Sustainable Transportation Systems
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Lecture No. 45
National Clean Air Program and Transport Sector

Hello friends, so today we will discuss about national clean air program and its relationship with transport sector. As you know, this course basically relates to sustainable aspects whether it is environmental, economic, social, and all kind. So, in terms of air quality at the national level, what is the contribution of transport sector and how it is figured in national policy?

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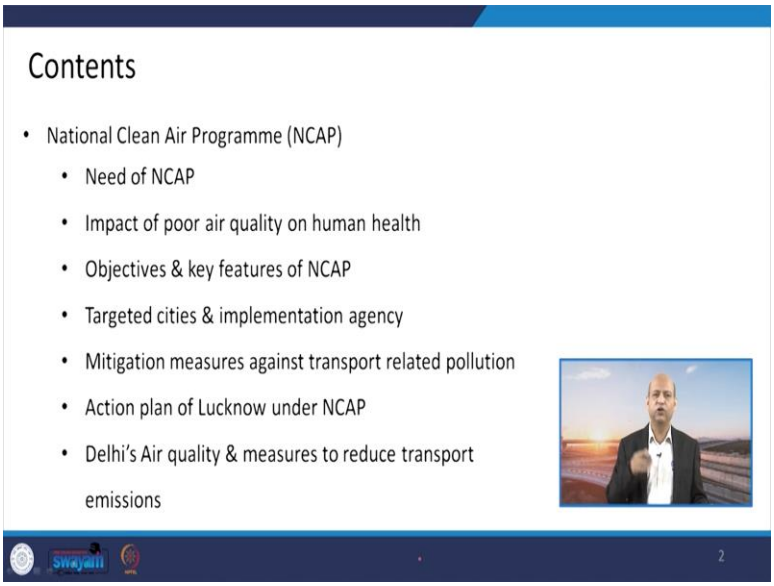

So, this is one very important policy which is known as national clean air program, which India has launched to clean the air because as you know, the air pollution is causing several health effects as well as genuine mental impacts. So, to reduce those impacts and to fulfill the demands of the public to have this basic right this is related to human rights you can say that we should have the clean environment and clean environment means clean water, clean air and whatever environmental components which really help us to live healthy life that should be clean.

So, in that context, the Government of India has launched one very ambitious program which is known as national clean air program or NCAP. So, today we will discuss about like what is the need of the NCAP, this is the contents of today's lecture that the need of the NCAP. And then

what is the impact of poor quality on human health as you know, but we will just touch it, so, that we can really, make this case.

And what are the objectives and the important features of this program in overall sense and the targeted cities which are, to be kind of mitigation measures have to be implemented in those particular cities, so, that their air quality ambient air quality can be improved. And what are the implementation agencies of this particular program.

Then, different kinds of mitigation measures which are needed for improvement of, transport sector related pollution issues. Because there are several sectors like industrial, domestic power plants, agriculture and many others, but within that, that kitty of sectors, the transportation sector, we will focus because this is the course on sustainable transportation systems, then what are the action plans in different cities?

So, as a case, we will take two cases one of Lucknow and another one of Delhi and after that we will conclude this so, that you can get an overview of this NCAP program and its impact or possible impact on the ambient air quality of national level in urban areas.

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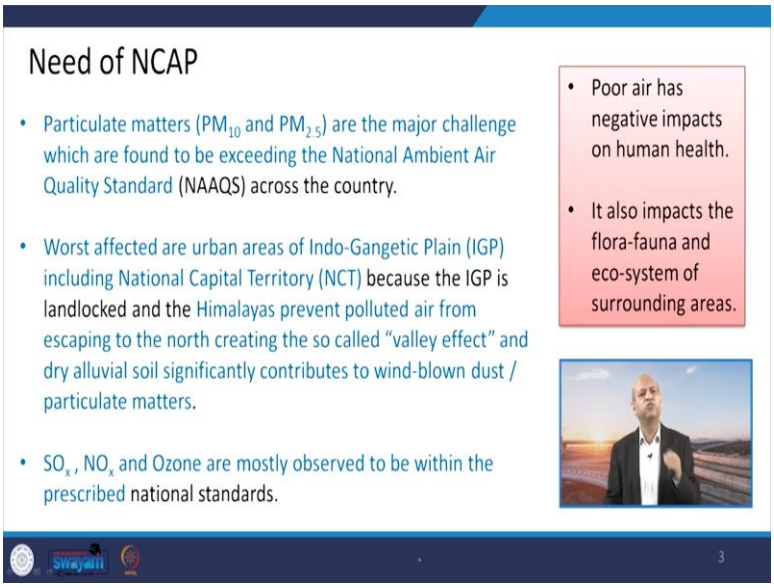

So, as you know, this poor air quality has negative impacts on human health as well as the environment. So, that is the need because, especially, of course, different air pollution, air pollutants have different health impacts, but particularly, this program is focusing on particulate matter because you have to prioritize, we have limited resources so, we have to first prioritize.

So, based on the science and this science based policy, this has been determined that the impact of particulate matter is small particles like PM 10, PM 2.5 the difference between PM 10 and PM 2.5 I hope like PM 10. It is also known as RSPM, Respirable Suspended Particulate Matter which can be separated okay.

Because larger coarser particles beyond PM 10 like PM 20 or PM 25 those can be really trapped in the nostrils that mechanism we have, but small particles can be inhaled. So, PM 10 is basically those particulate matter which is equal to or less than 10 micrometers. Similarly, PM 2.5 that means, the particle size is equal to 2.5 micrometer or less than that. So, you can say that PM 2.5 is also part of PM 10, yes, but PM 2.5 does not include the PM 10. So, different categories have been classified depending upon their health impacts. So, particular focus is on basically PM 2.5 and PM 10.

So, these are the, particulate matters which are of major challenge in the sense because their impact on air quality is tremendous because they are exceeding the prescribed limit. And then if you see this Indo Gangetic plain we are densely populated areas are there and cities have polluted air or very poor air quality The reason is because in the north Himalayan region is there so, that prevents the airflow across this plane. So, this acts like a kind of you can say belly and air movement at the larger scale becomes like a stagnation in that particular area.

So, if some transportation of pollutants are there from those upwind side kind of sources then the pollution can be trapped especially in winter, otherwise in summer there are air movements and a lot of boundary layer is available height or boundary layer is quite significant. So, dilution happens, but in winter because this boundary layer becomes very low and this masses of here is very much polluted and sometimes inversion also happens.

Inversion means the vertical movement of the dispersion is very much restricted okay. You know that these socks like SO_2 means oxides of sulfur, the NOx that is the oxides of nitrogen and ozone they are of course within the prescribed limits. So, they are also criteria pollutants, but they are not the focus of this particular study, we will focus on only particulate matter.

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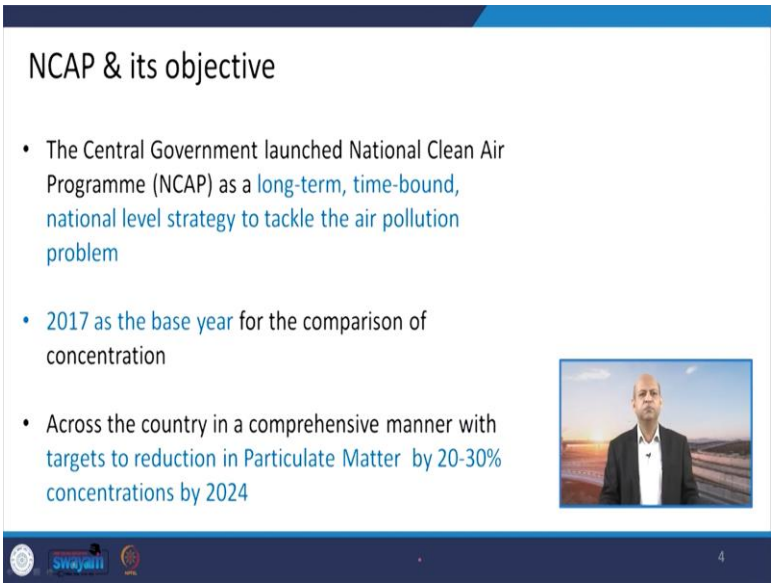

Then in this NCAP especially, the target is some cities and when we want to improve something then we should have some baseline data. So, in this case particularly the 2017 has been the base year. So, whatever air quality is there in 2017 that will be the term or basis to compare that how much we want to reduce. So, in comparison to those levels which are of 2017. So, the goal is that 20 to 30 % concentration should be reduced by 2024. So, within, 7 years, but the implementation is from 2019 so, you can say within 5 years.

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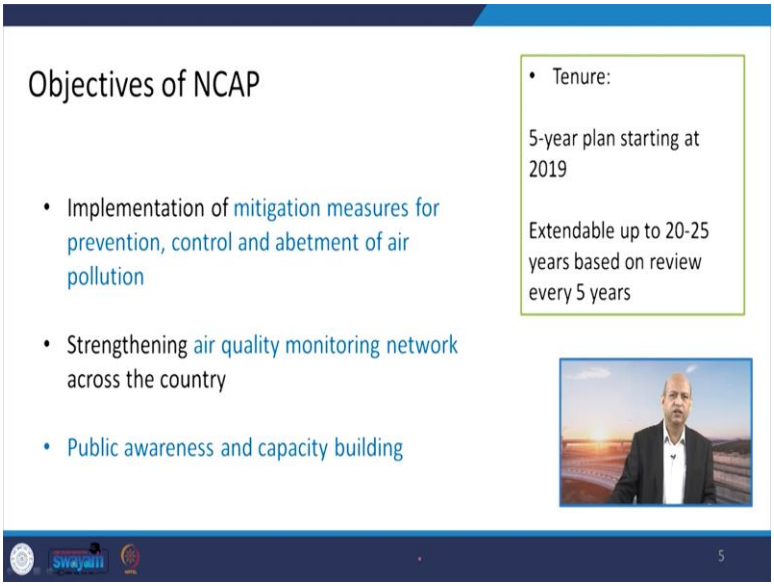

And then objectives this 5 year plan is starting from 2019 and it can be extended up to 20 to 25 years, every 5 year it can be reviewed. And what are the improvements which are taking place some lessons can be learned some changes may be made in policy as well as program related aspects. But the basically implementation is of different mitigation measures so, that emissions are reduced and then your quality is improved.

And it is also part like public awareness and the capacity building so that the urban local bodies should have people who can really monitor the air quality they can analyze and then there are collaborations with the higher educational institute like IITs, NITs or research labs like NIRI or other good universities. So, their resources have to be tab, also central Pollution Control Board and the state Pollution Control Board.

So, you can say this is the combined efforts of pollution control boards of the central level as well as state level and then educational institutes and urban local bodies and the public participation is expected of course.

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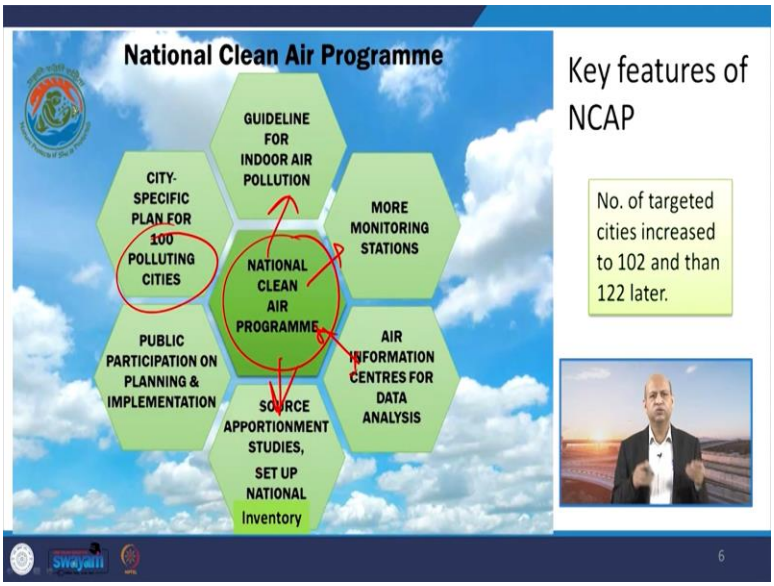

So, if we want to have this overview of national clean air program or NCAP, then this figure shows all the aspects like how many cities. Initially the 100 polluted cities were targeted there after that, number was increased to 102 and then 122. So, other cities were also clubbed so that their air quality could also be improved and different aspects like indoor air pollution as well as outdoor monitoring stations plus source apportionment studies and inventory setup of different

cities at the local as well as national level and then the public participation and Information Center establishment for analysis of the monitor data modeling monitoring everything is there, that makes this complete program of the NCAP.

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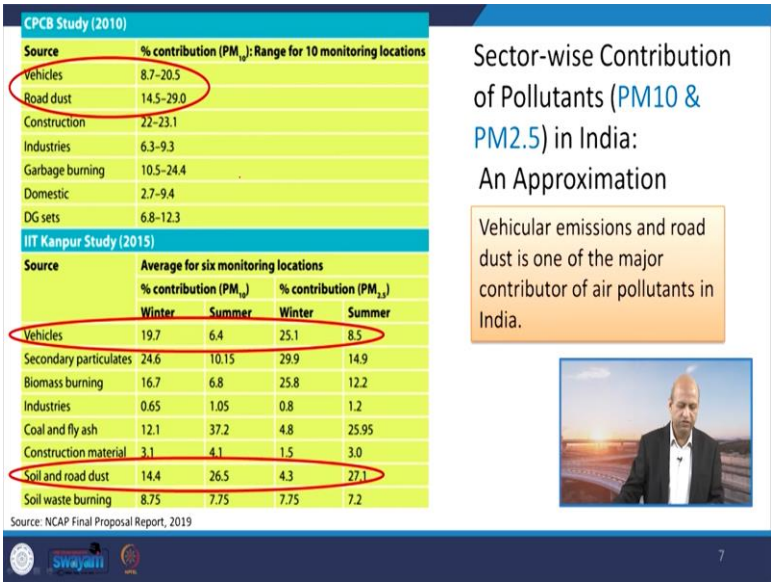

Well, when we talk about this these sectoral-wise contribution in pollutants are PM 10 and PM 2.5 at the national level then different studies give a little bit different figures but overall range is similar like CPCB Central pollution control boards. A study of 2010 they gave that these vehicles contribute around, 9 to 20 %. And, then the road does contribution is from 14 to let us say 29 %. So, the overall, you can say it is around, up to 50 percent.

So, this contribution is there plus IIT Kanpur study of 2015 that also give different contribution scenarios like PM 10 in winter and summer winter around 20 % and some are only 6 % the region because of no pollution loading is also dependent upon boundary layer and other activities. And the soil and roll this resuspension of the dust happens. So, PM 10 like 14 to 26 % winter and summer. So, you can say that in summer these vehicles contribute less and this soil and resupply resuspension of dust is more 26 % you can say so, around 32 % total.

Here again around 33 % but, in winter vehicles contribution is more and the suspension of dust is less in comparison and so, the weather also plays role. Similarly, for PM 2.5 if you want to see from winter to summer so, we call our contribution is around 25 % and in summer it went 5 % this 25 % is for winter and summer 8.5. Here is this resuspension of the dust is 4.3 % and 27

percent if we compare winter and summer for PM 2.5. So, that way their contribution can be linked with the season as well as in comparison to other sectors.

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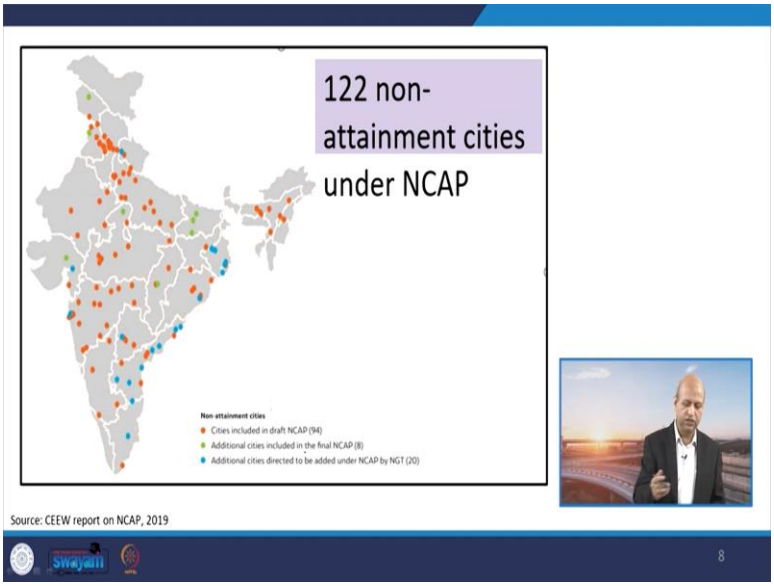

And this figure shows the distribution of 120 non-attainment cities that means, non-attainment means the prescribed limits are being exceeded by the air quality concentration ambient air quality concentration which has been monitored by different stations and the data have been processed and then average value has been compared with the prescribed limits. So, these are the 122 cities which are staggered in all around the India.

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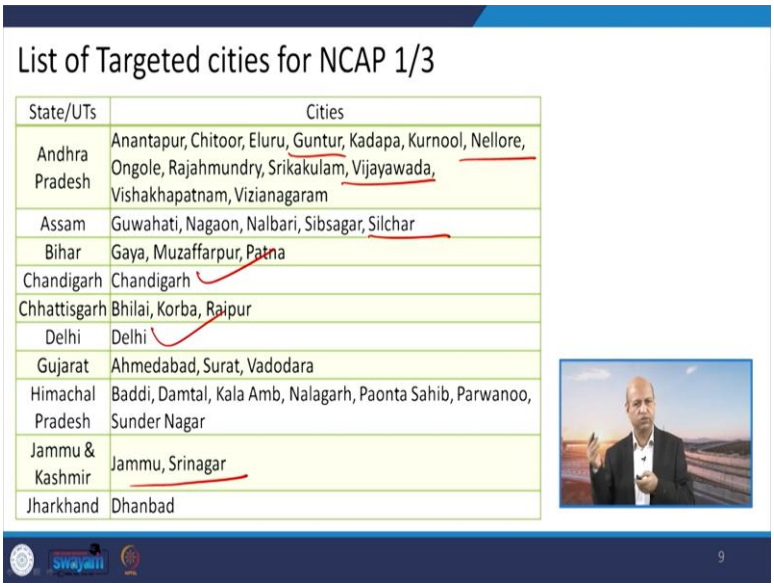

Then the list of targeted cities you can see in different states different number of cities are there for example in Andhra Pradesh this Anantapur is there then Chitoor and then Guntur and this Nellore you can see then Vijayawada so, Vishahkapatnam all these cities are known attainment cities means these cities have to be studied. And some mitigation measures have to be implemented. So, that they are air quality can be improved.

Similarly in Assam, Guwahati, Silchar UTs are also union territories like Chandigarh is also there, Delhi is also there, which is kind of a state as well as UT you can see now state it is where it was UT. Jammu and Kashmir so, Srinagar and Jammu both cities are there in Jharkhand, Dunbar is there because of pollution sources mines etcetera those activities.

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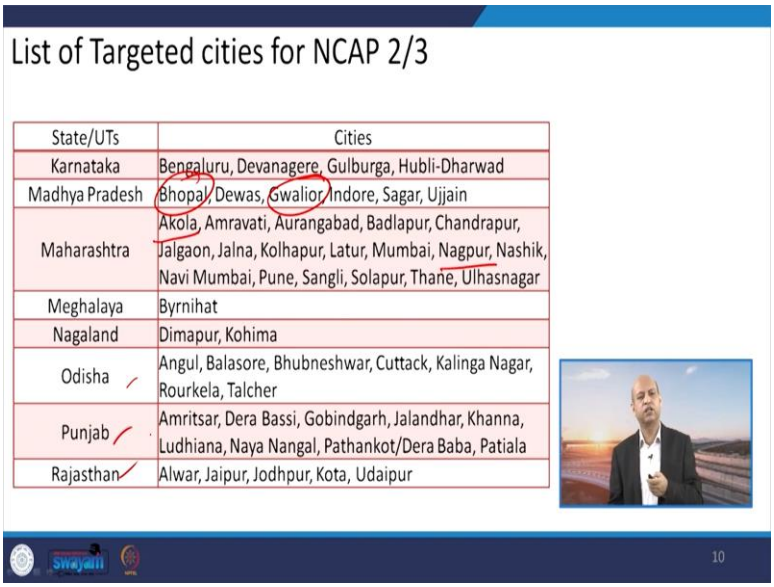

Similarly, other states you can see mother Pradesh, Bhopal, Gwalior indoor okay Ujjain, all those cities are included in Maharashtra number of cities are there. So, you can say because of different activities like in those states where a lot of industrial activities are there, then it is but obvious that the pollution levels becomes higher and the air quality becomes very poor.

So, in Maharashtra, Akola, Amravati, Aurangabad okay and then Chandrapur, Nagpur, Mumbai all these cities are included as non-attainment cities. Then Nagaland is there Odisha, Punjab, Rajasthan every state is there and certain number of cities which are not meeting the prescribed limits of PM 10 and PM 2.5 they have been included in the city.

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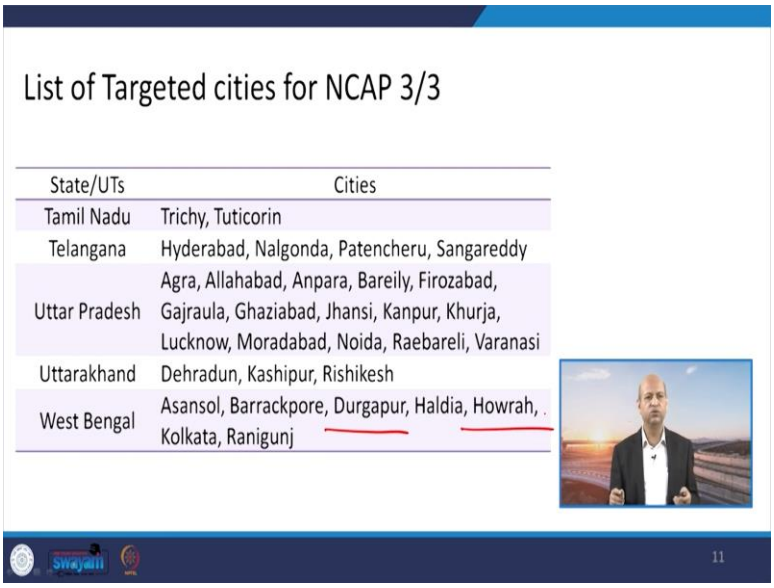

Then you can see this list of targeted cities for other state like Tamil Nadu, Telangana, Uttar Pradesh, okay in Uttar Pradesh again Gajraula, Ghaziabad, Jhansi, Kanpur, Khurja all these cities including Lucknow, we will have the case study of Lucknow today. Then West West Bengal, Durgapur and Howrah, Kolkata all those cities are there in these non-attainment cities list.

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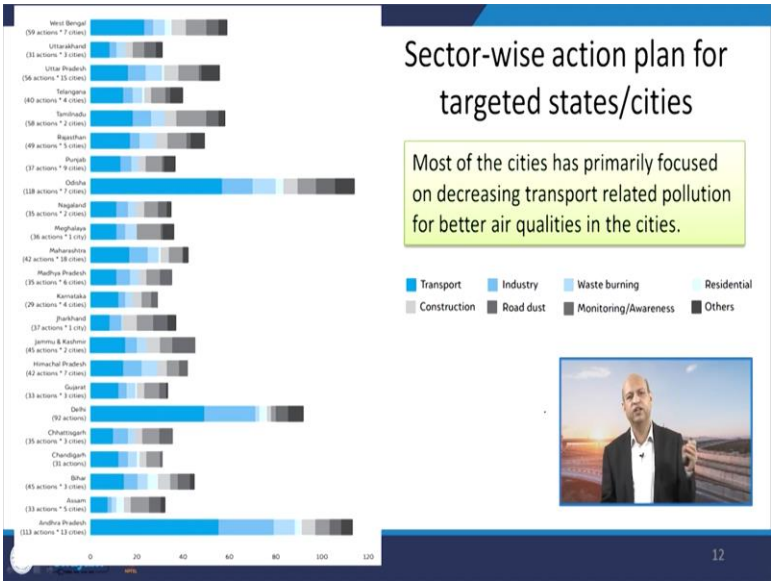

If you compare this sector wise action plan for targeted states or cities, so, you can see like this is the transportation related icon and this industry related and then waste burning. So, you can see like in Orissa, this transport related is quite significant. Some cities are like Delhi, some cities are

more into transportation sector because of see a number of vehicle population is much more in those particular cities. So, those have been included and accordingly, those mitigation measures are to be adopted.

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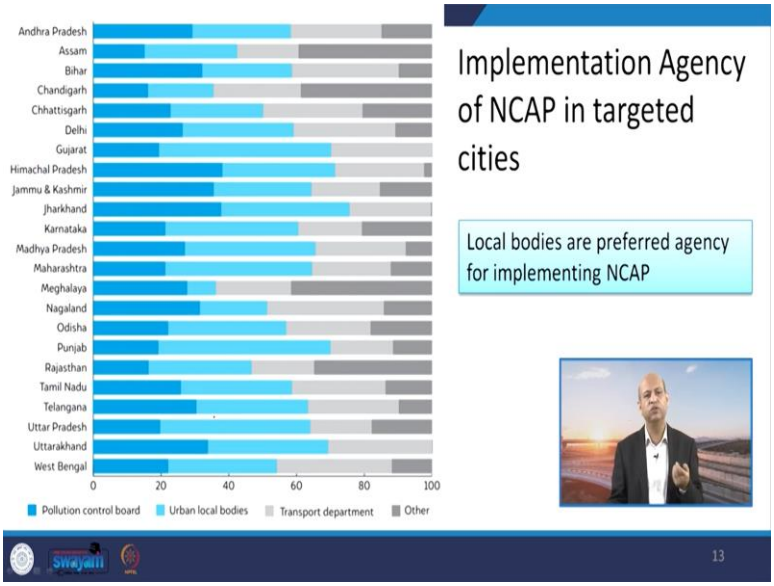

So, other cities are also there in this and then local bodies have to implement those NCAP because of these sector wise implementation is there and our focus today is more on transportation sector you can say.

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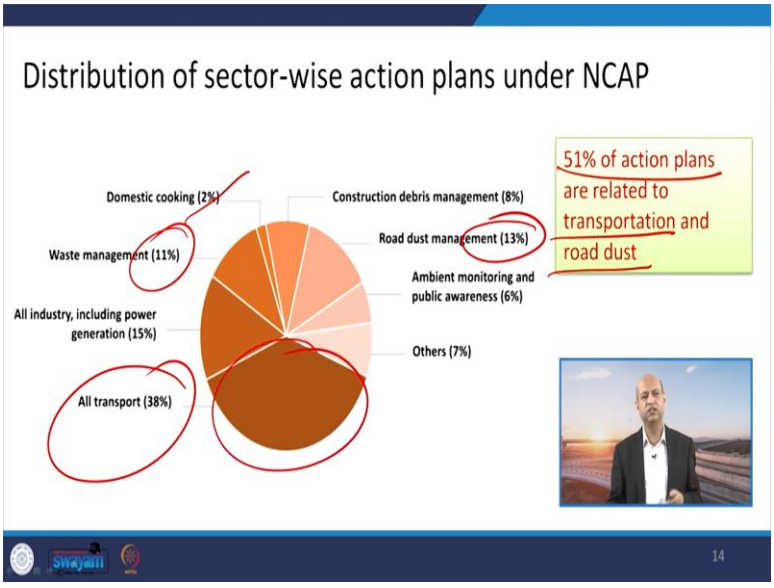

So, if we see the distribution of sector wise action plans under this NCAP, so around fifty-one percent of action plans are related to transportation. So, it is a very significant number you can see around 50 % more than 50 % is related to transportation sector because road emissions then the road dust as well as the suspension of dust all those kinds of things are there.

So, the transportation and road dust in total they contribute around 51 % here you can see waste management only 11 % domestic cooking only 2 % construction activities only 8 % the road dust management 13 percent and all transport 38 %. So, total around 51 % is there this you can this big part of this pie is related to transportation sector.

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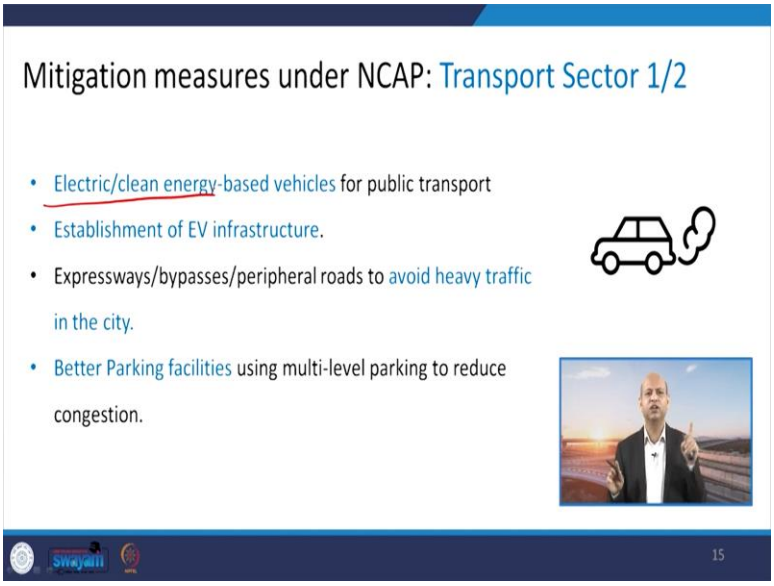

When we talk about the mitigation measures under NCAP and especially focused on transportation sector, so now focus is on that we should shift towards renewable energy resources like rather than fossil fuel based transportation sector we should shift towards renewable, like we can charge the battery that means electric vehicles.

So, we can charge those batteries with electricity produced from renewable resources otherwise, even if fossil fuel based power plants are there for producing electricity at least local level emissions will be significantly reduced even if total emissions are reduced not reduced the local level emissions will be reduced and local air quality will improve.

So, the focus or emphasis on electric or clean energy based vehicles for public transportation. And then established off infrastructure which are needed for electric vehicles so that people feel

motivated if we do not have a number of infrastructure like charging stations etcetera. Then people feel a little discouraged otherwise, they have to charge at their place, if we have very good infrastructure then people will buy more number of electric vehicles. Then those expressways and bypass and peripheral roads so that heavy traffic just go, without entering to the city. So, those kinds of infrastructure are like in Delhi, you might have seen this peripheral road network is there.

So, now heavy because not go inside the city they just want to go from one state to another, they just take the route of the Delhi and they go to their destination a straightaway. Then battery parking facilities using multi-level parking to reduce condition otherwise people park they have tendency to park on the roads. So, if you have multi-level parking etcetera at particular locations and we prohibit parking on the road, then also the smooth flow of that road traffic can be ensured or achieved.

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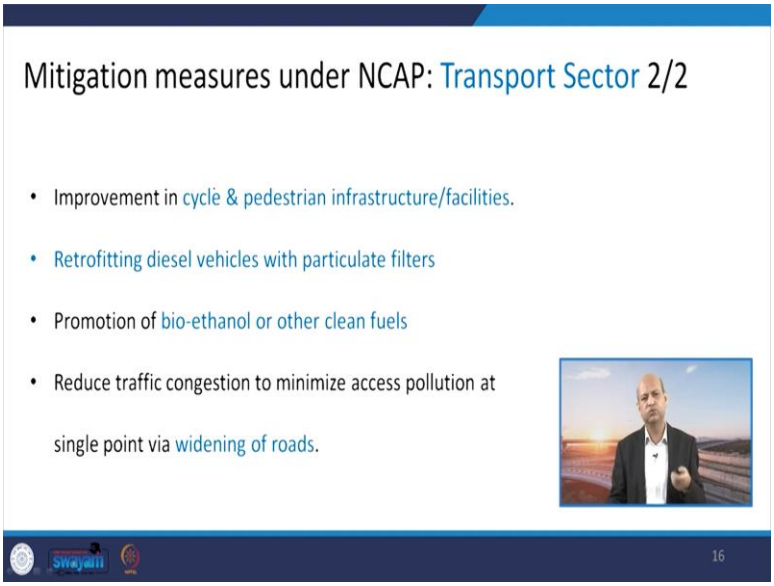

Similarly, like this improvement in bicycling and pedestrian related infrastructure and facilities so that people feel more motivated for non-motorized kind of transportation means. Then retrofitting of diesel vehicles because diesel vehicles are known as polluting vehicles. So, with particulate matter or filters, if we want to reduce the particulate matter then those particulate filters we have to really retrofit in those vehicles.

Then promotion of bio ethanol can be there in place of diesel etcetera because it is a cleaner fuel in comparison to those diesel and petrol vehicles. Because this octane number is high so, with the same amount of the fuel more energy is produced plus toxic emissions are less in comparison to those other fuel fuels you can say. Then we can also reduce this traffic condition by minimizing, these kind of these movements in a particular direction. So, widening of roads are there then other means other policies can be implemented. So, that condition is reduced and more smooth flow is there.

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Now, you can see like maintenance of forest cover, urban forest especially that means, so that absorption of pollution can be easily there, plus these urban forest act as the lungs of the city, because they absorb pollution as well as carbon dioxide, they sink and then they produce oxygen. So, they are known as the lungs. So, green buffers can be created within different parts of the cities. Then, this water fountains can be implemented at several place where this dust emissions disrupts the suspension of dust is much more in those locations basically.

So, that that dust can be settled down easily and then wall to wall payments can also be there so, that less amount of dust is there for resuspension. Then you can also have metallic roads black topping, so that this road is smooth and properly maintained otherwise, potholes and then the damaged roads also gives more emissions because our driving is not as smooth we have to apply brakes several times and that cause a lot of more emissions.

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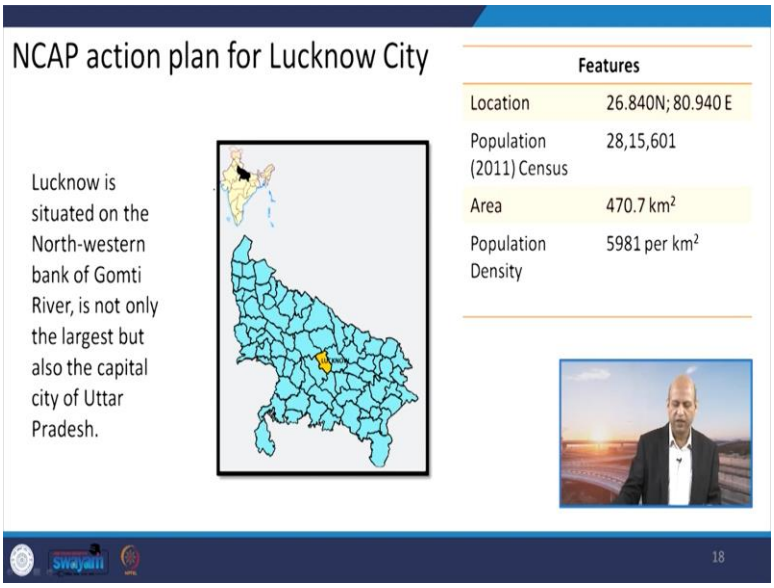

Now, we want to discuss about like Lucknow city NCAP action plan, what kind of action plan is there for Lucknow city so that this NCAP related targets can be achieved and we will focus again of different those action plans especially, the this transportation you can see.

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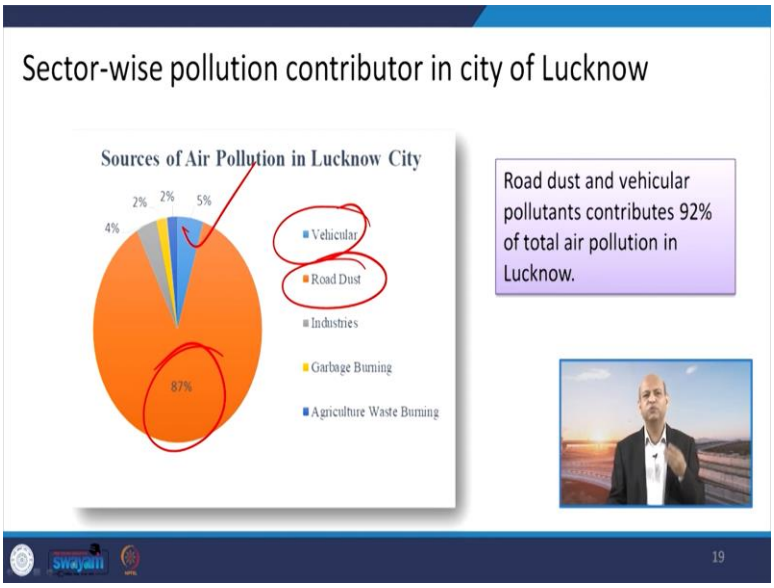

Here you see this if you see this contribution okay sector wise contribution. So, again this is the road dust which is around 87 %. So, resuspension of the dust from the road is the pre dominating source. So, if we can capture this lot of particulate matter can easily be removed from the air. So, 87 % around, then vehicle is this regular emission is there around like 5 %. So, 87 plus 5 92 %

around 92 % is basically from transportation related activities whether road and a straight way from the vehicle.

So, this is the very important sector in case of Lucknow. So, whatever majors if you want to implement let us target this sector. So, that achievements and improvements can easily be visible after some time.

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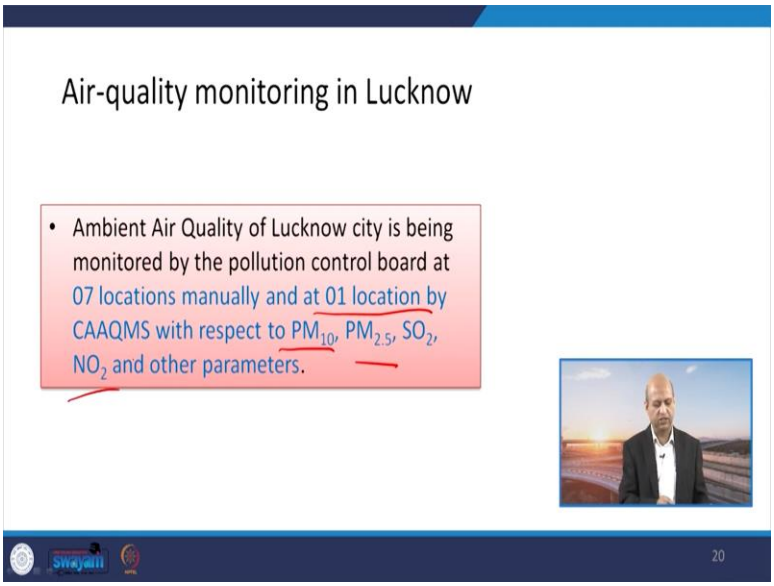

Air quality monitoring is there like seven locations manually and one location is automatic reading is there and then data is analyzed. So, PM 10, PM 2.5, SO2, NO2 and other parameters are measured by these monitoring stations.

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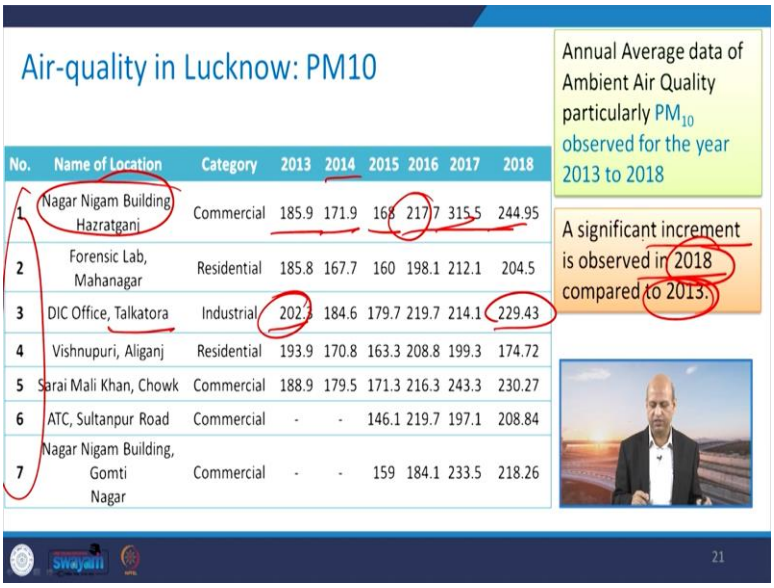

And if you want to see these 7 monitoring stations and they are different years readings for PM 10. So, like in 2013 it was 185, 2014 171 little word reduction 2015 168 more reduction, then again an increase because of several reasons, air quality can be deteriorated not only from the source, but also metrological factors. So, from 2016 the air quality is deteriorating quite because it is becoming like 217 or 315, 244.

These are annual averages well as you can see and this is for particular this Hazratganj related area monitoring station readings. Then if you see this Talkatora Industrial this monitoring station. So, again you can see from 202 from 2013 now it is 229. So, overall you can see that this air quality is deteriorating means the concentration of PM 10 is increasing in the air. So, significant increment basically from 2018 from 2013 to 2018 if you compare means in comparison to 2013 if you take the bass here.

And if you compare with the air quality concentrations for 2018. So, a lot of gap is there. And within these 5 years, air quality has deteriorated significantly in terms of PM 10 and you can see.

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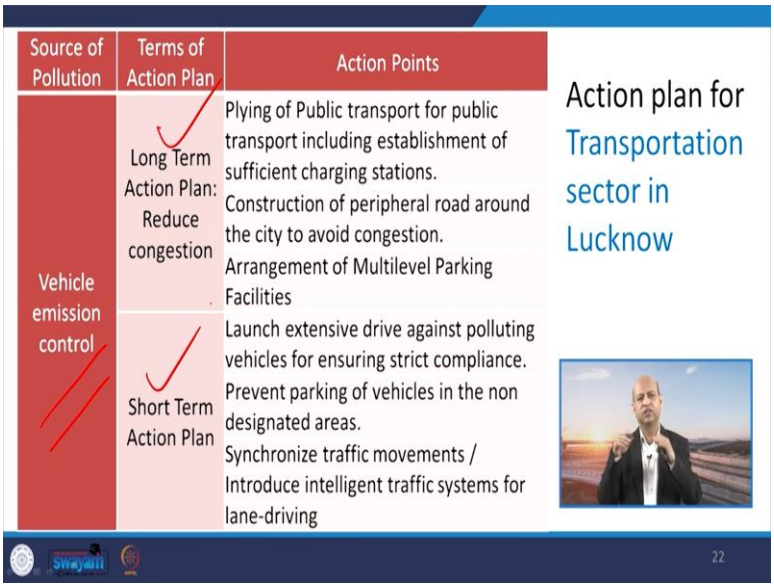

Well, if we talk about this action plan from vehicular emission control. So, there are long term action plan as well as short term action plans. So, for short term you can say like you can have these extensive drives for polluting vehicles you can target those vehicles so that strict compliance can be achieved. You can prevent parking vehicles in non-designated areas you can find those people who are parking there. And then, traffic movements and intelligent traffic system can be implemented so that there is like some particular lane driving so that there is no congestion. So, those are kind of short term plans.

But for long term if we want to talk then you have to do many things like you have to construct some, peripheral road around the city so that heavy traffic does not come to the city. Then multi-level parking so that people are not parking on the roadside. And then public transportation more a shift of the public from the privately owned these two wheelers or four wheelers like call to public transportation system that kind of thing should be there.

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Well, again like the suspension of road dust is there. So, again short term and long-term plan can be there short term like you can say that this potholes free roads should be there. So, a free flow can be there and then this metal roads should be properly maintained so, that there is no application of breaks quite frequently. Then for long term you can say that forest cover can be increased so, it should be at least 33 % of this as per the master plan.

And then you can have these canals/nullah side roads should we brick line it should not be only dusty otherwise the suspension of dust can be there proper plantation can be there. So, those kind of long term plan can be for reducing the resuspension of the dust.

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If you talk about the case of Delhi, Delhi is always in news for poor air quality especially when winter happens then there is a lot of debate that this is locally air pollution or it is coming from the outside is stubble burning and those kinds of issues are there. So, when we talk about this National Capital Territory basically Delhi and the area around this Delhi, then you can see that this winter season a lot of news is there as you can see these are the news clips.

And the lockdown period a little bit improvement was there of course, but these it report these kinds of scenarios really gives us message that we should do something serious effort, so, that air quality of Delhi can be improved.

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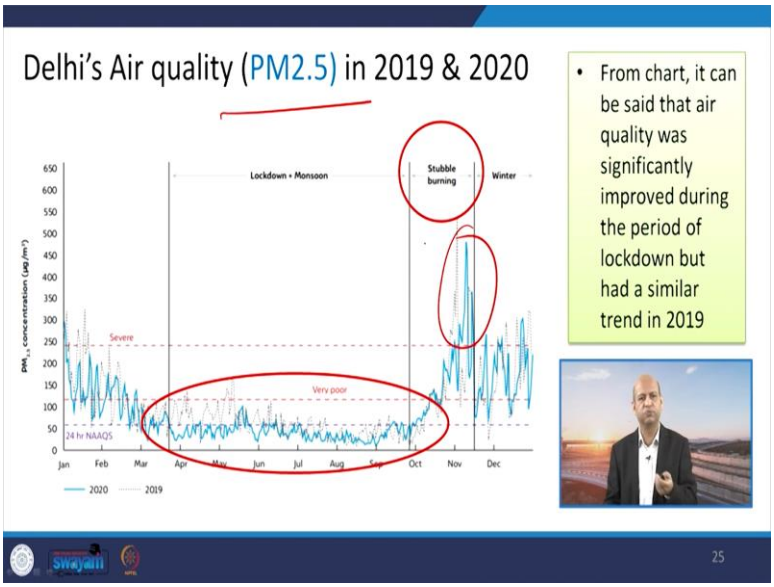

Because not all population is there and this health effects can be very tremendous, if we do not address these issues for these kind of cities where so, many people are leaving. If you talk about PM 2.5 2019-2020. So, this stable burning period and these peaks of these high spikes you can say the concentration of PM 2.5 are almost within the same kind of period. So, there is this kind of common sense that relationship exists within this of course, both kind of publications can be there, but means most of the publications and researchers agree that of course contribution is there from the outside also from nearby states.

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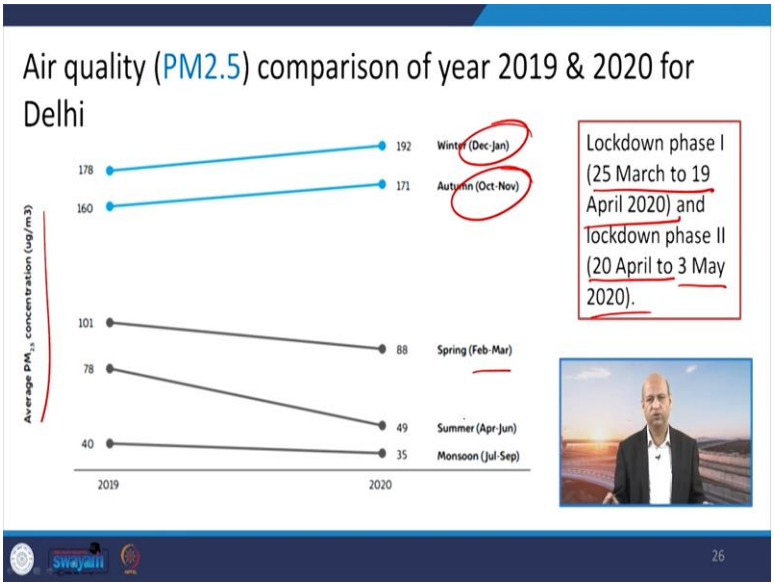

When we talk about again the comparison of PM 2.5. So, the lockdown phase 25 March 2019 April you can see and then this second 20 April to third May. So, you can see one is reduction and one is a little bit increase this PM 2.5 concentration you can see 178 to 192 this December January to October November. And this is the period where this February March and this reduction is there.

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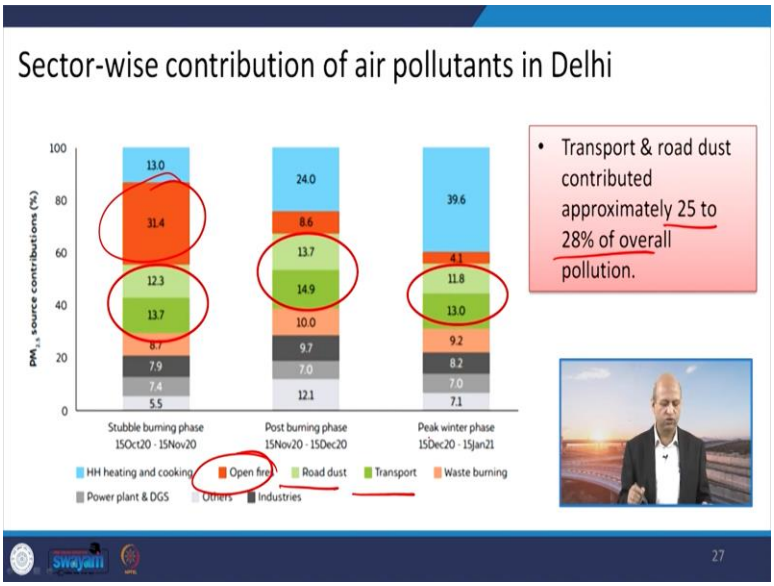

Well, when we compare about sector wise can contribution in air pollution of the Delhi, then you can see this like this road dust transportation again we are focusing on those. So transport and road dust they contribute around 25 to 28 % of overall pollution load. But open fires are also significant when we talk about these this particular period. So, that that should also be, curtailed and some programs must be there to reduce those kinds of things, but in other periods this was not so much. So, maybe public awareness was there and some other means were implemented.

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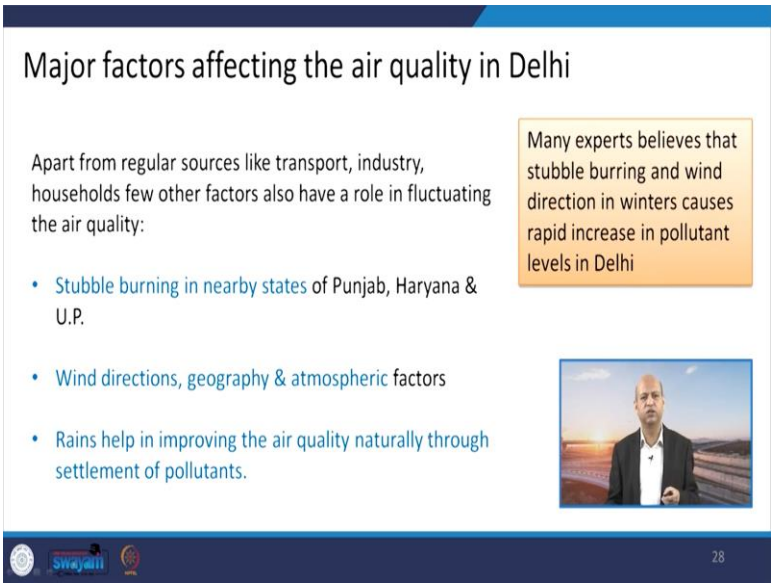

When we talk about major factors that affect the air quality of Delhi. So, as I said that there are a lot of publications and studies they say that a stubble burning in nearby states of Punjab Haryana and UP they contribute, to this pollution load in this mega city Delhi because local pollution is also there. And this is also because trans boundary pollution happens as, here is notice stagnated at a particular place, unless some particular episode is there, because of metrological episodes otherwise, pollution transfers from one place to another one.

Then wind directions, geography and atmospheric factors are also there as I said, and sometimes this precipitation or rains, which has to improve the air quality because this wet deposition happens.

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Well, when we talk about actions taken to improve air quality as that public transportation again, this increasing capacity of the metro so that its expansion can be there. So, most of the populations should shift towards public transportation whether these, DTC buses CNG based buses as you know, already CNG implementation has been there in Delhi and Metro is also taking lot of people. So, this is a good effort and more and more people can be shifted towards this public transportation, if it is kept, it can be enhanced.

And also like non-motorized transportation means like bicycle pedestrian, if those facilities can be increased. So, again we can speak to people when we talk about, this transit oriented development TOD. So, in that sense in a lot of integration happens for non-motorized vehicles, as well as means like bicycles or battery driven rickshaw those kind of things are there and people also tend to walk if distances are shorter. So, those facilities are to be enhanced or implemented.

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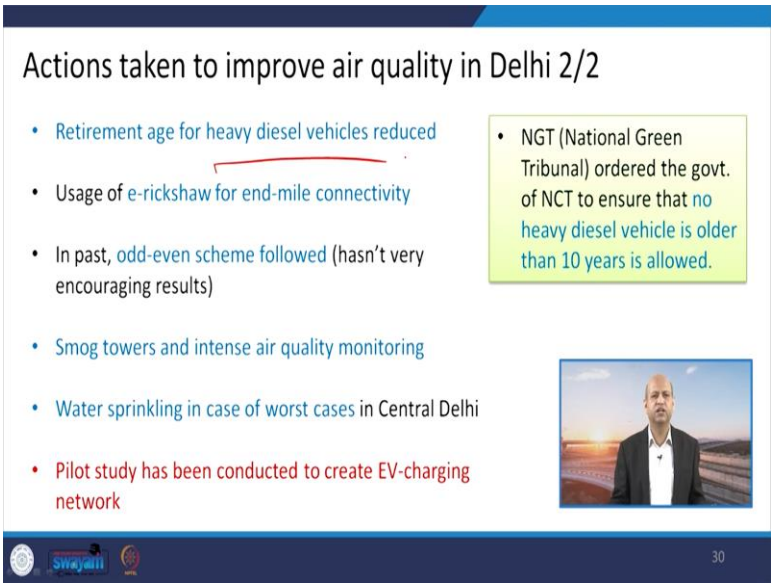

Then, if you talk about more like, like heavy diesel vehicles or they are so, if we can take them out of the road by certain age factor certain years, then again we can reduce a lot of those emissions. And e-rickshaw and this last mile connectivity through e-rickshaw can be taken care of that would be really wonderful.

All odd even scheme was followed, but the results were debatable means not so much encouraging as earlier also we discussed that sometimes people the bought because if they had a very critical need for travel traveling, then they bought those old vehicles with the odd or even number according to Delhi commutation so, the purpose was defeated you can say.

Then smoke towers were also used, but again, they are also the cases are debatable water sprinkling all those kinds of things have been implemented basically, and this pilot study has been conducted to create this EV-charging network so that electric vehicles can be enhanced.

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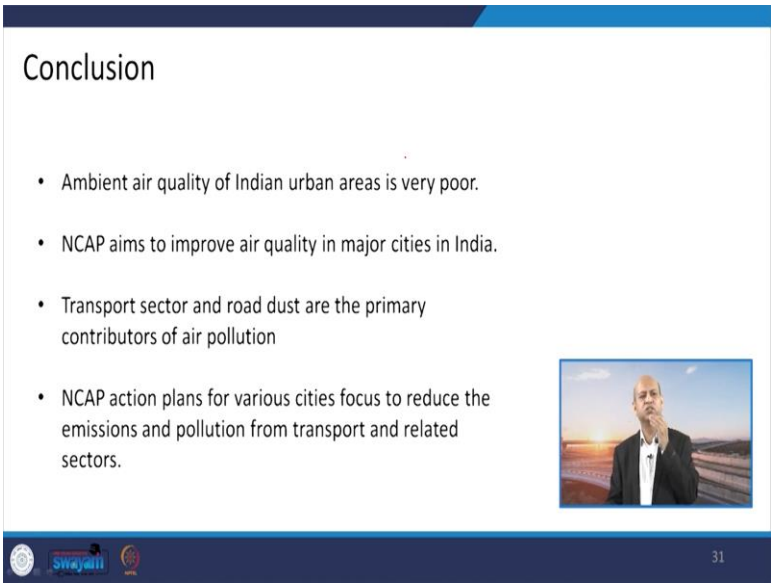

So, in conclusion, we can say that this ambient air quality of Indian urban areas is very poor and there are like 122 cities which are non-attainment cities you can see what a big number it is. So, those cities need some intervention technological as well as policy related so that the emissions can be reduced from different sectors and transportation sector is really very important sector if we consider in that sense.

So, from fuel from technology, from shifting people from privately owned vehicles to public transportation, all those things we have to do. So, this NCAP is aiming to improve the air quality of these major cities and transportation sector has a very important role to play in this achieving these NCAP goals. So, that is why NCAP action plans are including transportation sector in a big way.

So, that was today's lecture related to how this transportation sector can really play a critical role or important role or crucial role for enhancing these efforts to improve air quality urban air quality. And this NCAP program which is the India pan India program, national clean air program to achieve the goals of NCAP transportation sector is important and we should give much more focused on the this particular sector so this is all for today.

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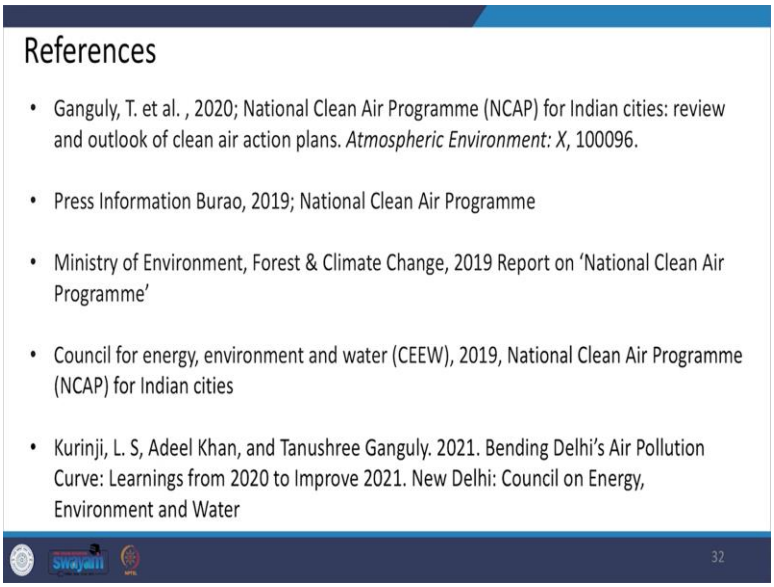

And these are the references which you can go through to have additional information. So, thank you for your kind attention, and see you next time. Thanks again.