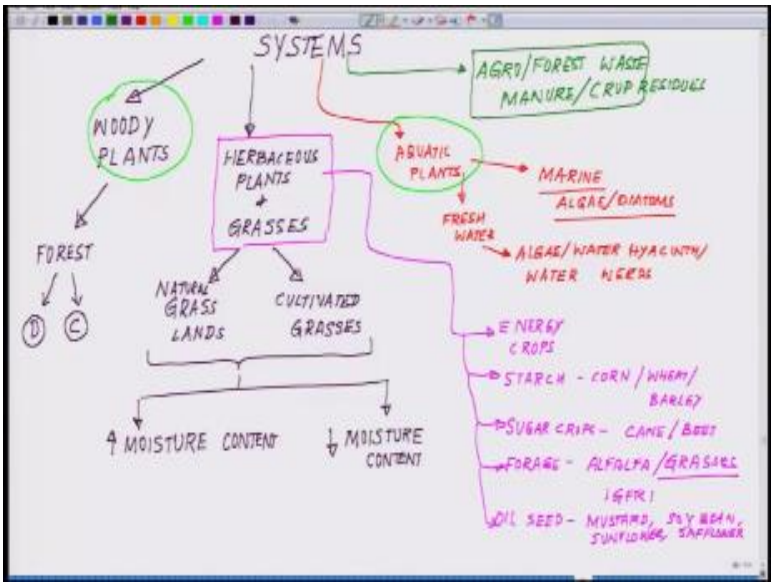

The first classification would be the woody plant which is resource could be either the existing forest it could be a forest wealth, deciduous forest, coniferous forest disease of them for this deciduous I am putting D for coniferous I am putting C similarly you have herbaceous plants and grasses so this could be wide coverage of grassland so the natural grasslands okay, as well as cultivated grasses okay, and they could be further classified by another mode which is actually very significant for us which is based on the moisture content.

So they could be either high moisture content high so the arrow upward arrow showing upward arrow showing higher moisture content and they could be of lower moisture content okay, lower moisture content and some of the examples what you can think of that line higher moisture content maybe something like you know sugarcane and some of these crops, further these could be also classified.

This category could be further classified I am just boxing this category herbaceous plants and grasses could be further classified by another way which is if we talk about the energy crops okay, then we are having starch crops which includes your corn so this is all those cultivated one

wheat, barley okay then you are having sugar crops sugar crops include cane and cane sugar and beetroot sorry, beet sugar sorry to beet sugar and you could have forage crops.

The most prominent is alfalfa and several other grasses which are grown as much just fory our information one of the major grassland Research Institute in our country in India is IGFRI in chassis Indian grassland and for the research institute okay, then we have the oil seed crops including mustard, soya bean, sunflower safflower okay, so these are the different energy crops starch crop, sugar crops, forage crop and oilseed so these are the other set of classification how you can classify this part.

Now apart from it you have another set of classification which falls under aquatic plants okay, aquatic plant includes either it could have marine origin or it could have fresh water origin, if it is a marine origin the major chunk is marine algae diatoms these are the major sources and other marine green species okay, in the freshwater case you will have algae water weeds and water hyacinth there are many other I am just taking few examples okay, so the freshwater algae, water hyacinth and you are having water weeds okay, so this is the third category.

Now let me just circlet hem so this is the woody plant this is herbaceous this is the aquatic plants, now there is a fourth category in that and the fourth category is the agro forest waste and the manuals or forest waste okay, agro forest with manual and other in a human excreta and everything those are also source of could be utilized for energy production as you know most of you know the global gas and all those kind of thing where cow dung is being used similarly there are different ways by virtue of which you can use this kind of waste.

This includes with wisps like you know the burnt crop residue or the crop residues which are left they are burnt they could be instead of burning they could be utilized for different kind of processing for production of energy, okay. Now coming back where we were to the slides so these are the agro and the forest waste and manure okay, so this is overall if you see the classification where we stand as of now in terms of the different let us summarize the woody plant, herbaceous plants and grasses aquatic plants agro forest, forest waste then the crop residues to add up on that and processing them.

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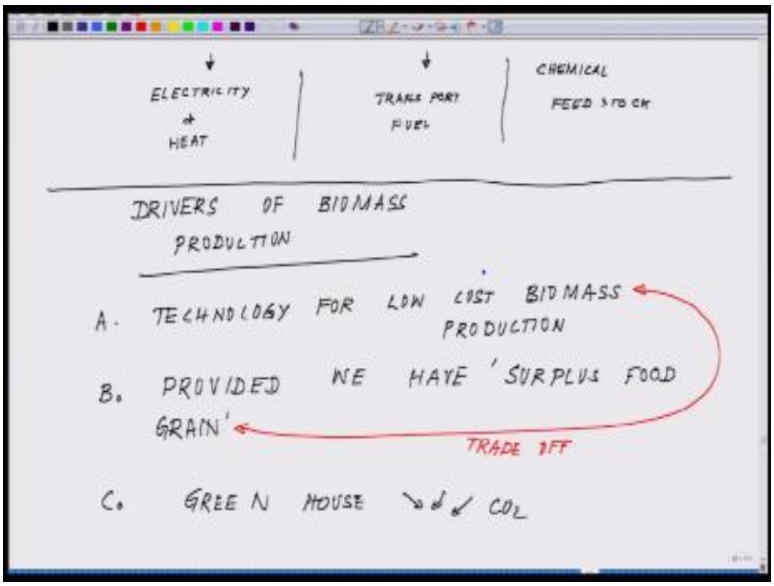

So this whole biomass production system is either used for electricity production and heat energy one aspect second thing is for transport fuels and third thing is chemical feed stock. Now having feed this that these are the different usage of it this brings us to a different kind of situation so situation is this, now if you see electricity and heat transport swells chemical feed stock so these are very different requirements.

So these different requirements need different kind of chemical composition and different forms of crops which could be utilized for this specific purpose so now what we will do let us enumerate what all are the features of the crops which are selected from this will now say for example coming back to the slide you see through this. So there is a wide array of things but then which one we should pickup which one are significant for us because you have to always realize this whole system is not exclusively for producing energy this is also our primary source of food.

So there is always a trade-off so try to realize this point say for example there is a land which is traditionally used for production of rice or any other production system, but all of a sudden if we make a policy change we say no, we are going to use this for energy production then there will be a compromise so there will be a shortage of food.

Whereas you have excess of energy so we always have to ensure there are two things two interesting points which has to be talked about here so first, thing what you have to talk about is what are the strategic aspects which always have to be taken bold in mind before we really know think in this direction first thing what we have to figure out is that what are the let us enumerate what are the drivers and then we come to it drivers of biomass production other than of course the natural light and other sources.

So there are three key drivers one driver is the technology for low-cost biomass production okay, technology for low cost biomass production so here it is very critical when we talk about the low cost biomass production we have to take it into account that we are not utilizing the land which is already been earmarked for production of food grains, because then there will be a very stiff competition there will be a shortage of food grains as compared to energy crops, so there has to be a very conscious of strategy by virtue of which we ensure that if there are fallow lands which are not being used or you know degraded land where you can grow certain crops which will harvest rich energy benefit.

We should use those lands or we can use the water bodies we have the whole ocean bodies out there if we can grow stuff in saline soils or there are alkaline and saline soils which does not promote any growth of any kind of crops we have fallow land we have wasteland you know so we need a very conscious thought process before we really you know burge into that direction that what is the trade-off what are we doing are we really utilizing the existing land which is used for mankind especially this is very, very significant for a country like India which has a very heavy population density and one of the highest population in the world that.

We have to be we have to make very clear cut choices that what really are we looking forward to we cannot afford we do not have so much land that we can afford to have a lot of energy crops growing all over the place because we have to feed the timid millions okay, so this is one very interesting thing that is why i said technology for low-cost biomass production comes with a lot of trade-offs you may have a low cost but then you have to ensure that that low cost thing works in places where you know there is a tug-of-war for the land resources or other option is that if we have vertical farming.

We have a stacked farming for these kind of energy crop small location we have a stack farming we have some way or other we can give different kind of life sources if possible, okay. So there are lot of food for thought that how we can really make a difference without compromising the food production okay, so this is the first driver coming back to the slide the second driver in this whole process is just provide it this is provided and this is exactly linked to the previous one provided we have surplus food or surplus food grain this is very, very critical that we should have surplus food grain so that we can do a trade-off between so this is the trade-off zone, okay.

Now third in this line is the threat of greenhouse there is huge greenhouse problem which is picking up or accumulation of lot of CO2 because of lot of industrial processes so these three are the key driving force in this direction which at points we have to make conscious call, now having said this, this brings us to add another level of kind of a conscious choice. So the second conscious choices are we going to use the old biomass or are we are we there to grow newer and newer biomass what does that mean.

So when each one of us are born we inherited this earth with say X acreage of coverage of earth with plants trees algae see resources and everything so that is a fixed amount with which is changing dynamically over period of time as per natures rule, but then we cut a forest we either use them for furniture or burn them so what we are essentially doing that X amount of acreage what we inherited and there is a reduction in to that okay.

So we are increasing the CO2 in a process so unless otherwise and mind it the problem is this out of that X acreage how much you have cut how much you have removed by deforestation or any other process one has to keep in mind that forest would not grow so fast as the rate we teach you have depleted it so it takes you one month to deplete a forest a part of the forest but it only takes a month reality to you know re-grow those plants so essentially what is happening you are have actually generated more carbon dioxide than what you have captured so there is a carbon budget.

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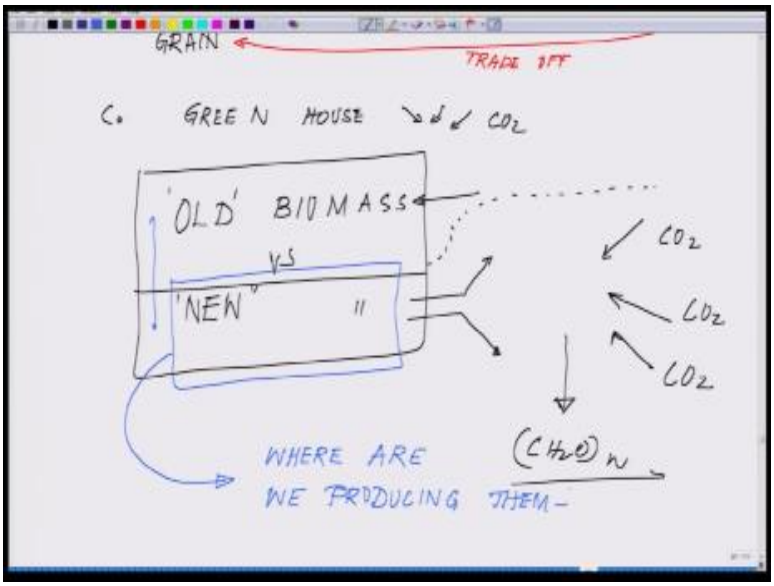

So one of the ways is this so there is a word which comes called wood biomass old biomass and new biomass versus new biomass so the old biomass is what I am telling you that there is this what you have inherited at the point and the new biomass is that is where the catch lies so what kind of new biomass we will look forward to because this is very important that we continuously grow newer and newer biomass because that is the only way we will read to we will be able to capture as much carbon as we are thinking to capture and convert it into the carbohydrate.

So that is only feasible like this but if we keep on cutting this old biomass replacing this old biomass will be a tough deal and especially those who are involved in forestry and all other they know how systematically they cut a cut the number of trees and replace them so there is always a maintenance of a log record logbook that ok if we cut this much how we are going to cut them how you want to get rid of them.

When we should get rid of them so there is always a growth pattern which has to be monitored and this monitoring cannot be done at a very small level this has to be done at a very global at the government level it has to be monitored that you know there are systematic deforestation

which are being done it is not that it is there any crime or anything it is done in a very systematic way.

Because there is a whole range of mathematics which goes through it that this part of the forest will clear it up so there is other part already grown by other trees and how they will grow what will be the height and there is a huge dynamic in computational forestry what people does and how they decide but this comparison or this linkup between old and new biomass and how they have to be handled has to be done very, very carefully and second thing whenever we talk about this new biomass this new biomass has to be ensured that where are we growing them where are we producing them.

Because this is what will bring you to the previous point what I made are we compromising on the food grain production land hope not because then this is not very help us because then a part of our population will be starving okay, so these are two critical points which has to be kept in mind when each one of us starts thinking about that biomass is the future yes, it is the future but it has to be handled very, very carefully we cannot do a random walk here like okay, do this do that likewise it will only lead to a very hyper third situation okay.

So keeping this in mind what we will do now will go for what are the kind of crops which could be you know selected out of it we will resume from here in the next class okay, thank you.

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