Infrastructure Planning and Management
Sustainable Development and Socio-Economic Analysis Part-2

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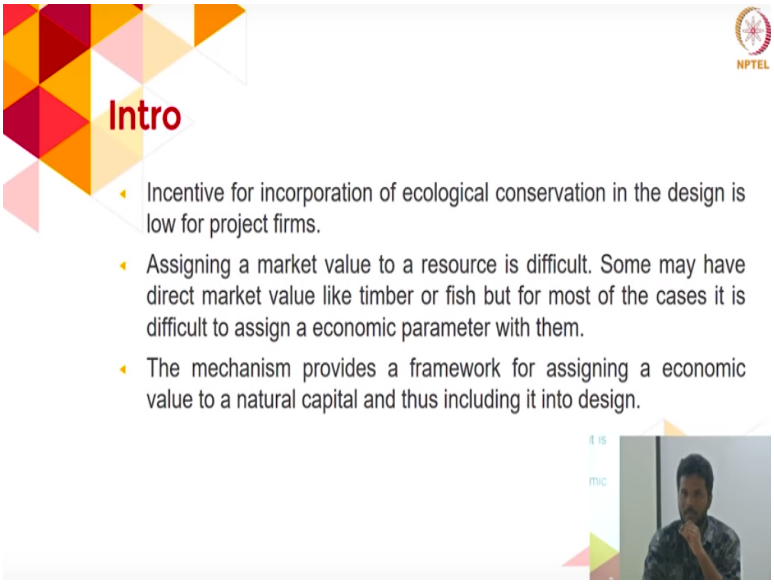

Now we are going to discuss about project level assessment of an mammal impact, so the author was trying to tackle mainly two problems her one is how associate a cost a particular resource and how to provide incentive to those companies which has incorporated this contributing measures, so like there are some natural resource for which we can directly say that a cost is this much say for example a timber or a fish which has some market value we can say that environment cause for this these are so this much but there are some other natural resource for which we cannot associate a particular value say for example our solid soil like soil acts as a filter and like water paper plates through it remove the suspended particle.

So it acts as a service there but we cannot really associated a particular course for that, so the other will try to see how to associate a course for this kind of service and how to incorporate this ecological conservative measures into the financial statement and there by providing incentives, so as a point out assigning a market value to all those all certificate like the soil example are a given.

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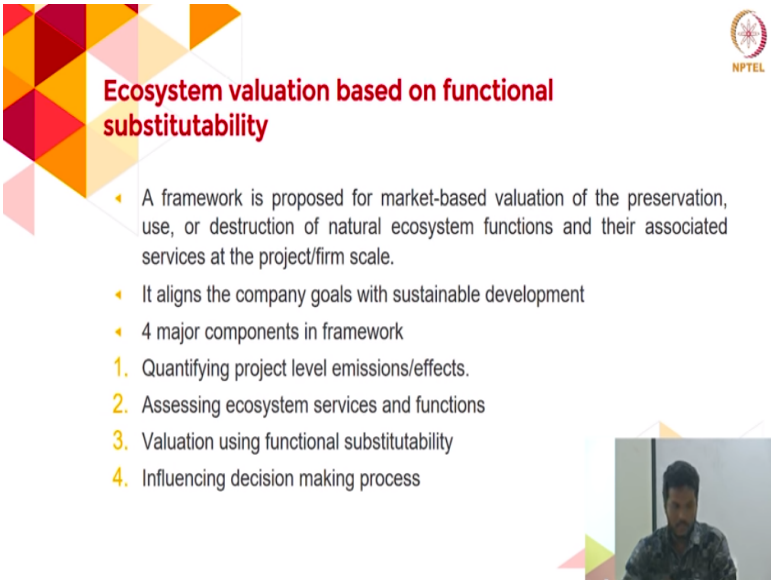

So the order comes up with a framework which consist of four components one is quantifying the project level emissions and effects next is assessing the ecosystem service and function third one is valuation using functional substitutability and influence decision making process.

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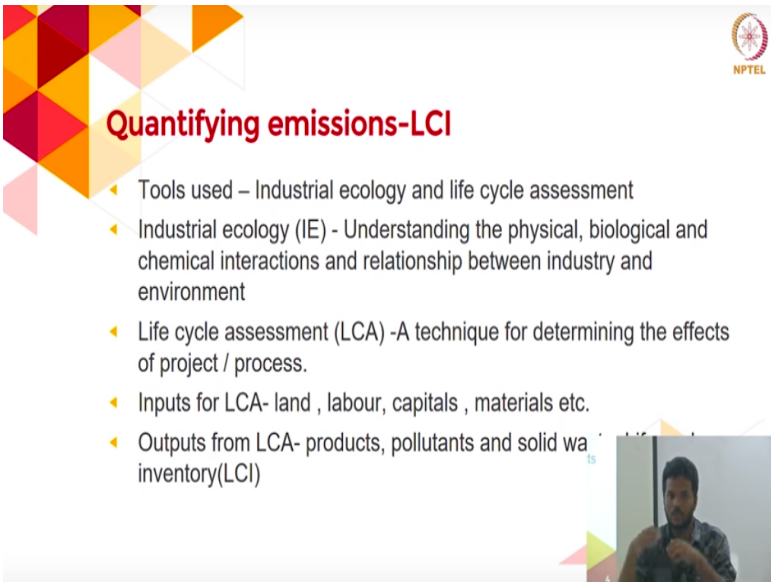

So before going into the course associated with the resources we need to find out what will be the impact of a project on environment the first step will be quantifying the emission this is LCS and for life cycle inventory, so the basic tools used in this quantifying emission will be they are industrial ecology and life cycle assessment industry ecology is nothing but the interactions or

relations the industry has with the environment and life cycle assessment is a technique for determining the effects, so once we determine the effects of a particular project we can associated particular course for that.

So input for a lifecycle assessment will be land labor capital etcetera and output which is the life cycle inventory will be the product pollutant and the solid waste.

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So next one will be assessing their custom service and function, so a ecosystem function is a natural process and ecosystem services the benefiting humans get through that say for example a decomposition of organic matter this is a process which happens with the other human are indifferent, so this is an example of acquisition and through the be composition we are actually fertilizing the soil that is a benefit so this comes in their ecosystem service, so when we are saying their environment we are assigning environmental course to the natural resources we are actually dealing with the ecosystem services and not the functions, so ecosystems services constitute the natural capital and at the basis by which humans have provided value from natural ecosystem.

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So the third will be the function substitutability and a final influence decision making, so once we said that the impact of a project will be design this so we have to find out the course associated with their particular destruction degradation so say for example there is project and it has a particular impact on this so we are losing that particular service from the nature, so what the author is suggesting that we need to come up with an engineering systems in a man-made system which would serve the same purpose as the natural component and a cause for that engineered system will be the environment cause for that resources and the influent decision influential decision making means we have to incorporate that particular coast into the balance sheet as sub-mentioned out, so that the company will be creating some incentive for that.

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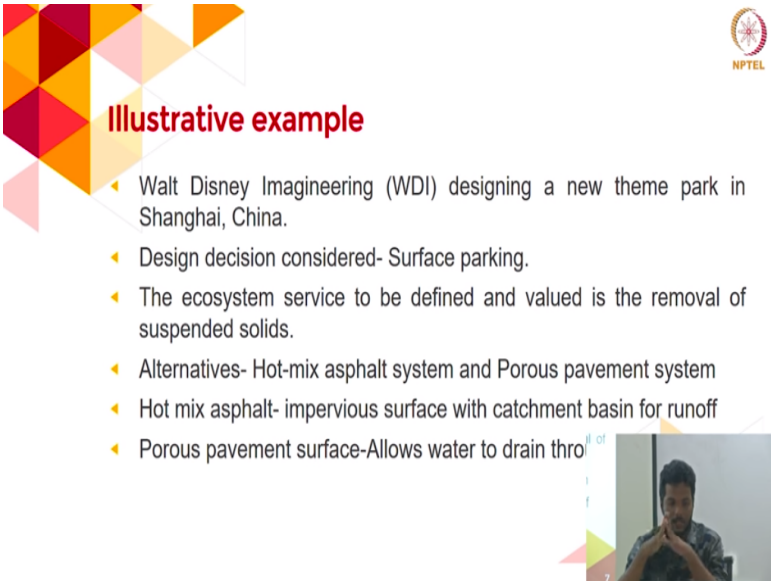

So other was giving an example of an hypothetical team park in China, so the design decision concept was the surface parking, so the first thing was quantifying the emissions, so they were having two alternative one was either go for an a hot mix asphalt pavement over foreign porous pavement surface, so the first thing we will be going to find the effect, so if you go for a hot mix asphalt as well it is impervious fit does not allow a water to percolate.

So that is an issue second one is porous pavement which allows water to go through that, so second one will be assessing the ecosystem services so basically if you do not allow water to go through it actually water goes to the soil it reaches the ground water table water acts as a natural filter and remove the suspended particles, so that ecosystems service is getting affected here that will be the second one a seeing the ecosystem service now the third one will be.

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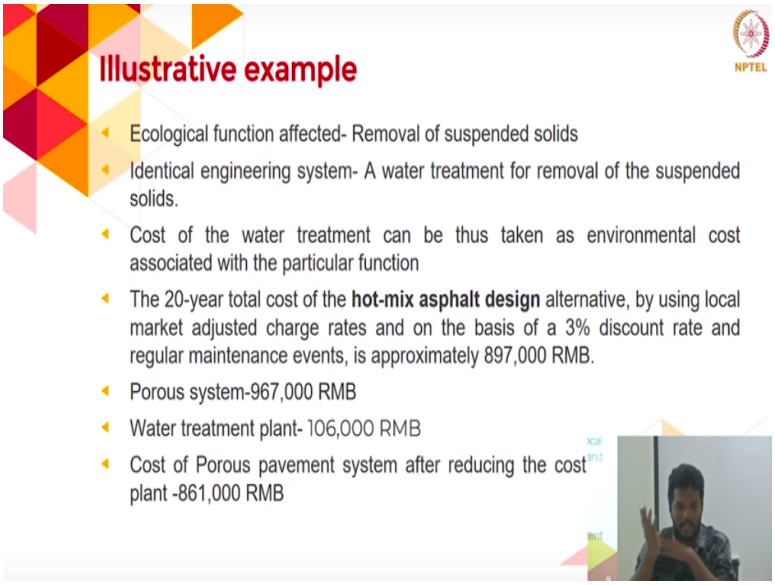

The third one will be a finding a substitute for that and access of fit for that, so the service is getting affected that is removing the suspended particles we need we come up with an engineering systems it is nothing but a water treatment plant, so the cause for water treatment plant maintenance installation cost all those some up makes the environment cause for their particular parameter, so like they called a quality function affected was the removes was from the particle identical ends engine system for the water in my plant.

So here they were mentioning that the cause for hot-mix asphalt design was around 8 Lakhs 19 thousand Chinese to a unit and for porous system around I thought it was around 9 lakhs sixty seven thousand, now considering the cost of water treatment at one lac six thousand we can subtract this course on the porous system and this can be included in the financial statement which can be an incentive for the companies, so this was a match camp inside by the order for providing incentive associated with natural resources.

So I hope you guys understood this method and how this sort of work, so it is essentially we start of by saying the action that you are doing what kind of services or ecosystem services is it impacting, so in this case if I am laying any concrete road or asphalt road in this case there are a number of things that are happening one you know very clearly many cases you might be affecting percolation of water into the ground water table impact you might also if you have too much impervious surface there is too much of run off from the rain and that might increase you

chances of flooding because all of that water particularly if you have a heavy rainfall event all of that water no place to go because you have got an impervious surface and it runs over in this particular case an additional issue is the suspended solids.

Now the dissolved solids in the water which continue to stay in the water instead of because the sand acts or the road or I am sorry soil acts as a natural filter, so when you take all of this water and it rains and it percolates into the aquifer below there is a lot of natural filtration that happens that makes the water in the aquifer relatively clean, so by building you know an asphalt road and the water is running off no one is doing that cleaning of my water that natural filtration is sort of not happening.

So the point is by building a hot mix asphalt road I am creating some negative effect and to illustrate they have taken one negative effect which is the suspension of the solid particle or the removal of the solid particle which is not happening which means wherever this is going to like let us say it is going to nearby lake that lake is now going to have water which has this suspended particle, so therefore there is an environmental harm that you are doing by building this, so like I said there are many environmental harm purposes of illustration they have taken one and essentially what they are asking is what is the cost of that harm.

Earlier there was something called the contingent valuation mechanism and a very simple way of looking at the contingent valuation mechanism is just almost to ask you the question saying how much would you pay me to not have this system in your backyard, and if I ask that to a number people or not ask you that question but to say if you know would you pay me five hundred crores not to have this system in your backyard and you might say wow that is too much would you pay me five crores not to have system in your backyard maybe that is still too much would you pay me 25 lakhs not to have this system in your backyard and you might start thinking about it would you pay me five lakhs not to have the system in your backyard you might say yeah sure right pay you five lakh acts not to have this system in your backyard.

And so there is a way in which I can constantly ask you to understand what your value pointed, so that is sort of a caricatured way of understanding what was called contingent valuation that is one way of valuing it is to just look at your perception of you are going to get muddy water in the lake as a result of the hot mix asphalt pavement, how much would you pay me to take that

problem away from but what these guys are talking about is saying look we do not need to be qualitative we can be quantitative we can sort of say if you built the hot mix asphalt road and you put all of that water into the lake then in order to have the same quality of water in your neighborhood you would have a build a treatment plant.

So treatment plant that would then treat the water, so that it is the same quality as the ground water after the natural filtration and percolation according to them costs one hundred and six thousand RMB Chinese currency, so in other word is the natural system is adding a value of one hundred and sixty thousand RMB that is the value that you are losing by putting in the asphalt pavement and you have to spend another one hundred and six thousand RMB in order to create that value back in your system in order to get that pure water back I have to spend another hundred and six thousand RMB.

So I can account for it in both ways, so I can say here if I can or maybe I could just do it on my slide because I am already marketing them up all right.

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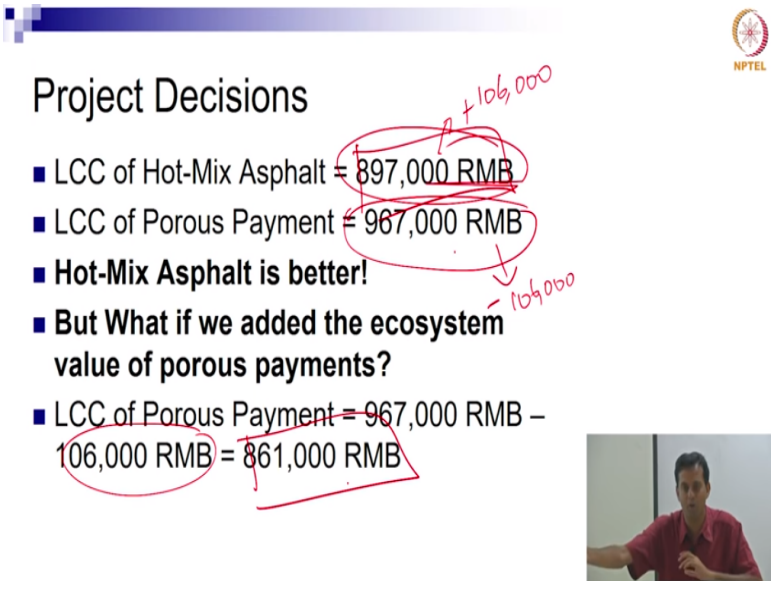

So here is the thing so if I just did a pure economic analysis the hot mix asphalt only cause eight hundred ninety six that is the net present value the net present cost, whereas the porous pavement essentially would cost me nine hundred sixty seven thousand to put all of those layers etcetera, so if I just looked it economically and I just want a parking structure I want a somewhat solid surface for people to put their cars on it is clear that I should go would with the asphalt it is

cheaper but now when I add this service the I also understand that this system also is delivering a service still it is also cleaning up the water that is filtrate that is filtering down it is taking away the suspended solids and the value of that system through the principle of substitutability is one hundred six thousand RMB.

I have created one hundred and sixty thousand RMB of value that is naturally created because otherwise I have to artificially created by putting in that storm scepter for 50 I or whatever that system is not that cost me around six thousand, so either I can say I want to add one hundred and six thousand to this cost because really you know I cannot just to put the road I have to put the road and the treatment plant or I can say this is now creating a value of one hundred six thousand rows and generally I like to look at it in term of ecosystems functions and values saying the cost of this project you may not put in the treatment plan you may just put the road and walk away.

So this is the cost of the project if you do it this way if you do it this way you are spending nine sixty seven thousand but you are also getting included in it the benefit of one hundred and six thousand because it is performing that function also and there for it is only eight sixty one thousand now I am comparing eight sixty one thousand versus eight ninety seven thousand, now eight sixty one thousand is a better deal than eight ninety seven thousand from a because these are cost, so the cost overall cost is eight sixty thousand now it I add on the ground water recharge and figure out a substitutability for that and I say things like we are dependent on ground water for water.

So either I mean I can just put a bore well and take out water at ten rupees a kilo liter versus buying water from you know a private water operator which is what I had to do because otherwise I have muddy water in the lake I cannot really drink it and that might be twenty five rupees a kilo liter then I am also adding an extra value of fifteen rupees a kilo liter through the porous pavement because I am actually able to draw fresh water from the ground and I can sort of quantify that and add that is another benefit.

So I can put in here and then if you look at once in 25 years we are going to have heavy flooding because of the asphalt pavement which just pushes water here and there and the loss to property from flooding because I mean if you are flooded your car is not operational because it is been underwater your furniture had been trashed because your entire ground floor is underwater, so

you can sort of say all of that is money lost and that is therefore money that I save by building in the porous pavement because I am reducing the incidence of that flood.

So I can start thinking about creative ways of trying to put numbers on to these environmental impact and it could be and it does not necessarily just have to be water and solids I can do the same thing with so for instance I take away somebody's agricultural land you got a point, so I am sort of going to build something which takes away someone's agricultural act how would I use this principle to arrive at a cost on that what's the way in which I could arrive at a cost on agricultural land perfect, so yeah so what I can do is I can sort of say look if this sort of green space was out there let us not call it a farm area palm forest whatever then this area would have sequestered this amount of carbon that is the service that it was providing.

Now that service is gone my CO2 levels are likely to be higher and therefore the logic would be that I could then buy some kind of air purification machinery or some carbon sequestration machinery to arrive at the same air quality that I would have had before and that might cost me I do not know 10 lakhs 15 lakhs whatever because now the second part the machinery I can find the cost from the market, so if I have a particular you know air purifier air IIT Madras incubated companies air purifier is what I want to buy I can go to the air guys and ask them what it cost and that is what I end up saving, so now I sort of say that by continuing to keep this is farm land.

I would have had an extra benefit of X which I am now losing, so put it on one of you balance sheet, so the question is on the practical applicability of this, so at the moment it is still not be applied, so what where this research is heading, so this is a paper by a gentlemen called Michael Apesh who teaches at Stanford and what he is trying to do in some sense is to influence accounting standards, so there is something called gap that some of you might be familiar with GAAP its stands for Generally Accepted Accounting Principles.

So that tells you how should your account for various things, so as a charted accountant when I prepared a company's balance sheet, I have to conform to certain generally accepted accounting principles, so is this an expense you know what category of expense does this come under can this be depreciated there are certain rules, so the idea is can put these thinking also into that generally accepted accounting principle, so that when I do project accounting which is essentially what I am doing it is clear that this has to be done that all of these effects in this

manner have to be factored it the you will actually find some debate on what goes in and what goes on at the moment this is still in the research level where people are saying look these are ways in which we do this.

So the objection to this for instance is that we have done this for just one issue, which is the suspended solid question the dissolved solid suspended solid question but there so many other and this was easy because I could find an analogous water treatment plant but if I really sit and think of all the environmental effect's you know flooding ground water recharge you know whatever else first of all it might be difficult to make an exhaustive list all of them may not be as easy to evaluate this example, so the practical you know you have to build a huge database a he matrix in some sense of potential things to consider when you are laying roads when you are building a power plant etcetera runaway in which you consider that.

So it does not practically applied straight away but the principle but this is the thinking that I think we need to head towards think this is what we need to start doing to project going forward we have got to sort of not only look at the NPV, we also have to look at the ecosystem services that we are adding or destroying put them in and then decide, how good this project is and in that way the theory is automatically minimize all of these issues from stakeholder etcetera because we have actually taken their systems into consideration and put them on the balance sheet and therefore it is no longer discretionary then banks can say I will not fund because I am following equator principles I will fund project where this accounting system is used and I come up with an IRR of 10 percent.

So I want you to use this accounting system come up with an IRR of 10 percent then I will fund that makes it much less objectionable as opposed to saying yeah you said you have a charter equator principle but we are not sure you know how robust they are who is going to monitor etcetera so the question essentially is fine it goes back to the same thing you know dissolved solid that is an easy question you know I lose you know a temple which is sort of you or the spirit in the water fall in the BUJAGALI dam project how do I sort of put of a value on that what is the substitute ability that I could.

So two responses to that one is clearly there are limitation there are certain things that you might just not be able to put on a balance sheet but on that point view is still that fine you know just

because you cannot put in certain things do not throw the entire methodology out of the window, so there are certain things that you can put in let us put those in and at least have you know a double bottom line accounting system is not a completely triple bottom line accounting system but let us certainly understand that they may be limitation second is and this is where sort of research you know continually brings out surprises is sometimes the limitations are a bit further than we think.

So social perception to some extent can be value and in the whole literature risk analysis and risk management people have come up with interesting ways of quantifying some social perception towards certain risk not necessarily heritage structure and something sort of deep seated out other preferences as well so I think the limits to what we can put on this balance sheet what we can quantify might be a little bit further then what we are think but I agree that I am not quite convince that every human emotion ecosystem function can condensed into this I mean the argument has always been even if you destroy an acre of wetland it does not matter if you build ten acres of new wetland elsewhere nature has evolved an interconnected series of function over.

So many millions of years that you will never be able to physically recreate it and therefore there is no way of saying oh this is what it would cost me because it is impossible to do, so therefore there are limitations clearly to this but again goes down to sort of saying it is not just doing stakeholder analysis transparent discussion and convincing NGO's you have got to convince government and project sponsors and finance here to pick project that have low environmental impact social impact but high economic returns and at least have them go through a process of putting in certain safeguards, so we need sort of banks and other to sort of subscribe to some prescription.

So that you actually have some control it can be completely qualitative like the equator principles just sign on to do no harm or may be make it a little bit more detailed come up with the process or it can go all the way towards actually coming up with method of quantifying impact and there is a large literature on socio economic cost benefit analysis sometimes ago I do not know if it is still online Asian development bank even had a handbook that was online on how you would actually measure these kind of impact that would be not even things like if I take away some acres of farmland then I am taking away the productive capacity of that farmland

from now till infinity and if I were growing apples there I can figure out how many apple I would grow per year what I would make per year and therefore.

The amount of revenue I would be losing in perpetuity I had be giving away that farmland for a road being build I can take that as a cost and put it on my balance sheet, so I think we really need to start thinking of the environmental impacts costing them putting them on balance sheet and then making decision based on the economic and environmental value but both quantified not one quantitative one qualitative then I think you will lend you will have banks and sponsors and governments and large developers making more environmentally conscious decision on projects and hopefully you will minimize protest except our going forward the question on CSR is.

So CSR is an investment corporate social responsibility is an investment made by company, now what we are trying to sort of say that is your cost what is the benefit what is the impact what is the ecosystem service that you are taking away or delivering because of this, so yeah like I said I create an ANGANWADI I created a school I can tell you how much it cost me because that is bill of material what is the impact that I have you know creative as a result of that is and therefore if I can say this is the kind of impact I have created then I can use the principle of substitutability somewhere I can tell people that by you know destroying certain livelihoods.

So this project is likely to destroy certain livelihoods in order to bring those livelihoods back you would need to build this kind of an ANGANWADI, and that would cost so much and therefore the cost to you of destroying livelihoods through bringing building a road through this community can be equated to be this cost of that ANGANWADI which came through a corporate social responsibility function but I think CSR per se is just what you know that is amount of money I spend I think what we are talking about is what is the ecosystem function or the ecosystem service that you are delivering and therefore can I value it if i agree that this is the value then what you spent a CSP will be the cost of that and then I will sort of put it right.

So this is very cutting edge so these are right topic for tem papers this ripe topic for potentially dual degree project and you know M tech project or what not etcetera to try to see how do we push the envelope further how do we use this practically can we do something like this in India or an IIT or whatever yeah couple of question and the we will stop good question so I am assuming one hundred and six thousand rupees or RMB of water treatment what if that number

changes going forward and therefore would I have miscalculated maybe in two year so only fifty thousand so maybe I should have been reduced only fifty thousand.

So that is tells you that the some of the issue of valuing this based on you know this kind of methods I would assume the value of sort of the of removing dissolved solid should not really change but clearly it changes based on time based on the method you see etcetera, so I think those are limitation, so we will have to sort of figure out maybe this is not a onetime thing maybe for instance in this case the authors would argue that plant would also have a recurring operation maintenance cost that might come down because of technological advances so do not take it as one single cash flow take it as a stream of cash flows and you know have some change over time.

So therefore in five year when I did the life cycle calculation for the storm scepter thing and you get many of you been in my class when we have done economic analysis we talked about replacement every six years every nine years ten years, when we assume when we replace with the same asset you assume that you replace with an asset that is going to be much cheaper and you do the economic calculation, so still it is doable but you are right it is a little bit more complex, so I would so this is just an example of one calculation.

So porous pavements have a bunch of ecosystem services that delivering possibly some ecosystem services that they are not delivering what makes us fall again this is one ecosystem service that hot mix asphalt so not delivering but they may be delivering other you know service for instance if you are actually saying I would not want to take ground water I want to actually channel water into the lake and take that whatever that is the service that this you know hot mix asphalt is actually delivering may be it is cheaper for me to pump water and purify and pump it out of the lake then each of us installing our own RO systems,.

So you are right this is just an illustration but that also your question also tell us how is complex this whole this is even for a simple thing as a parking lot if I am getting into so much debate when I build a dam or a road or an airport look at the number of things that I will have to sort of consider the number of options the number of benefits the number of dis benefits, so it is massive but may be steps we need to sort of at least come to say these are certain major impacts that we need to take into account let us put these on the balance sheet, so we need to start I thinking that direction.

So this is very-very new nobody is doing it today practically but I think 10 20 30 years out of climate change is going to be as predicted and I believe climate change is going to have significant impacts unless we really start thinking environmentally and socially about project in a very rigorous way I think we are in deep trouble and the only way to really think about it rigorously I feel is to bring it into the balance otherwise it is just know you versus me qualitative depend on the committee who is on the committee how favorable are they this too many unknowns as it is there is a lot of criticism that many environmental clearance are being given because the committee is not doing enough these committee are not doing enough scrutiny the committee's will say no no no they have met some basic parameters and it is just a qualitative argument.

So we need to move in these direction obviously it is difficult today to envisage, how we would change but that is the role of research and you know innovation and all of that this is to me I am very convinced this is the way forward to build infrastructure better we better understand this better and we better start figuring out ways to apply it on project, so another way of doing it is to say the water treatment plant costs one hundred and six thousand but it provides other services as well beyond just the TDS removal.

Now that is the benefit that the water treatment plant is giving which you now add on to the so which you now subtract from the hot mix asphalt side of the question, so this is where you have got to be very clear, so we have taken one narrow example to illustrate the method is what might can beach regular and other have done in this day but you are right I mean so I hope you guys are able to appreciate that just even such a simple thing you guys are coming along with there could be other technologies there could be other benefits this benefits etcetera.

So it is not easy just to sit down and list if you brainstorm more and more idea will come up just with the simple porous versus hot mix asphalt example and which is why I am saying when I scale this up to an airport I know that starts probably getting out of hand and that is why we need standards and we need to be able to say these are the main ecosystem services and function that you should include in the balance sheet there may be other ecosystem services and function as well but we have decided because they are not that critical that we will not include them.

So we look at water quality we look at marine life we look at certain category for those categories these are the methodologies that you adopt to evaluate them these are the substitutable elements, so we need to come up with guidelines and then insist that accounting standards take the moments, so that every project irrespective whether you are doing it or I am doing it or this is the committee we follow these patterns when we come up finally with a IRR NPV whatever and that is the basis on which decisions are being made then we are likely to more uniformly develop sustainable project because all of these effects have already been taken.

So that is the story of all innovation, so when I come in and so in my world in construction we have something called building information models they are out there the technology is there but no one is implementing them because there is not enough capacity out there people do not know what to do how to do it etcetera so there is a process of capacity building then a couple of arguments toward it one is to say while you are doing this do not just sort of drop a bombshell and say starting you know October 11th 2018 all project must do this.

So do not drop that bombshell over a period of time you know let us start indoctrinating people into this methodology, so let us have all whatever you know training sessions there is that certification programs all of this, so you sort of say we will have this in place in 2021 between now and we will out all kinds of materials public available we will create training programs and you guys get certified the other is to say if this is what you mandate the market will figure out if this you know if I put this in clearly there are market for people who understand how to do this and therefore just market forces will ensure that people will train themselves on the startup companies will them all exit right etcetera.

So that is a problem and you can solve and it has to be a little bit of a mix of both we have to set out certain guidelines certain certification systems I mean how do I know that this company should do this environmental evaluation versus that company today I can go to chartered accountant or to a medical doctor because they have been certified by some larger authority or even in engineer to get a stamp on your drawing you just cannot to anybody, so there is some kind of a certification process similarly I need certification process for this is there.

So it will take time for all of that to happen but just like you have chartered accountants today who are dealing with a certain set of things you will either have chartered accountants of

tomorrow I do not know project chartered accountants or maybe a completely different designation that will be certified to do this and that becomes a business opportunity chartered accountant generally make more money than engineers so think about it read about it.