

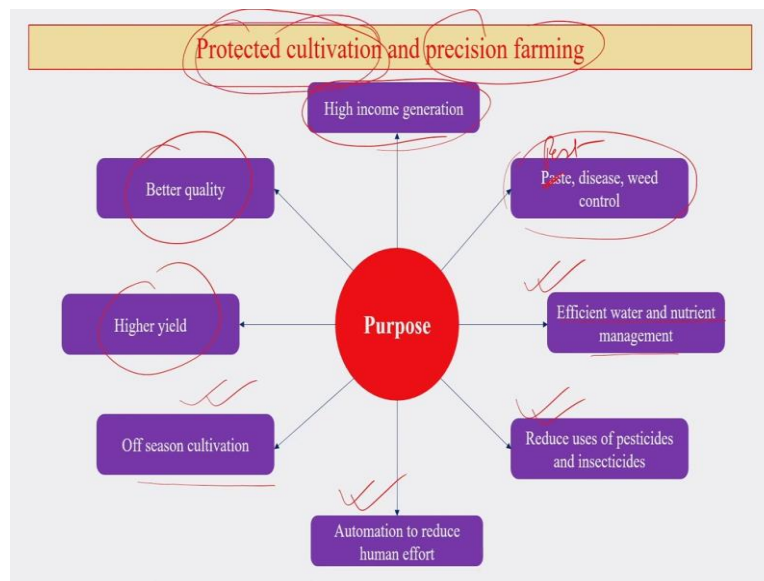
Natural Resources Management (NRM)
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Week - 06
Lecture - 38
Precision farming and protected cultivations
And Simulations applications in Agriculture for NRM
Part – 1

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So, participants today we will be discussing a new topic and that is on precision farming and protected cultivations and simulations application in agriculture for natural resource management. Earlier we discussed about various way of natural resource management and also the different kind of applications of modeling and simulation exercise for resource management, and also how that particular tool of modeling can be utilized especially in the field of agriculture, where the uses of natural resource management are quite significantly important for our community's livelihood.

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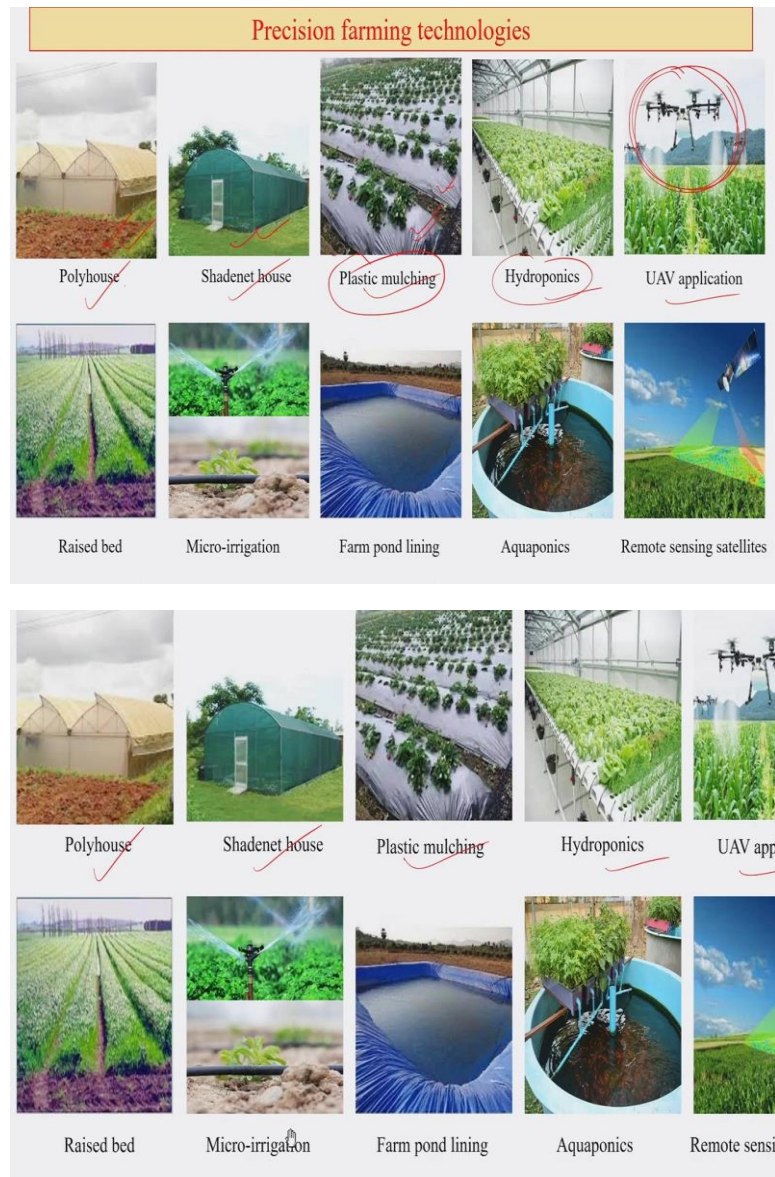
Now, if you look at a precision farming, precision farming as all of you might be knowing that it basically tries to do the farming in a very efficient manner, right amount of activity, right amount of input at the right place at the right time, that is the very simple fundamental background of precision farming. We try to make the farming system efficient and precise, so that the utilization of any input or natural resources would be such that with minimum inputs or minimum utilization of natural resources, you can maximize your output that is yield or any other targeted outcome.

So, the purpose of precision farming are different, as you see in this particular slide, one of the major objective is high income generation. Because enhancing farmers income is one of the most important objective of precision farming. But on the other side, it also tries, as I said, that while increasing the income, it also tries to restore or to create the minimum damage to the environment or natural resources. Precision farming also talks about efficient management of pest, diseases, weed control. It also tries to address the issue with efficient water and nutrient management.

It also helps in reducing uses of pesticides and insecticides. It allows the uses of automation to reduce the human effort in some cases not to stop or discourage the human power manpower into the system, but just to reduce the pain or the drudgery of human effort into agriculture. Off-season cultivation can also be facilitated through this kind of precision farming or protected cultivation also. I will talk about these in greater detail in the following slides.

Higher yield of course, is always the target for any activity, any intervention that you try to take in the field of agriculture, the fundamental target basic target is to increase the yield. Better quality of course, quality cannot be compromised. So, these are the, overall purposes of precision farming and also protected cultivation.

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I will now discuss these things in greater detail. Most of you, all of you have heard about this term precision farming technologies. Now, many things actually can come under precision farming technologies. In this slide, you see many examples polyhouse, shadenet house, plastic mulching, hydroponics, UAV application, raised bed and many other micro irrigation, farm pond, then aquaponics, remote sensing. So, these are the various technologies some examples of technologies which we can call as precision farming technologies.

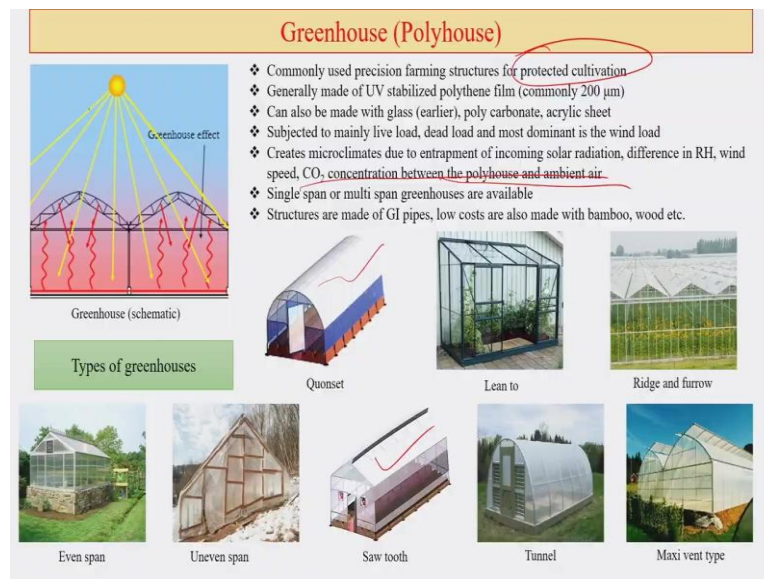
Each one of them has very different uses and can be utilized in particular condition. Use of UAV applications though very popular in the developed country, where you have continuously hundreds of acres of land, but in our condition in developing countries like India, Nepal, Bangladesh, where the size of the land is very small sometimes you will find very difficult to apply such kind of technologies. Because UAV applications if you have a large land with similar kind of crop, then the applications of a particular fertilizers or particular pesticides or any other applications will be much easier utilizing this kind of technology, otherwise, it may not be as beneficial as it looked like.

Hydroponics has become very popular in many parts of the world and so, in our country hydroponics being used largely now in various horticulture purposes to make fruits or vegetables also, there are a couple of organizations who are actively working on hydroponics, though hydroponics is yet to become a kind of a farming practices which is very commonly seen in across the country in any part of our country that will take some time, but things are moving in that direction.

Plastic mulching also you might have seen in very places. Yes, again, this kind of activity as it requires little bit of investment, you may not find very often a normal agricultural field run by our resource poor farmers. Shadenet house, polyhouse these are again very popular among contract farming or farming for some in business purposes.

So, but these technologies have already arrived, that is the good news in India and people can actually take the benefit of these technologies, but to make it easily available and to make it little bit low cost, so that it is being used by our farmers, the large number of farmers who are doing farming are actually resource poor in our country. So, the benefit of these precision technologies by those farmers still remain a challenge.

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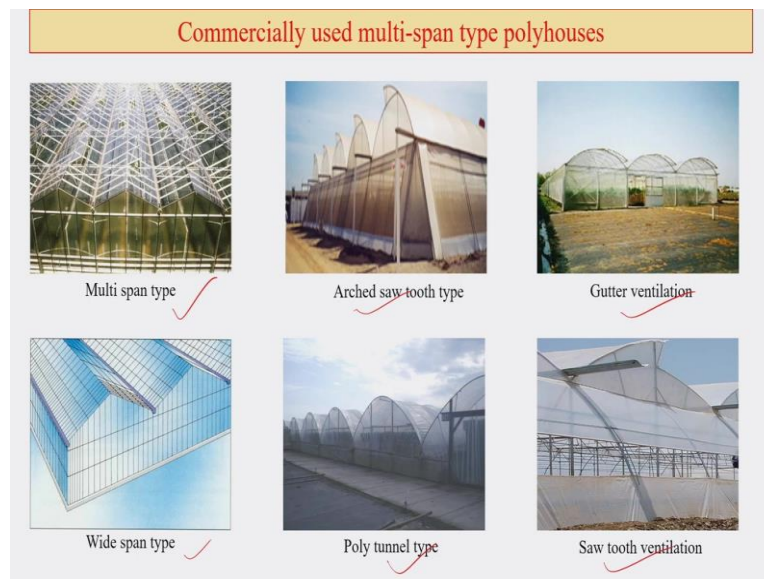


Now, greenhouse and polyhouse, whatever we can call it, this is being used for decades or more largely in the research purposes or as I say that by certain organizations, who are private organizations, who are into some agricultural or horticultural farming. So, these are commonly used precision farming structures under protected cultivation that we call as protected cultivation. Generally, made of UV stabilized polythene film, it can also be made with some time glass, polycarbonate or acrylic sheet. These are largely subject to mainly live load, dead load and most dominant is the wind a load that are actually given to these kind of structures.

Greenhouse also creates as you will know, that microclimates and largely due to the entrapment of incoming solar radiations and difference in relative humidity, wind speed, carbon dioxide concentration between the polyhouse and the ambient air. Now, single span or multi-span greenhouses are also available these days and they are quite efficient in many aspect. Structures are also made of GI pipes, low costs are also made with bamboo and wood. In our case, here in Assam in many places people use bamboos most of the time and this not only reduces the cost, but also it is sustainable in many ways.

So, yes, polyhouse greenhouse is a technique under precision farming and especially under protected cultivation, but till today, this technology requires little bit of investment. So, our poor farmers in Indian agriculture system are yet to get the benefit of this technology. And I hope that in future, the price or the investment required for such kind of technology will go down with advancement of further technology development.

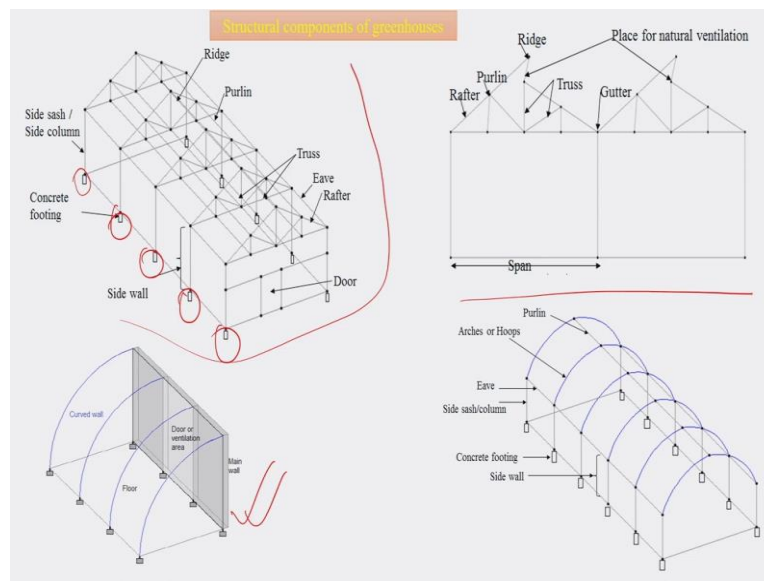
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Now, commercially used multi-span polyhouse you will find largely in case of private farmers contract farmers, contractual farming system and what they are to be honest popular in developed country, but still not much in our country. Multi-span type of greenhouse, I think that it would require really some more time before you can see that every Indian villages somewhere this kind of structures are there because mainly the investment the high investment that is required for such kind of structure are. Sawtooth type of polyhouses are also popular, gutter ventilations, wide span type, polytunnel type, then sawtooth ventilations, these are the technologies per se is being developed in a very faster rate.

Lot of R and D research work is also taking place in the field of precision farming and especially looking at the agriculture sector. So, technologies are available, but to make it available to the resource poor farmers remains a challenge and still people are working to solve that problem or that puzzle as well.

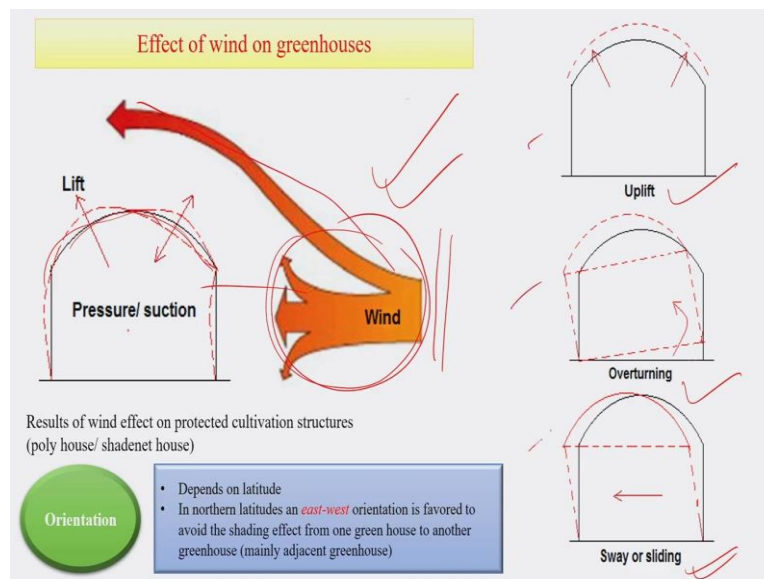
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Now, the structural components of greenhouse is that just now have mentioned, if you see that there are some basic engineering aspect of these greenhouses, which one use to look at. So, I will not spend much time on this particular aspect. So, you see that most of the structures are actually having quite well measured and well thought structural engineering, in every cases, it has been made in such a way that utilization of solar light or sunlight can be utilized in an appropriate manner.

So, in some cases, you will find that concretes have been uses for footing purposes, but in some cases to reduce the cost one can use also non concrete kind of footing. As I said, bamboos can also be used as pillars for these kind of structures, if you want to reduce the cost or investment involved with these kind of structures.

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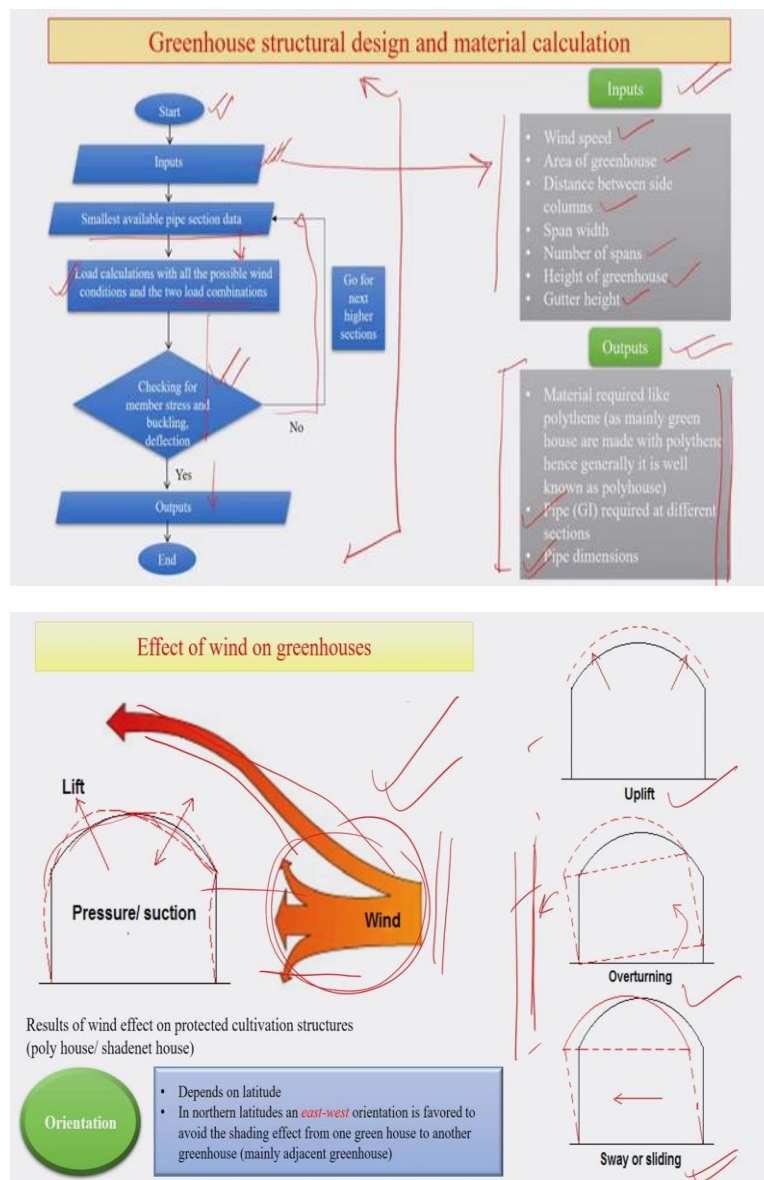


Effect of wind on such greenhouse gases is another very critical aspect which we need to keep in mind, because, there is often a chance of uplifting or overturning or sliding of this kind of structure because of strong wind blowing from one side to the other. So, results of this kind of strong wind on these kind of protected cultivation structures is one challenge, which engineers are trying to find out the answers solution is there with different kind of adjustment you can actually handle this particular problem with wind. This problem of wind also depends on latitude where you are located, in the northern latitude and east west orientation of your greenhouse is favored to avoid the shading effect from one greenhouse to another greenhouse.

But at the same time, as I said, that the direction of the wind and the structure of your greenhouse is actually should be made in such a way that you can avoid the direct thrust of wind on your greenhouse structure. So, these all those things are actually to be honest, a lot of R and D work has already been carried out across the world and precision agriculture is actually in now quite developed time and again, I am telling that in our kind of situation in developing country, the benefit of this technology is yet to be achieved. The basic reason is that, that we our farmers are not in a position to have this kind of investment that is needed.

So, we need to find a different kind of solution to bring these technologies for enhancing the income of our farmers. We saw that how wind actually can affect the greenhouse structures and there could be different kind of effect for gusty wind.

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Now look at that, how greenhouse structural design, and also the associated various calculation with regard to the material can be carried out for preparing greenhouse gases under precision agriculture. Now, to start with, there are two important aspect or parameters that are associated with the greenhouse gas structural design those are inputs and what are the corresponding outputs.

Now, if you look at the flow diagram of greenhouse structural design from the start we first need inputs. Now, as inputs, what are the different parameters that one has to look for, it is wind speed, area of greenhouse, distance between sight columns, span width, number of spans, height of the greenhouse and gutter height.

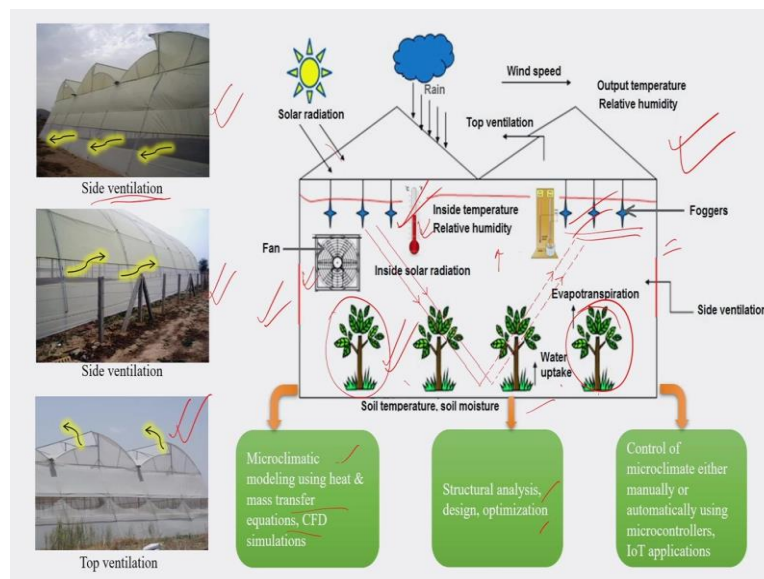
So, these are various inputs that you require for structural design of greenhouse. So, once the information about these inputs you have with you then you go for the smallest available pipe section data that are required for this kind of structural design. Now, once you got that, then you go for load calculations with all the possible wind conditions and the two load combinations. So, again look at this previous slide that we discussed with, so, there is a chance of this kind of uplift, overturning and sway or sliding because of strong wind.

Now, once this load calculation is also carried out, then you go for checking for the stress and buckling and deflections that may arise. So, you need to check that while doing so, if you find that the checking is not satisfactory, then you go for next higher section and then again you continue this process from pipe section later stage and come back here and once you are satisfied, then you go for the next step which is your final output. So, once what kind of output actually you can get from this kind of structural design here are the list of potential output.

So, the material that actually you need or require like polyethylene, which are most commonly used for greenhouse structure, and then pipe you often use GI pipe. In some places where, you want to go for little bit cost effective or low cost technology as I said earlier, that bamboo can also be used effectively. And then your pipe dimension can also be analyzed or calculated through this particular exercise. So, greenhouse gas structural design, these actually then allows you to calculate not only the design, but also the material which you need for erecting this kind of structure.

Now, if you again look back this particular slides, where strong wind can actually topple your structure greenhouse structure, so, if you go for certain kind of metallic frame, then you need to also look at that, the cost aspect of those metallic frame. Remember in our condition in Indian condition, majority of the farmers on the ground will not be able to actually carry this cost, if you suppose, propose this kind of structure to them and if they find that there is significant amount of cost involved, they would hardly actually go for greenhouse technology and to be the part of the precision agriculture. So, that is why till now, most of these kind of structures are limited with contract farming of farmers which have significant amount of capacity to invest for this kind of structure.

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Now, it typically a greenhouse structure, as you see that the flow of air or the ventilation is a very important aspect for plants to grow in a appropriate manner. So, the side ventilation and also top ventilations, these all need to be insured in an appropriate manner. Now, let us look at this typical greenhouse structure.

Now, here we could have temperature control inside the structure, you can have fan to regulate the air inside the structure. So, solar radiations will come in and of course, it will increase the temperature inside the greenhouse as we know then you can have also foggers these days inside very advanced greenhouse gas structure to maintain the humidity, required humidity inside the greenhouse.

Now, plants which are growing here inside the greenhouse structure, it is very, very important that proper air circulation or ventilation, humidity should be maintained. So, on the basis of that you can calculate a rest of the requirement for appropriate management of this kind of structure.

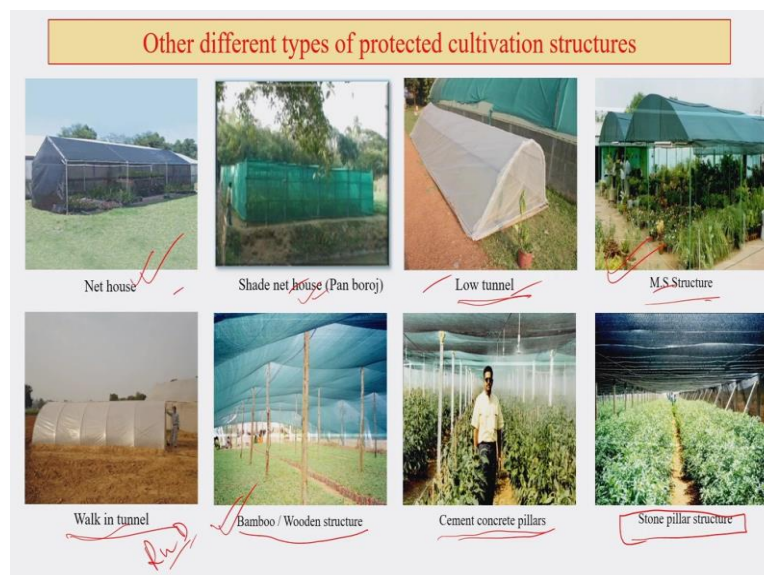
So, what are the different information or aspect that we need to keep in mind once we actually build a greenhouse structure and then going to grow the plants inside that. The microclimatic modeling using heat and mass transfer equation, CFD simulations often help us to understand or optimize the inside the greenhouse gas environmental conditions.

Structural analysis, design, optimization of greenhouse is again an important parameter. Because this kind of investment, you are not going to make for few months, a few days, but few years, maybe a decade or so, it requires a significant amount of management, proper

management monitoring. So, that means, you need skilled manpower. So, a greenhouse structure not only allows you to produce quality product, but also can generate employment, so, skill manpower would be required to run this kind of system.

Now, control of microclimate as you see here, temperature, fog, humidity. Control of microclimate inside the greenhouse can be carried out either manually or automatically using various microcontrollers, these days, we have also IoT. So, this is how basically this kind of structure can be managed by one or two person if they are well trained. So, this basically, mean for as I said that for farmers which who has the money or resources to invest in our condition.

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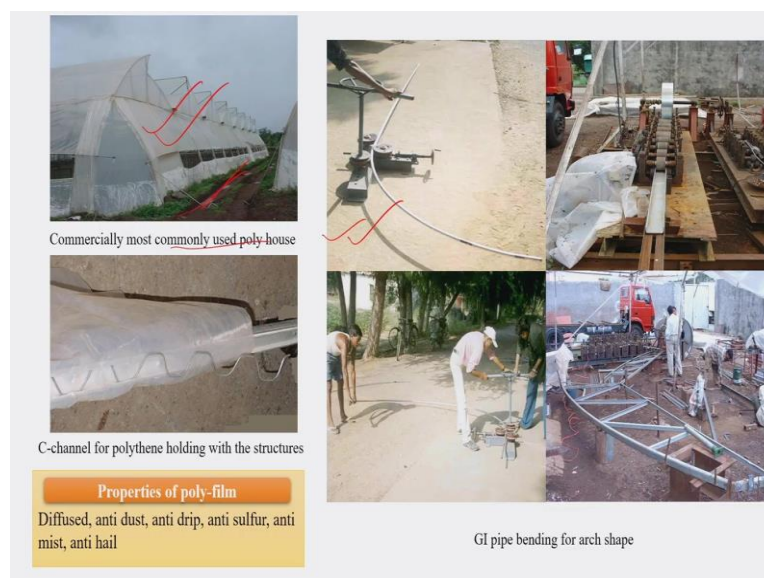
There are other various types of protected cultivation structures, you will see these are the pictures actually in which are in and around various parts of our country that means, these technologies are available at present. Net house, now, very common one then you can have shadenet house which many people can actually utilize and in fact, our farmers resource poor farmers also can have this kind of shadenet house. Low tunnel, some time it is very effective to grow certain kind of plants for private horticultural businesses, you will find that they like these kind of mild steel structures, which are easy to maintain as well.

Now, these all structures in these particular slides are available here in India. Walk in tunnel largely used for R and D purposes research and development purposes by researchers to carry out certain experiment and then we can have bamboo or wooden based greenhouse kind of structure or net house structure as I was telling that for Indian condition, this kind of system

would be much more what you call useful, because we cannot propose some techniques or technology which are very costly in nature in Indian condition in the Indian different areas, where most of the farmers are resource poor.

So, challenge is to have almost similar kind of effect, but with much less cost, cement and concrete pillars also, in some cases you might see where the people want to go for rather a permanent kind of net house or greenhouse gas structure. Stone pillar structures are also visible in many places. Overall, the function and energy of all those structures that are visible in these particular slides are relatively with low cost technologies and that is why I said that most of them are visible for available in our Indian condition.

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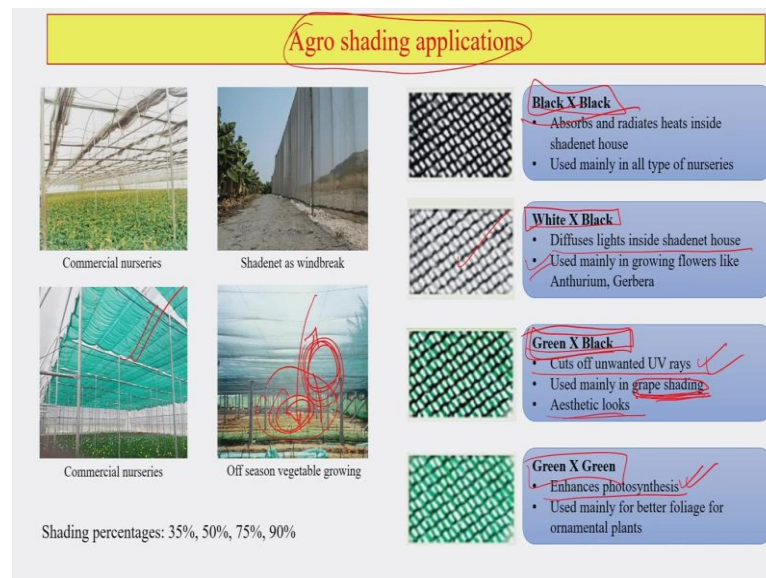


Now, few more technology is that which actually, slowly slowly in Indian conditions, we are trying to bring in from advanced countries. Commercially, as I said that mostly polyethylene is used as you see that this kind of poly houses, huge poly houses where you can have thousands and millions of small saplings and basically you can have a very thriving business of horticulture or fruits, vegetables also you can produce in this kind of structures. Now, this is again it requires certain amount of investment and also lot of different technologies and skilled manpower are required for maintaining this kind of structure.

So, as you see that this kind of structures once it is developed, certainly it will continue to give the profit or the benefit of developing this kind of structure for a long time to come. The key is that availability of skill manpower, maintenance and maintaining or optimizing the

environment inside this kind of structure. So, that is often a challenge that is found mostly in case of our condition.

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Now, agro shading application for different kind of purposes people also go for different kind of shading because some plants which when it is at the growing stage at the very preliminary stage, they cannot actually withstand very strong sunlight. Commercial horticulture business, commercial nurseries, you will find that lot of uses of this kind of structure with net or plastics often are used for this kind of shading structure.

Now, there are couple of aspect in these things, now, all plants do not require similar kind of shading. So, there are certain plants which required 35 percent or 50 percent, some plants required 70 percent shade, and some plants may need 90 percent shading. So, these kind of adjustment need to be done your structure should be made in such a way that you can actually open and close the roof shading facility.

Now, let us look at about this shading material a bit what kind of different aspects are involved with this kind of shading material. Now, one is black and black kind of material, which actually definitely absorbs lot of radiating heats inside the shade house, the sunlight coming in, it cannot go out and fully will be absorbed by the roofing material that is if it is black, then it will definitely increase the inside temperature. This kind of material are used mainly in all type of nursery you can have also white and black kind of material, roofing material which diffuses lights inside the shade net house and these are used mainly for growing flowers like anthurium, gerbera.

So, here the inside the structure the temperature will not be going as high as these black and black structure. Green and black structures also available and visible in our Indian condition is largely cut off the unwanted UV rays, use largely for grape shading. Because grape is a very sensitive fruits and a large industry, which are directly linked with livelihood of many people and quality is important in this particular business and grape is very quickly perishable. So, the quality of grape, its storage, these are various issues. So, in case of this kind of particular plants, what you have to do it only go for green and black structure, which also gives different kind of look.

Now, green and green as you see here, green and green structures, it enhances the photosynthesis of the plant and these are used mainly for better foliage for ornamental plants, which are in high demand in various metro cities and business houses. So, depending on purposes your shading application need to be decided. What kind of plants, what are the nature of their growth stages, these things need to be kept in mind before you decide what kind of material or what type of agro shading that you will be using.