Plastic Waste Management
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Lecture – 10
Global and Indian Data

So, welcome back, we are looking at the last video last module for the second week which would be lecture 10. And in this lecture we will be looking at Global and Indian Data of Plastic Waste pollution. We have seen some of this data already in the previous module we will so, there will be some similar information and then we will there will be certain newer information up there as well. And with this video will cover our second week of the material which is if you remember the, with the concept that was focused on this particular week was looking at the Plastic Waste Sources.

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Whether it is coming what are the different sources of plastic waste? What is the production data? Production data or generation data I would say how much plastic waste is actually generated. And looking at the global picture as well as the Indian picture. So, we saw some global picture already, so we will see some more, and then we will talk about some of the Indian a statistics, the Indian data of plastic waste production.

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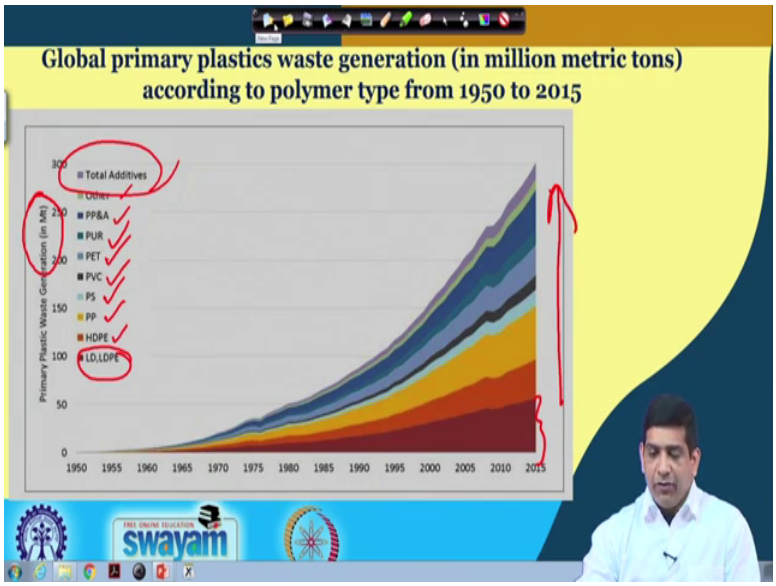

So, continuing with our global data in terms of the plastic waste. This particular graph here, we are looking at the global primary waste generation in million metric tons according to polymer type. So, different sources, different types of information, but one thing you will see from all these different slides are that the trend is very similar. We see lots of plastic waste coming from the packaging industry and there are some other industries which contributes to that as well. Here the example is more on this particular graph is focused more on the type of plastic in terms of the polymer type.

Remember that number 1 to number 7 which shows up in the recycling as a recycling number in different products that we use for plastic. So, as if you look at different types of plastic, again the number 1 sources or kind of see we see that LD and LDPE, LDPE then HDPE then polypropylene and these are again these are as per metric ton. So, metric ton is weight and for plastic is one type of material and which is when you look at from a weight perspective or when you look at from a volume perspective. Since some plastics are very low density so they have lots of volume.

But when you weigh them they are not that they are not that much. But since their volume is more, it kind of you see them and you feel like oh there are so, much of film plastic out there. Yes, there are lots of film plastics out there. But if you compare that to LDPE HDPE or polypropylene, they are actually much less. And PET then as you can as

you go up, you can see the different types of plastic. We have polystyrene polyvinyl chloride which is the PVC pipe PET which is the water bottle.

Then PUR polypropylene and others are total additives and all that. So, as you can see most of it is LDPE, HDPE and polystyrene. Polystyrene is the Styrofoam as well which is used a lot in packaging industry. So, now a lot of plastic waste generated again this data is from 1950 to 2015. So, that is a lot of data for 65 years of primary plastic waste generation in metric ton for different types. And as then as for the, if you look at some of this newer data or if you can break it down to different years, you will find that actually.

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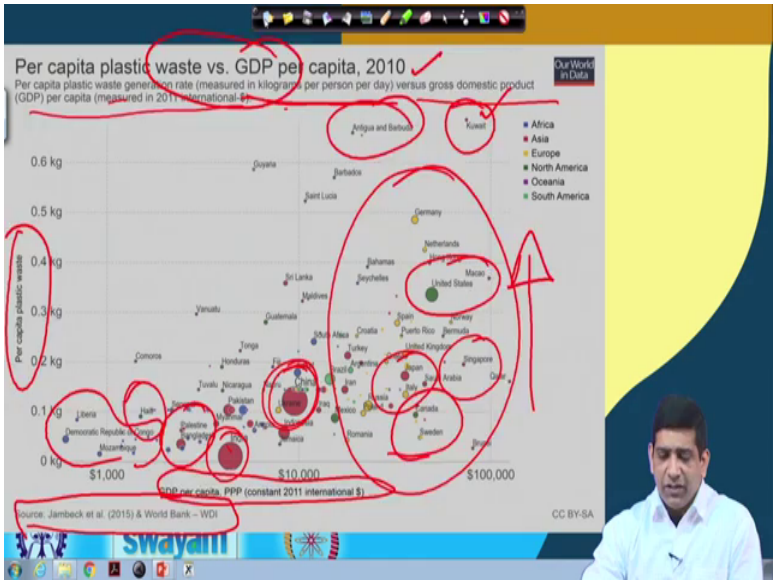

The plastic type of plastic is much less in a for the different type of where you will find that, your graph will change a little bit. When you look at the different types of different types of different time durations sorry. Now, this particular picture well again from the global perspective which includes the Indian data as well.

Here the per capita waste, versus GDP per capita. Again those of you who have taken solid waste you remember that as the GDP of the country increases, the waste production increases. And we saw that in the previous discussion as well when we are look at the China, Africa those countries are as opposed to European country. European and American countries the per capita waste plastic waste generation was much higher. Because the wealthier the country more the packaging material, more the waste generation, more throwaway society as well.

But some of those country also has better waste management system. So, if you look at the per capita waste as a compared to GDP versus GDP in this is 2010 values, per capita plastic waste generation rate measured in kilograms per person per day versus the GDP per capita major in 2011 [20] 2011 international dollar. So, as you can see per capita plastic waste is in our y axis GDP per capita GDP is also given per capita like purchase parity basis PPP.

So, this work was again published in Jambeck et al and the World Bank data. You will see here that and the different colors have been shown Africa has been shown in blue, Asia in maroon, Europe in yellow, North America in darker green, Oceania which is Australia, New Zealand in purple and South America in light green. So, you can see that as per higher GDP and higher plastic waste produce, Kuwait is right there up there.

So, Kuwait that is the Kuwait you may not be able to see it in that screen right here I am sorry for that. But you will be able to see it in your power point when you when you give you the handout, you should be able to see those are pretty clear because they are ok. But since its being projected on the screen you may not be able to see that very clear over there, but that is Kuwait which is a very high then Antigua Barbuda. And if you look at the other side which is a very low waste produced and low GDP as well, per capita Mozambique Dominican republic of Congo Liberia Haiti..

Haiti is right there, Bangladesh although produces quite a bit, but the GDP is much less lot of mismanagement of waste. And United States produces a lot of right there United States, Macau, Hong Kong, Netherlands, Germany. So, these are rich countries rich countries are right here actually. Most of the rich countries are showing up over here. And as you can see many of these rich countries what this is it's a beautiful graph actually. If you as you can as you go up, you see that many of these countries are rich ah, but they also there are some countries which have programs in place which helps in reduce is producing less plastic waste.

So, for example, here in Sweden or Canada or Singapore, Japan or they produce much less plastic as opposed to as compared to say United States, Germany, Bahamas, Chiles, Hong Kong, Netherlands and other countries Kuwait is of course, on the top. In middle in terms of per capita plastic waste generation and the value in the circle that you see

over there is circle kind of gives you an indication of total plastic produced. So, that is why you see a huge number for India in China because our populations are huge.

And India is kind of in the middle in terms of our GDP and the per capita plastic waste production is very low. But since you multiply it by 1.3 billion people you see a bigger bubble. Similarly, China per capita waste production is higher than India it's a more than 0.1 kg per person per day. But again you have to multiply it by 1.4 billion people which is a Chinese population and Chinese GDP is also much higher than Indian GDP. So, that is why you see over here where China it kind of sits right there rights over there.

Then we have South Africa and Maldives, Sri Lanka. So, pretty interesting graph in terms of per capita plastic waste print out production versus GDP. Higher the GDP of the country if you look at a there is a tendency of kind of going things up, more the GDP more the waste that is being produced.

But there are countries in place which are producing much less as well and there are some countries over there.So, if you do a best fit line kind of will be something like that which will kind of correlate that higher the GDP higher the waste. Which is a well known well established data we will establish correlation we see for other waste stream as well including for municipal solid waste that we have seen in previous like a discussions in different courses too.

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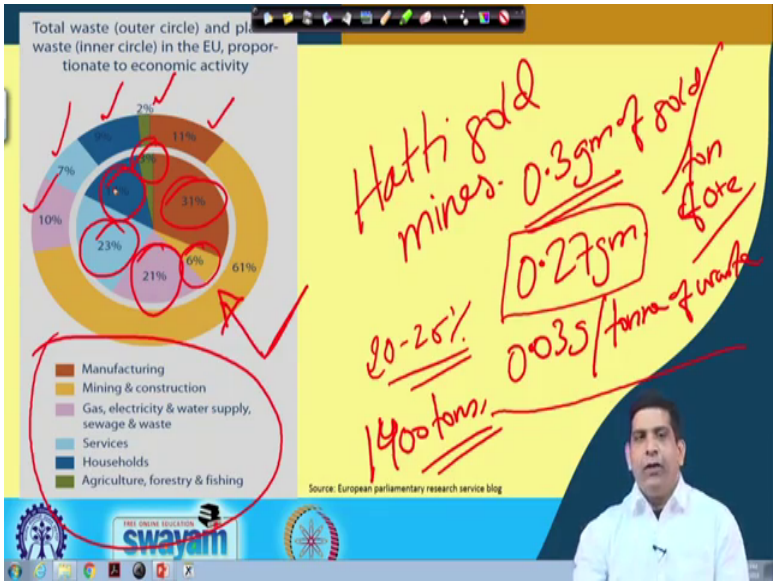

So, if you look at the total waste and in terms of the total waste which is the outer circle then the plastic waste which is the inner circle in the European Union. So, if you adjust this particular one we are focusing on European Union, and then try to look at their economic activity. And the economic activity in terms of the manufacturing, mining and construction, gas, electricity, water supply, services, household, agricultural, forestry and fishing. So, on top is the total waste for the European Union.

So, in terms of the total waste mining and construction was actually pretty high 61 percent because mining thus produce a lot of waste. [Vocalized-noise] Especially if you and you try to do a lot of metallic mines and recently we visited Hatti gold mined; which is Hatti gold mined which is in the corner of Telangana Andhra Pradesh and Karnataka they were in Raichur district. And they are presently they are the o that they are using has 0.3 gram of gold for turnoff ore think about that.

So, from one tons of the gold ore that they are using they are only producing they can theoretically they can produce 0.3 grams, they are able to extract 0.27 grams and rest 0.03 gram per tons of waste is gives of the mine tailings is just getting dumped in there as a wastage. So, mining thus produced a lot of waste it said they produce a lot of waste out there. So, out of 1 tons only 0.27 grams is what is going extracted and rest is just getting into. And there are some other there are some gets recycled within the mining industry, but there was around they told us around 20 to 25 percent.

So, nearly 1400 tones of a of mine tailings are being produced like a on a regular basis. And that is getting into dumped into the into those mine tailing big like a disposal area. So, mining produces a lot of waste so that is certainly a 61 percent of the total waste of the outer circle. Then manufacturing had a 11 percent, agricultural forestry had 2 percent, household was 9 percent, services 7 percent, gas, electricity, water supply, sewage was 10 percent. So, that was in terms of total waste.

Now when you look at the plastic waste kind of you see that big yellow becomes a very small yellow right there at 6 percent. So, mining and construction in terms of plastic is only 6 percent, the biggest one in is the manufacturing sector which has 31 percent of plastic waste coming out. Household again 14 percent which is not too small then 23 percent is the service sector, then we have a 21 percent from the gas, electricity, water

sewage and waste so that is your 21 percent. And then agricultural is again a small at 3 percent.

So, lot of processes kind of gives you an idea of what is the total waste produced from what is the different were different stream and in compared to that how much is plastic waste what are the sources of plastic waste in European Union. These most of these graphs are actually pretty interesting graphs. You can spend a lot of time just thinking about and writing things about these particular graphs. And this again came from European parliamentary research service block.

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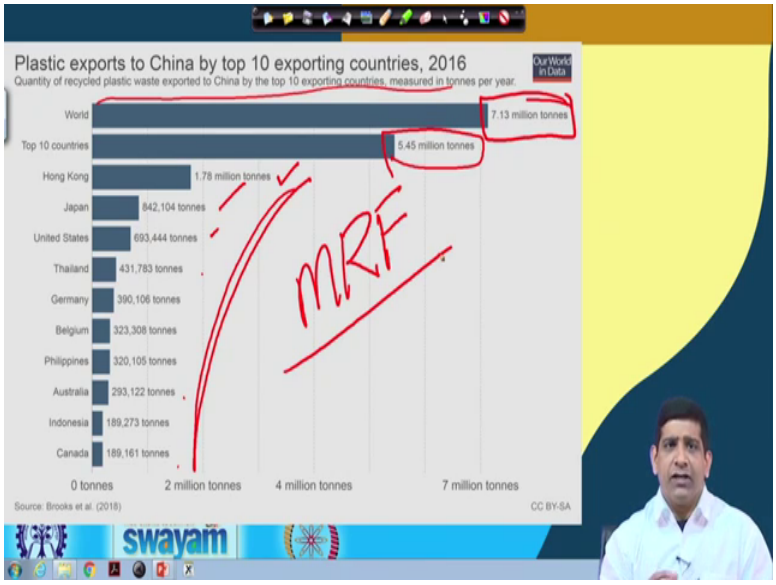

So, you can find if you find some interesting stuff, please do share with us we will be happy to look at. And here we will be talking about some of those things that is going into the in China, which will get into that discussion in a minute. So, let us look at how things because the Chinese band was one of the biggest thing that is happened in recent times.

In just less than a year apple of 2018 when China has decided that it's not going to take any more dirty plastic waste from other countries. In fact, we have in one particular week we will be talking about that in great detail what is known as the China assured policy. We will talk about that and how that is impacting global plastic waste management practices and global waste management global plastic waste industry. So, we will talk about that, that is a very important thing that has happened in just past within a year.

So, before that this particular graph is showing as the data from 2016. That plastic that was exported to China by top ten exporting countries in 2016, and as you can see if you look at the top 10 countries around total plastic coming to China was 7.13 million tonnes. So, this much of plastic waste was coming to China quantity of recycled plastic recycled plastic waste exported to China, measured in tons per year. Top ten countries was around 5.45. So, if you look at the percentage wise company early more than 80 percent now around 80 percent 75 to 80 percent.

And one of the major one was Hong Kong which was one and then Japan, United States, Thailand, Germany, Belgium, Philippines, Australia, Indonesian and Canada. So, that is where things were coming to China from these countries. Now, what was what is happening in the global world today? Is once they these plastic waste gets into what is known as the Material Recycling Facility MRF; which again those of you have taken solid waste you can possibly understand it much better. But others can I will try to just explain it briefly too.

But you know recycling facility is the place where the waste is taken and different potentially recyclable materials are separated. So, plastic is also separated and then it's a plastic material it's not a plastic waster anymore. Although we are calling it plastic that is why we called plastic export of plastic waste exported. But waste which was exported for the purpose of recycling. So it was essentially a plastic material and since it's a global economy it's an open economy people can bid for that parts plastic waste for plastic recyclable plastic wastes.

And whichever country whichever company bids the most gets the gets the that particular material. So, since China does a lot of manufacturing and China needed those plastic material so, they were bidding for those plastic from these developed countries and they were getting into China. So, that was that is why you see so much of waste plastic waste going into China. Because there was a demand for those plastic in China for their manufacturing industry because, China is number 1 manufacture in the world today. And they are pretty much you go to any big mall you find lots of products are made in China.

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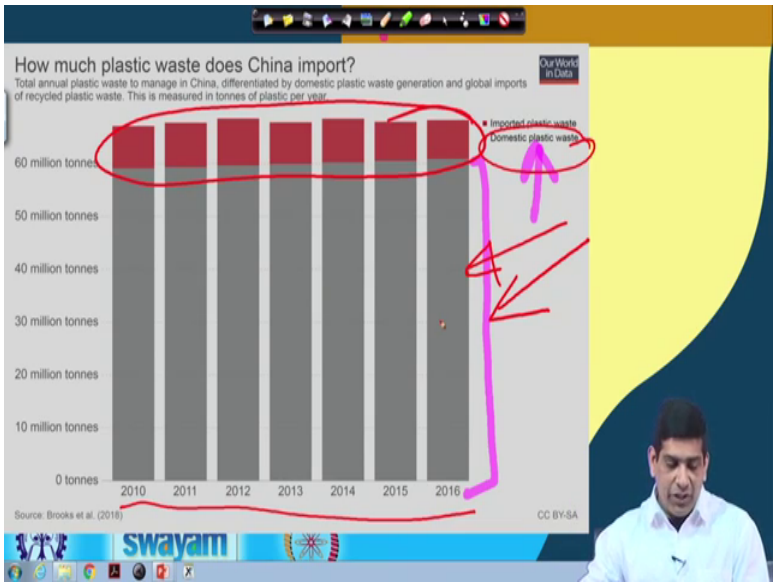

So, that is the reason why and they used to do that. So, if you look at the how much plastic waste that China import as compared to the domestic plastic weight that they produce. So, although China imports plastic wastes are used to import plastic wastes not anymore after up April 2018 they still can import plastic, but there has to be really clean plastic. So, the China assured policy when we talk about we will try to tell you in more detail.

That it's not the China has totally banned plastic waste import or plastic recyclable plastic import. Just they wanted to be a cleaner material they do not want dirty material coming from around the world they want cleaner material from around the world and they are ready to take it. But other countries are saying that, if I am going to clean it in my country why should I give it to you I should probably try to use it within my own country. That is what the discussion going on in Australia this last summer from May to September of 2018 I was in Australia as part of their government of Australia Endeavour fellowship.

And there was a lot of discussion going on this plastic in terms of if we have to clean it up in Australia before giving it to China, why do not we try to find a market for this recyclable plastic within Australia itself. And that is because what happened in from if you remember from early; if you follow the global world economy and all that from 1918's onwards most of the manufacturing has shifted from other countries to China. So,

China was the place which is doing most of the manufacturing for the world. So, that is where the demand for recyclable plastic was, but since then now as you can see over here in this particular graph China by itself is producing lots of the domestic plastic.

So, this is the domestic plastic waste that China is producing. So, since China is producing lots of domestic waste by themselves they think that; why should we take this dirty plastic now. So, what has happened over the last 2-3 decades Chinese economy group and Chinese purchase power has gone up people of China is comparatively more wealthier as they were three decades ago. They have been using lots of packaging material; they themselves are producing lots of plastic waste.

So, the thing is that why should I take the waste from other countries when I am itself is producing lots of plastic waste which I can deal which I need to deal with it anyway. And so that that is the whole the policy was that ok. Now, I do not want plastic waste from abroad I if they want to send me the plastic as a as a material it needs to be cleaner stuff because I have lot of dirty plastic to deal with me at my home itself. And whatever is the demand for plastic in term in my manufacturing industry I can produce that I can satisfy that demand from in house recycling within country recycling as the same time by producing more plastic rather than taking this dirty plastic waste from around the world.

So, it was kind of a very smart move for China. First they took the dirty plastic waste for 2-3 years developed this plastic recycling industry using the money half the global of these developed countries because; whenever they used to send plot they use the those plastic and take those resources they developed their market. Now, since their economy themselves have a lot of plastic to deal with they do not want dirty plastic from elsewhere this is kind of kind of make sense.

And as you can see in this particular picture although for last from 2010 to 2016 like there is a very consistent figure of plastic domestic plastic waste produced in China itself which they need to deal with; which is the pretty much a like if you look at the percentage wise probably nearly 80 to 90 percent of the total plastic that they handle. So, so, this is this is ten of plastic per year. So, they are lots of plastic to handle by in the China itself.

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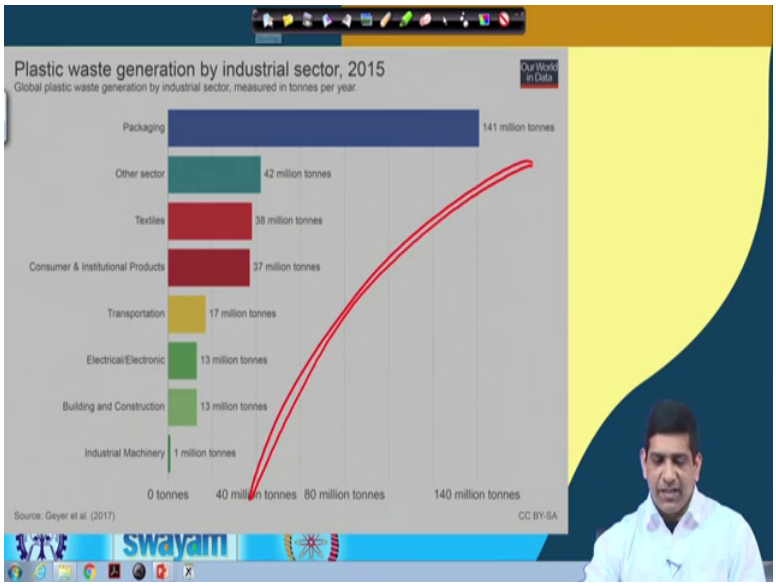

Ah Now, if you look at the industrial sector where the plastic is coming from again global plastic waste generation measured in tons per year again 2015 data packaging is the number one. Then other sectors, textile, consumer transportation, electrical kind of same thing that we have seen earlier. So, just the different report different kind of data points, but again similar information that packaging packaging packaging.

So, if you have to really target one sector to reduce plastic pollution, to reduce the plastic waste. I should not call it plastic pollution plastic pollution is when we have plastic waste is not managed properly and creating pollution. If you want to cut down on plastic waste its one of the packaging industries what needs to be targeted in terms of a reducing the plastic waste coming into the disposal stream.

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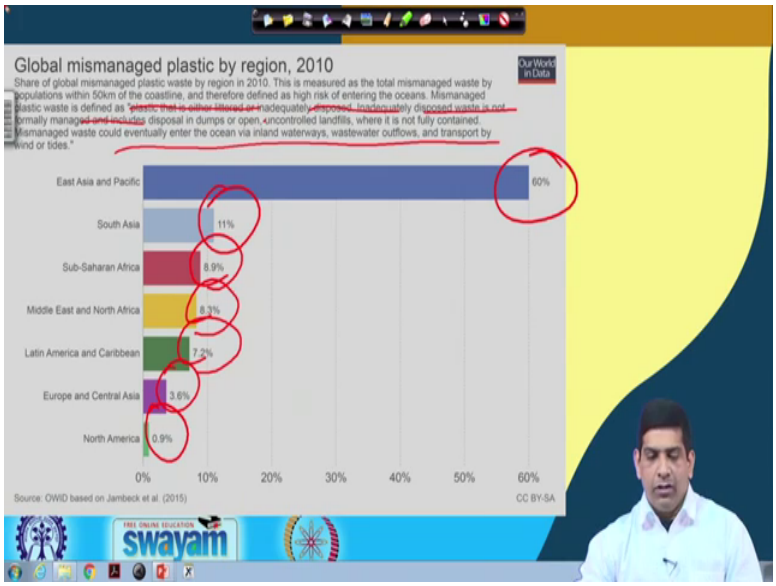

And a global mismanages plastic by region in 2010 most where we saw lot of plastic being mismanaged. This is the share of global mismanaged plastic waste by region in 2010. This is measured at the total mismanaged total mismanaged plastic by population within 50 kilometer of coastline. Therefore, define as high risk of entering the ocean. Mismanaged plastic waste is defined as plastic that is either littered or in adequately disposed. In adequately disposed waste is not formally managed and include disposal in dumps or open uncontrolled land for over it is not fully contained mismanaged waste could eventually enter the ocean via waterways wastewater outflows are transported by wind or tides.

So, East Asia and pacific was nearly 60 percent, South Asia 11 percent, Sub Saharan and Africa, North Africa Latin American Caribbean Europe and central Asia and North America was close to 1 percent. So, again this is the global mismanage plastic which they are looking at in 2010 of how the places where the waste management infrastructure was not that much in evolved those places you see more chances of plastic getting into the ocean.

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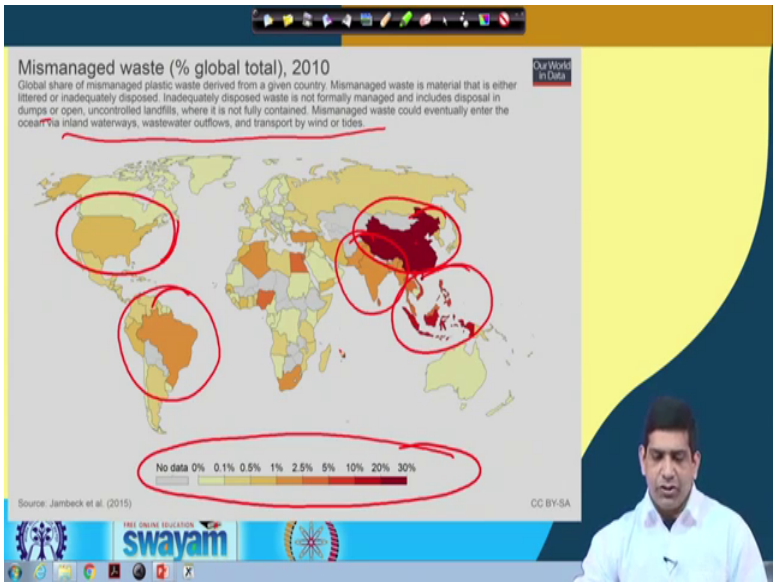

Now, mismanage waste if you look at the mismanaged waste as a percentage of global total in 2010. And similarly we will look at the other ones as well just let me fix this a little bit because that is kind of getting covered in my other stuff. So, this should be good say if I can. So, we were looking at mismanaged waste as a percentage of global total this is 2010, this is the this is the data that was collected some of them are primary some of them are secondary data.

This is the global slayer of mismanaged plastic waste derived from a given country. So, this is coming from a particular country mismanaged waste again is material that is either littered or an inadequately disposed mismanaged ways could eventually enter the via water waterways outflow and all that. So, here they have in terms of the percentage. What is the percentage of waste getting mismanaged? So, as darker the color you see more the waste goes to 30 percent, very light yellowish to dark yellowish to finally, to purple as well to finally, to magenta color where is dark magenta is 30 percent.

So, China some of the countries in this Islands over there is close to 30 percent. And India would be sometime around 25 like around 5 percent India, Pakistan, Bangladesh (Refer Time: 24:50) and those countries are in the range of 5 percent. And if you look at in North America is kind of 0.5 to 1 percent. And near South American some of the countries are between 2.5 to 5 percent. So, it kind of gives you a picture of how much

this is gives a picture of the percentage waste, but like in terms of the global totals a global share of mismanage plastic waste coming from a particular country.

So, nearly 30 percent of the waste is coming from these countries which you see the dark magenta color. And around 5 percent is coming from the Indian scenarios where we are getting around 5 percent of the mismanage plastic coming from the Indian scenario. So, that gives us a picture of mismanaged waste coming from different countries.

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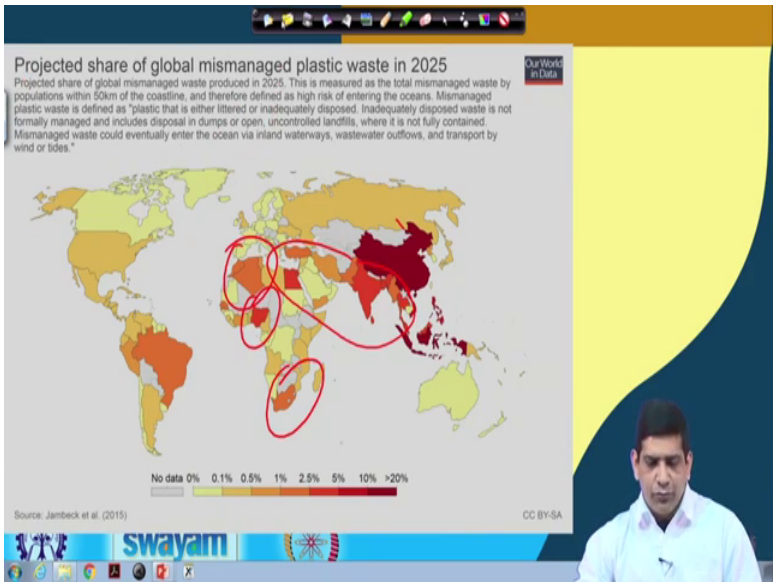

So, if and that was for 2010 and assuming that there is not much improvement of the global management practices. If we try to project it to 2025, you can see that many of those countries now are showing up in the darker colors. Like; India and other countries which was not in darker colors these countries are also showing up in darker colors. That means more and more plastic waste will be coming out of these countries, but this assumes that there is no adequate facility has not has developed.

But if the countries developed there adequate waste management infrastructure this data this graph will not come true and we hope that it does not come true. So, because this is assuming that there is no change in waste management infrastructure. How that mismanaged plastic will increase from some of these countries sorry.

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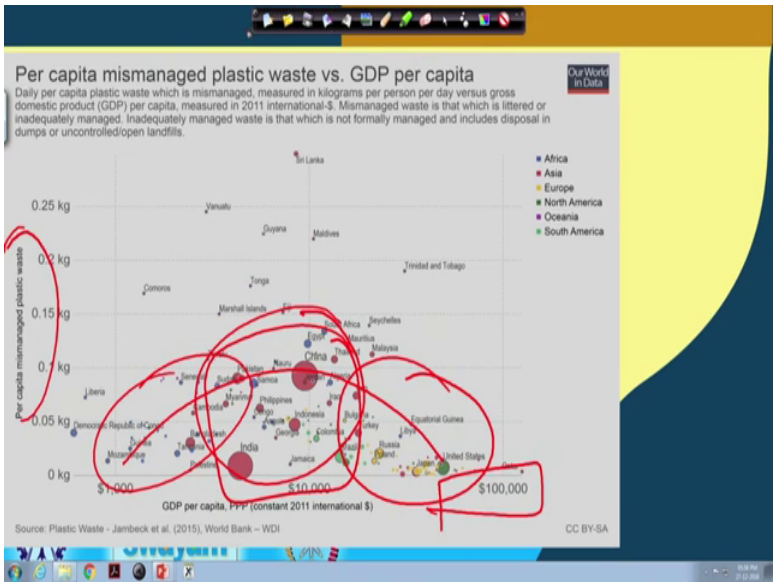

So, mismanaged plastic versus coastal population as you can see that say people which is here talk talked about mismanaged plastic this graph shows total mismanaged plastic waste versus total coastal population. Coastal population is the population within 50 kilometers of a coastline India has a huge coastline. So, that is why we kind of we have a lot of population along the coastline and you see right there. And mismanage waste is a material that is either littered or inadequately disposed same at definition that was earlier.

So, as you can see as the coastal population is increasing mismanaged plastic waste is also increasing which is because more and more people are there. So, you kind of see a kind of correlation right there. So, as more and more coastal people more per capita waste generation is of course, get multiplied by the population. So, you see more and more like waste that is being produced. Some countries which has a lot of population like India and China, Philippines those of Japan you start seeing them much higher like a waste coming into mismanage plastic waste coming in to the ocean from them .

Per capita again the same thing the per capita mismanagement plastic waste versus GDP per capita. So, if you put the GDP per capita as compared to per capita mismanage plastic waste. Earlier we had the similar graph where we had the per capita total waste produced. Now, if you look at the per capita mismanage plastic waste as opposed to GDP this gives you a very wonderful this is the kind of a graph like you see you see a nice thing over here kind of something like this why? Because, here of course, our population

is low, per capita mismanage plastic is less, here population is less or GDP is also less, but waste is not getting related around that much as people I have got little bit wealthier as in this particular area.

As people got a little bit wealthier, but the waste management infrastructure has not improved yet. Waste management infrastructure has not cop up is not in the same rate although the people purchasing power has gone up people are using lots of packaging material we have mall culture has come in. But at the same time our waste management infrastructure has not developed in that particular in yet. So, we see more per capita miss managed plastic waste for these countries right here. But as you go to this area although their per capita is more they are producing more plastic waste.

But since they are able to manage it in a better way the mismanaged plastic waste is coming down. So, it's kind of shows a very nice as society evolves as the society the waste management system evolves for a particular country you will see a change in terms of how the waste will be managed. So, as country like India and China developed their waste management infrastructure we will see that per capita mismanage plastic waste will go down over the years.

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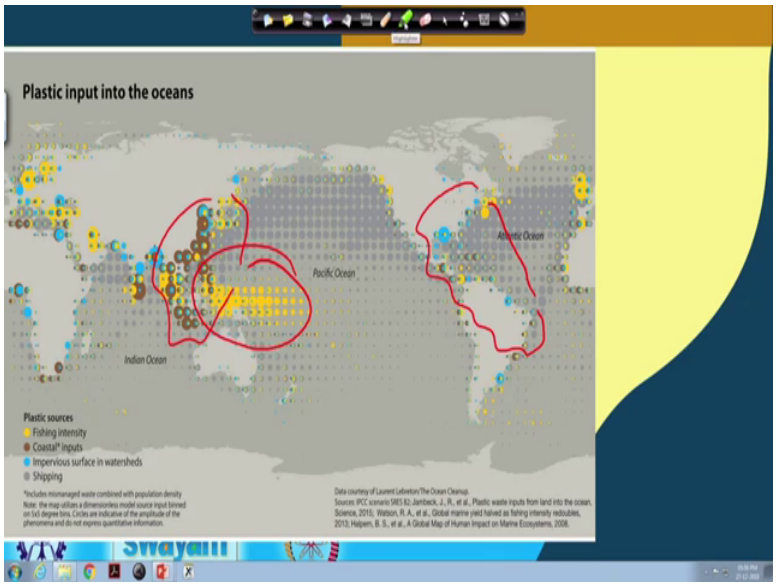

Now, plastic input into the ocean with the fishing intensity, coastal input is also there impervious service in water land sipping. So, different sources are being shown over here as you can see the fishing intensity is much higher; in Pacific Ocean as well as in like a

other. So, that is your fishing is the yellow one coastal input is what the mismanage plastic waste coming into the ocean or people going into the beaches.

The impervious surface are some of this which kind of water coming water sources from rivers and other things getting into the Ocean. And some from the sipping industries as well which you see lots of those grey dots, which is essentially coming from those sipping industry, which are dumping lots of plastic as they travel as the ship travels on those oceans and on globally. So, that is again a big source as well.

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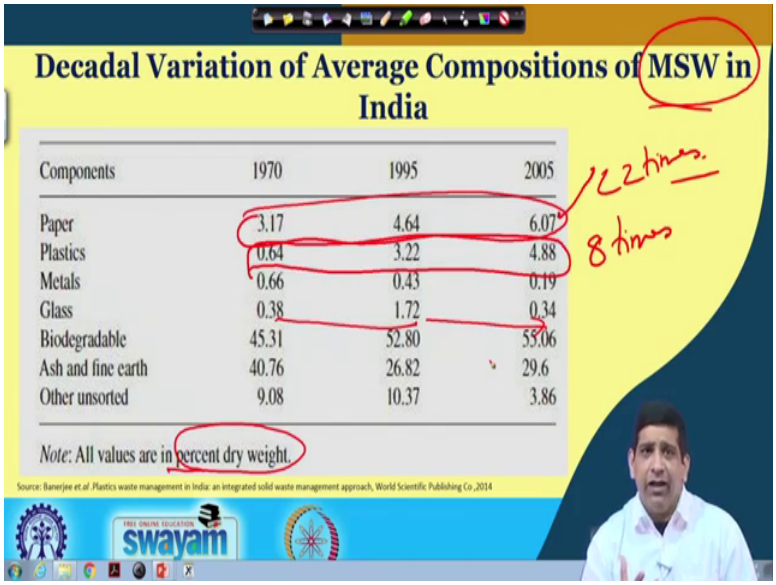

So, if you look at how the plastic waste is managed which we will talk about in great detail later on as well. Estimated share of global plastic waste by disposal recycle is very less incineration is also happening. But most of it just gets discarded and many of them are discarded in a very informal way. If you look at from an Indian perspective how the plastic waste has changed will the other waste stream kind of this is a very interesting table. If you look at plastic here as compared to other waste stream if you just compare it with paper right up there.

And as you can see the paper has gone from all values are in percentage dry weight. So, paper has gone from 3.17 percent to 6.07 percent; which is kind of what may be less than double. Plastic has gone from 0.64 percent to nearly 5 percent 4.88. So, 8 times plastic is 8 times and paper is less than 2 times so it's 1.5 to 2 times. So, and similarly you will see

the metals has actually gone down because we are using and this is I think in the municipal solid waste and municipal solid waste we have we started using.

We have replaced metal with plastic that is why you see plastics more and more plastics showing up. Similarly glass we have replaced glass with plastic. So, you see that glass actually went up, but now it has went down because, we have rather than using glass we are using lots of plastic. So, that kind of gives you an idea that why this plastic waste is becoming a huge waste stream in terms of the municipal solid waste as well. And lots of lots of plastic waste is showing up in the municipal stream.

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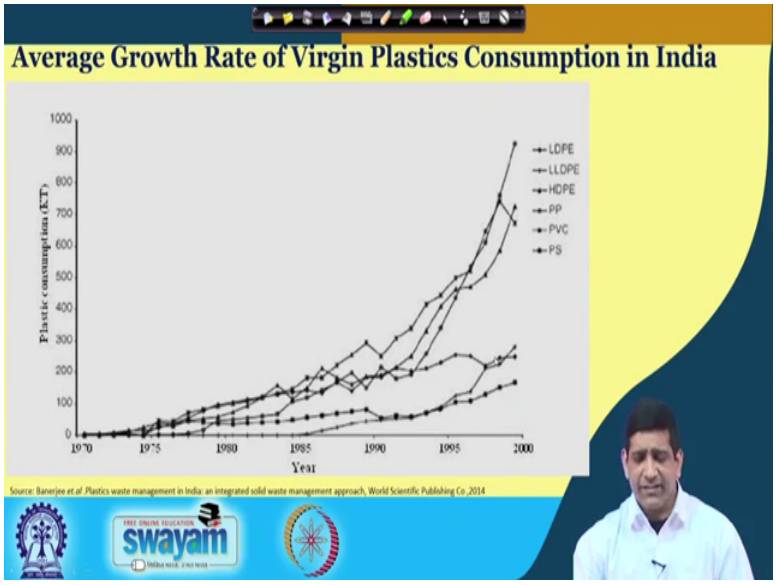

This is some graph we will come back and look at those in detail and later on as well. So, as you can see the different types of plastic there is a for all different types of plastic there is a consumption is going up this.

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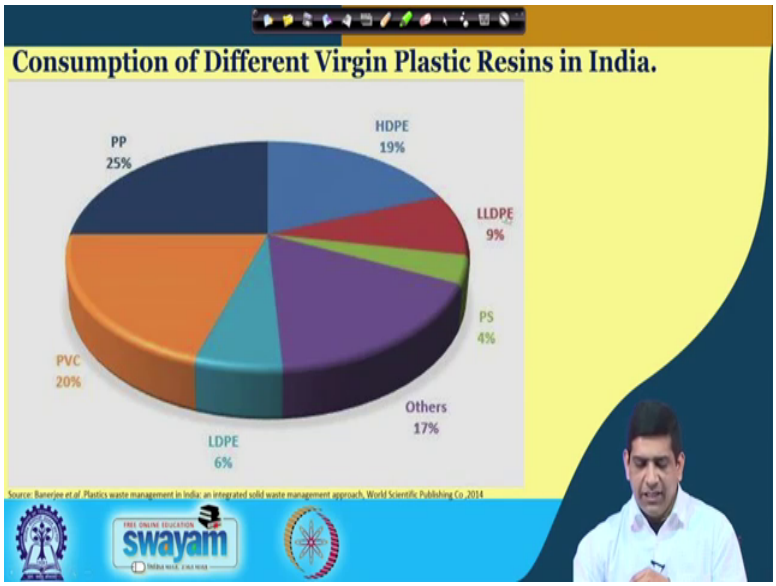

Shows you the consumption data different plastic resins consumptions of different plastic HDPE, polypropylene, PVC's, and those are kind of the top ones. Then LLDPE polystyrenes and those things are also there in terms of plastic regions usage.

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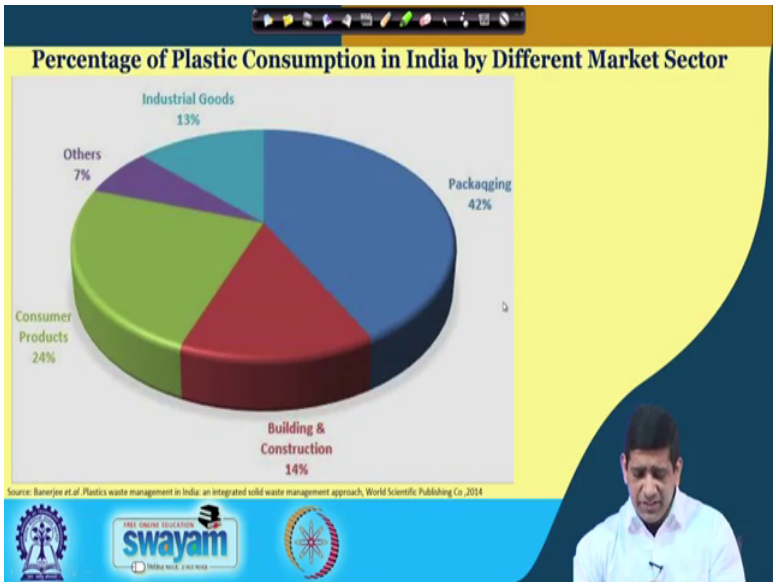

A market sector packaging again leads the number one; is around 42 percent and then we have consumer products 24 percent building construction sector. So, different sectors are also it's a using those plastic. So, these are again based on just 2014 data so, not too old.

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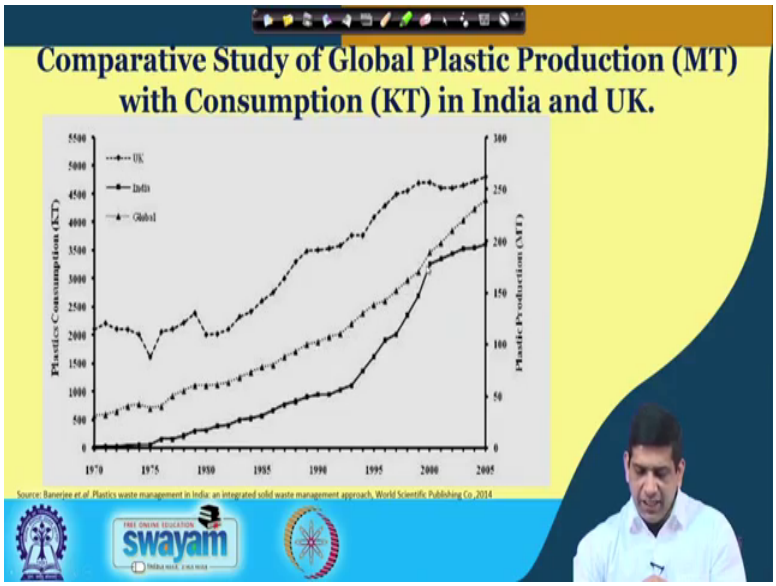

Ah if you look at the global plastic production with consumption in India and UK; the top the global plastic production is kind of going up plastic production in metric ton. And at the same time if you look at the Indian usage as well as a global both all are kind of picking up. Especially in Indian context we are picking up quite a bit after there was a gradual increase, but there is a after 1995 the slope is pretty high; in terms of the plastic consumption that is happening in India.

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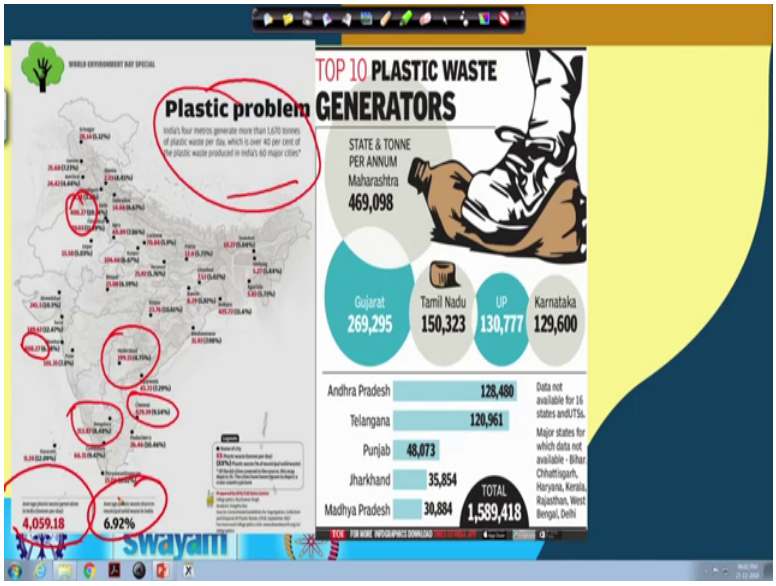

And plastic problem has been identities being is being highlighted in Indian context as well quite a bit. We are saying plastic pollution is being highlighted from a different (Refer Time: 33:53) you see that in media top 10 plastic waste generators in India and Gujarat the leads the pack like a say. So, in Maharashtra leads a path and we have Gujarat, Tamil Nadu, UP, Karnataka, Andhra Pradesh, Telangana, Jharkhand and Madhya Pradesh.

And if you look at in terms of India's metro; we where the in India where the plastic poor metro generates more than 1600 and 17 tons of plastic waste. This is coming from this is actually coming from the Indian express newspaper which was done on the world environment day. And here as you can see the plastic the 1st number the red number shows that the plastic weight tons per day and then in the bracket they saw a plastic waste as a percentage of municipal solid waste.

And as you can see over here nearly Srinagar was is in terms of percentage of municipal solid waste in average in Faridabad, Delhi 11 percent, 10 percent, which is kind of the highest in the percentage wise. And the minimum you will find somewhere in northeast probably 5.4 percent, Kolkata is 12 percent Dhanbad 5 percent. If you are in Bhopal you are close to 6 and half percent of municipal solid waste is plastic and the numbers the highest numbers that I see in terms of plastic waste tons per day is Delhi which is 408 tons per day which is a big city right there.

Then Mumbai would be close 408 in Mumbai as well its same numbers I do not know how it got the same number. Hyderabad is close to 200, Bengaluru 314 and Chennai 429. So, Chennai is actually is the highest in terms of, but percentage wise it's a less. So, that kind of kind of gives you a picture that there is a lot of plastic being produced in India. There are lot of plastic waste generation happening average plastic waste generation in India tons per day is 4060 tons per day.

And out 7 percent out of 47 percent of our municipal solid waste is now plastic waste which is a big chunk it is not a small value 7 percent of our municipal solid waste is plastic. And since they have lightweight material many of them if the volume (Refer Time: 36:11) this show up lot. So, with that we will close this session and so, this is the end of 2nd week. So, in the next we will start with the newer topic. So, I hope you are

enjoying the course so far. You had week 1 quiz similarly for this week you will have another quiz you had a 0 means 0 quiz as well.

So, take those quiz and those of you are familiar with NPTEL system you know that quizzes are very important for your assessment. And I would encourage all of you to take exam as well. So, you should register for the exam and take the exam too to get the certificate for this course. Again thank you for taking this course and I hope you are enjoying it. And we will continue this exciting journey of this plastic waste management into week 3 from the next video.

Thank you.