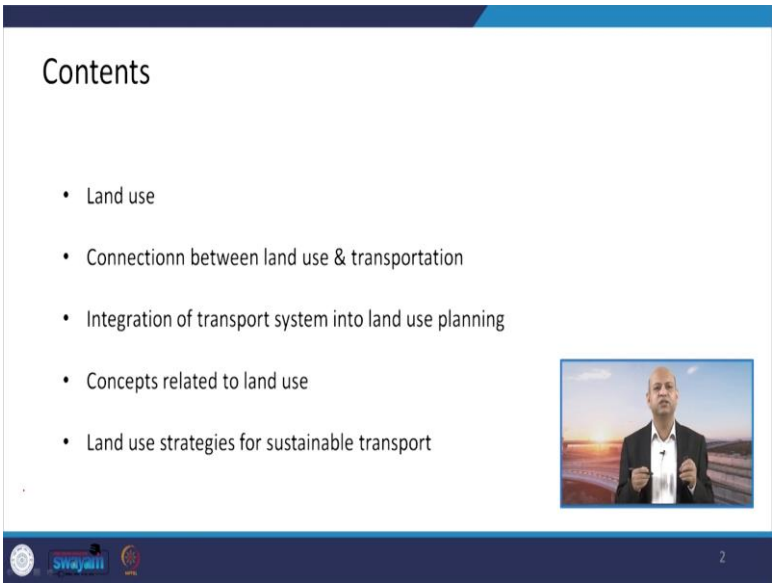
Sustainable Transportation Systems
Professor Bhola Ram Gurjar
Department of Civil Engineering
Indian Institute of Technology, Roorkee
Lecture 22
Introduction of Land Use

Hello, friends. So, after completing theoretical as well as practical aspects of EIA, today we will start to learn about the land use and land planning or land coverage and what is their role in the transportation planning? So, those aspects of land use and land cover we will discuss in today's lecture.

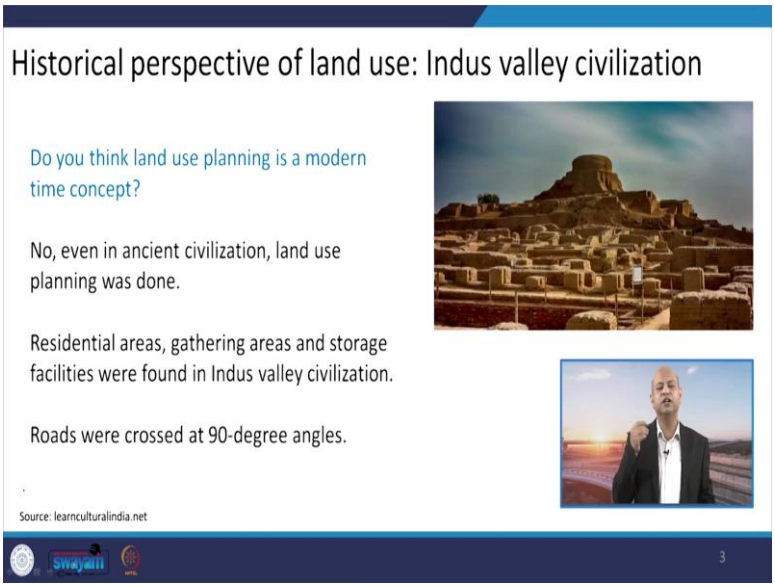
As you know, land use is basically architectural or planning related issues, but this is again part and parcel of the transportation planning because you have to plan properly the land in terms of for example, you have to convert agricultural land into transportation related usage. So, you have to change its patterns and there are certain legal implications also.

(Refer Slide Time: 01:13)



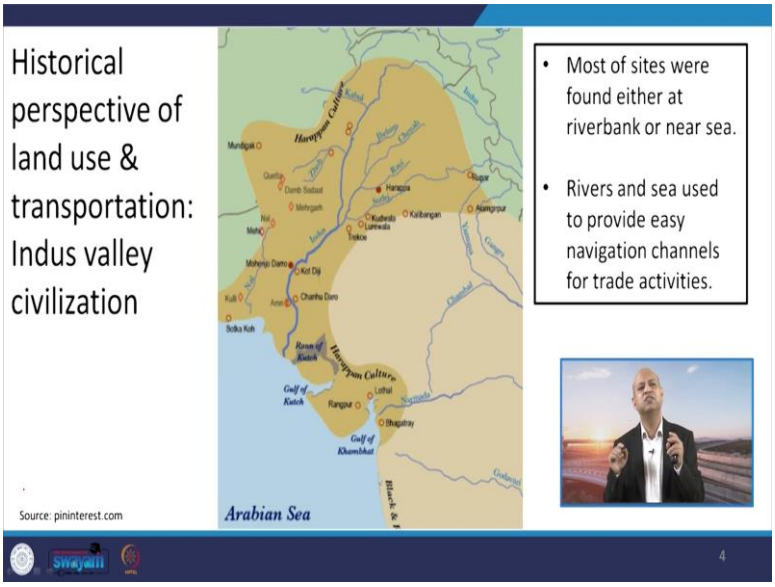
So, we will discuss today like land use, what is land use basically, fundamentally and how does it connect with the transportation, viz-a-viz land use and transportation, how transportation influences the land use patterns and how land use influences the transportation related systems. Similarly, how to integrate the transportation system between land use and its planning. So, that integrated approach again we would like to discuss certain concepts of the land use we will discuss and then we will see the strategies that will be implemented for better land use for sustainable transportation system.

(Refer Slide Time: 01:48)



So, if we go for historical perspective of the land use, then even in Indus Valley Civilization, there was planning of the land for different kinds of purposes like bathing hearts or those places, residential places and the roads were intersecting at 9 degrees, 90 degrees. So, at that time also those Harappa or Mohenjo Darro those kind of very ancient civilization habitats or setups were completely having the sense of land use that okay, this is the particular purpose of the land, so, we have to promote this particular activity. In that sense, we can see that the land use has been the part and parcel of the human civilization from the ancient times, it is not that only randomly people are using the land and resources.

(Refer Slide Time: 02:38)

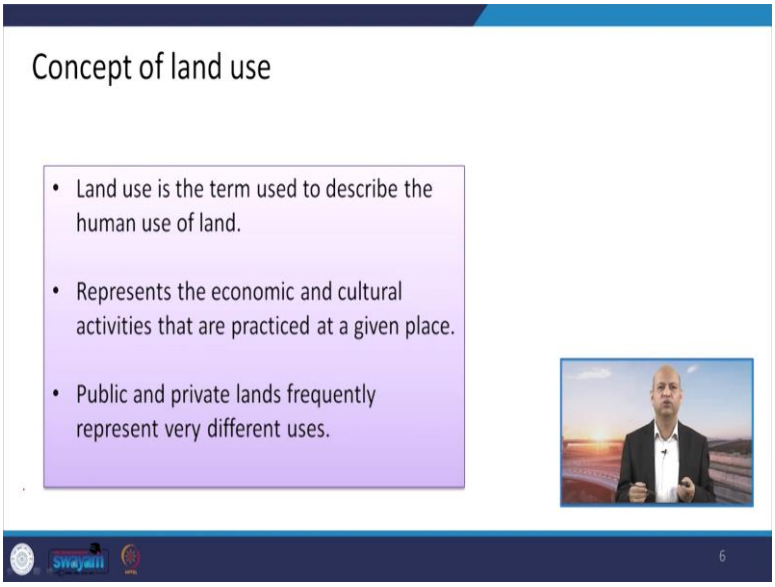


Well, if you see, all ancient cities were developed at the bank of rivers or at the coastal areas and reason was very simple, because these were the centres of the trading commercial activities and transportation through river and through sea, this was easy to reach at the destinations for various kinds of activities.

So, you can say that the transportation itself influences the land use patterns, as we see that many cities are at the bank of the rivers and of course, the water is prime resource for every kind of activity, but transportation rule cannot be ruled out. So, if we shift from the river to the landmass or transportation on the land, then again, there are evidences.

For example, the Grand Trunk, this road, GT road, which we call from Kolkata to Kabul, this was developed by several empires at that time. And later on, even during British Empire, it was properly developed and several kinds of amenities came into existence surrounding the GT road, many cities, or commercial centres. So, you can say that the transportation system itself promotes certain human activities of commercial nature or cultural nature also, because there are certain places where tourism related or religious related activities go on and they are quite near to this GT road.

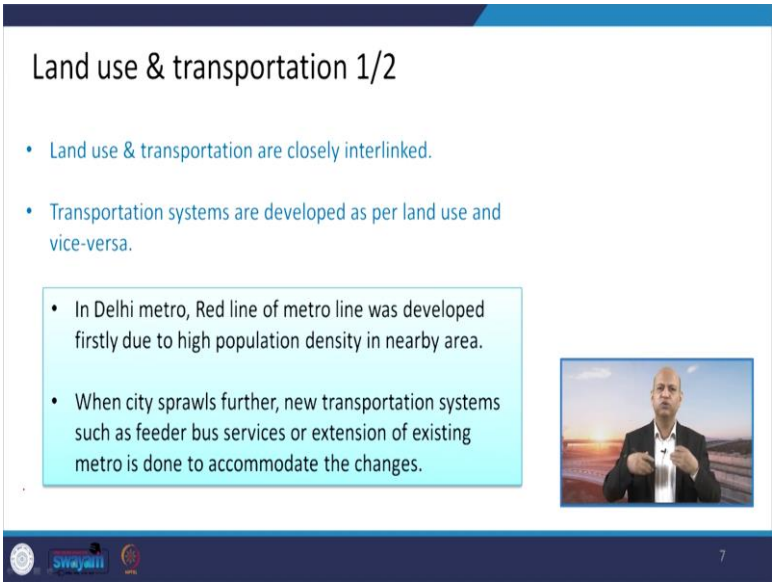
(Refer Slide Time: 04:22)



Well, the concept of land use has been in the development of human habitat, whether it is villages or agricultural activities, those kinds of things. So, they were thinking about these activities, whether of the economic nature or cultural activity, and then private lands and public lands, all these have different purposes. So, the land use patterns, you will see that the privately owned lands will have different kinds of activities or patterns for the uses, and the

public land masses have different kinds of uses. For example, for transportation or for other amenities which are used by all the public means shared with the communities.

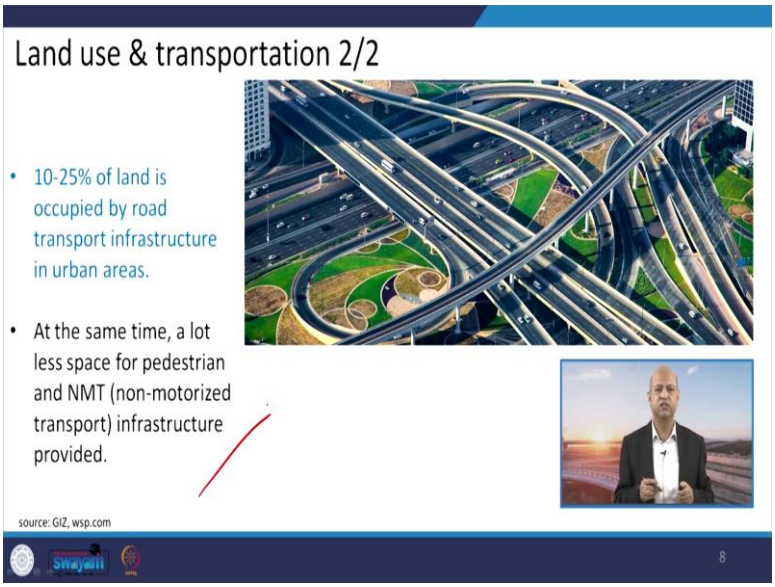
(Refer Slide Time: 05:04)



Then if we see this land use and transportations interaction, so, they influence each other. For example, you can see there the Delhi Metro, this red line was planned to go through highly populated dense, densely populated areas so, that they can serve its transportation needs, but at the same time when needs, then it increased and the transportation system was again planned in different way.

So, it was sprawled, it was expended for catering the needs of the nearby areas. So, that way you can see that the integration happens from one particular place to another one. So, and at the same time, wherever these metro stations came up, there are several kinds of commercial activities and then feeder kind of transportation systems, non-motorised or motorised, so service lanes, all those things, they emerge at the same time. So, you can say that the transportation system again as I repeat again and again that it influences the land use patterns and the land use itself promotes certain kinds of transportation.

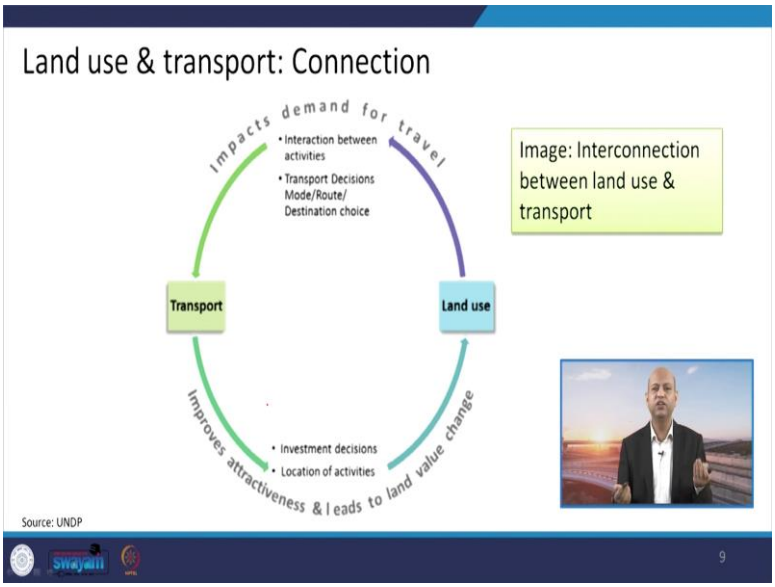
(Refer Slide Time: 06:20)



Well, this is the one example where land use promotes a particular type of transportation. For example, in cities, cities are, densely packed population you can say, and because they need this transportation, road related transportation or railways, so, 10 % to 25 % of the land in urban areas they are occupied by the roads for that particular transportation needs.

So, it is huge amount of the land which is being used for the transportation purpose. So, you can say that the land use is being influenced by the transportation needs. At the same time, you can see like non-motorised or pedestrian related transportation systems, they need very less amount of the land in comparison to these other kind of motorised or automobile-based transportation.

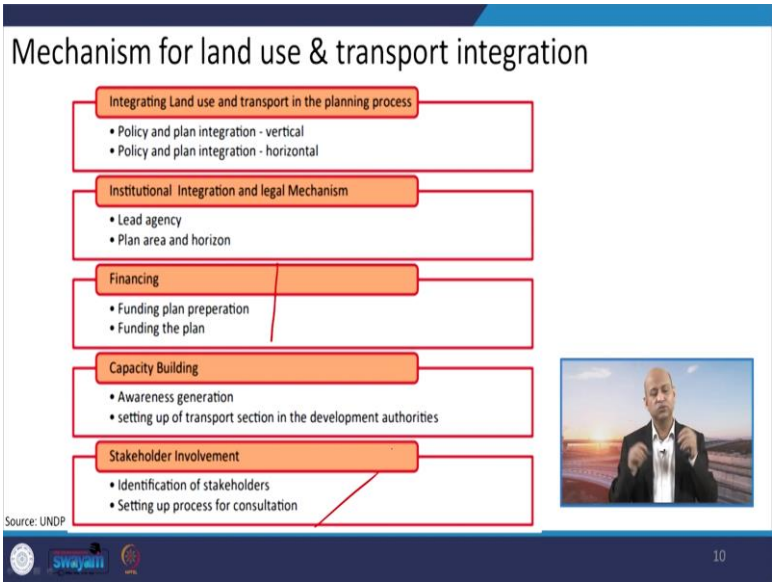
(Refer Slide Time: 07:14)



So, when we compare this land use and transportation connection or interaction, then you can see like, they give feedback to each other. So, like transportation gives certain needs, it like needs of the roads, needs of the railway tracks or something like that, or stations and then feeder services.

So, similarly, the land use also if new towns, if it is coming, then you will need certain kinds of connectivity, connectivity with the rest of the region, rest of the state. So, you have to provide roads, you have to provide railway connections, those kind of things. So, you can say that they are related to each other, they are not in isolation, you cannot develop land use in isolation of the transportation system, and you cannot imagine or plan the transportation system without giving due care to the land use related issues.

(Refer Slide Time: 08:12)



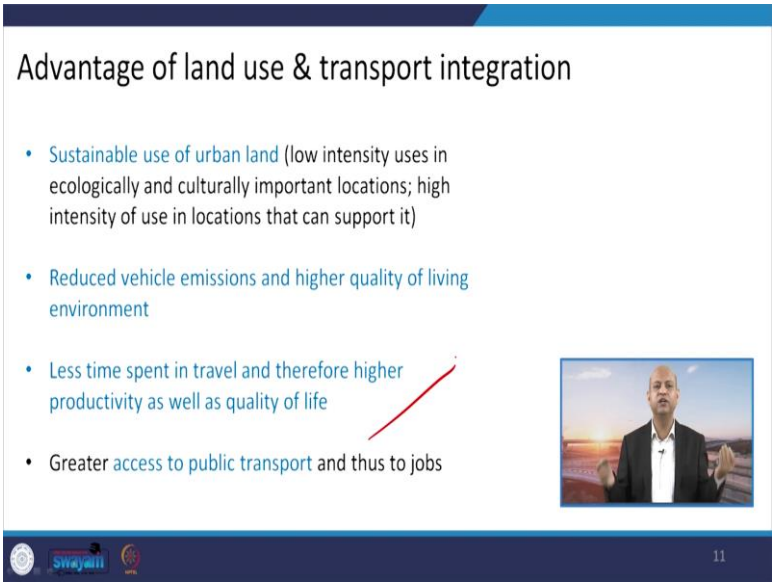
Well, if we see the mechanism for the land use and transportation integration, then there are certain steps like we have seen in EIA also that kind of integration happens here also. For example, there are policy and plan integration means, certain policies are there, then you develop certain plan to implement those policies.

So, the verticals can be there, horizontal way can be there for the expansion. Then there are some lead agencies which we give the responsibility for institutional integration and the legal mechanism. So, that the clearances are to be taken from different agencies, and then we need to have some this finance related or financial related funding agencies so, that we can get the money to support that particular activity to develop the transportation or that particular facility.

Then capacity building because to run a particular transportation system, you need certain skilled people. For example Metro, you just cannot hire and give responsibility to any kind of person, they have to be trained in certain way. So, the engineers or technicians, so, all those who know those kinds of technologies and for repair, maintenance of the tracks and to run the whole system.

So, then they should also know the computer-based programming or the apps related activities, all those things means different kinds of activities will be there, so different kinds of capacity building has to be there. At the same time, you will see like stakeholders involvement as we have seen in EIA also, so all those steps are to be fulfilled properly for integration of the land use and transportation.

(Refer Slide Time: 10:02)

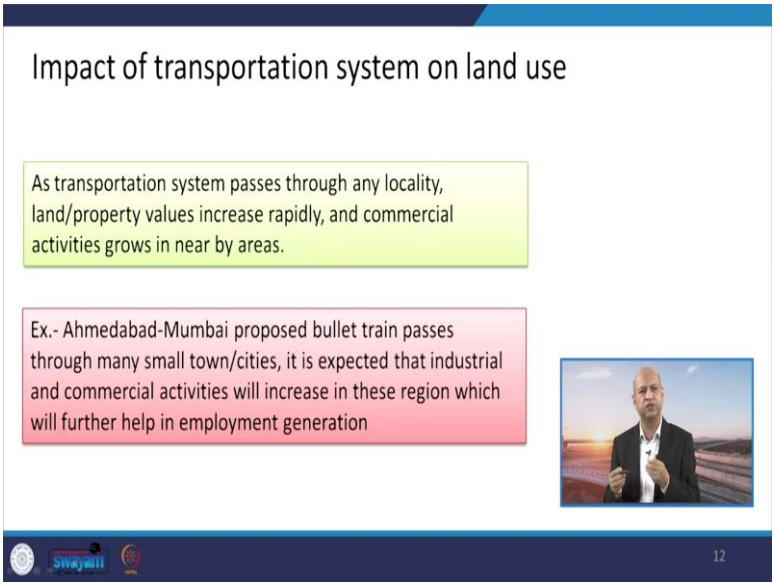


Well advantages of the land use and transportation integration because if we do not develop them in isolation, then there are very less problems in the future, because then you can have some scope to further expansion of the transportation system as we have seen the example in terms of Metro like phase 1, phase 2, phase 3 those kind of things means futuristic planning, because the needs will arise, finances will be available, then expansion will be there.

And also like if we do better planning, then of course, we save the time we save the congestion related problems, because then traffic moves very smoothly. So, we can also promote the environment friendly kind of vehicle or system. So, that way less time in the journey.

And then the access to the public transportation system is also better, plus creation of the jobs all these things can be there if we do better integration of the land use and transportation because at the, around this facility of the transportation corridors, there will be many developments and the prices of the land also increases. So, all those things may be there and with this integration of the transportation and land use.

(Refer Slide Time: 11:19)

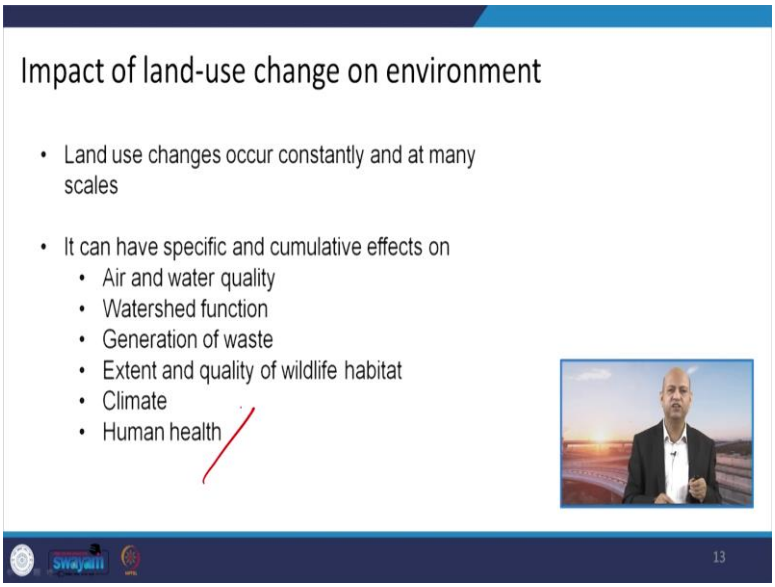


Well, the impact, impact is because positive or negative impact as we have already seen that if you do proper planning, then we can reduce, we can minimise the negative impacts due to these negative externalities. But there are positive impacts also for example, like we have discussed this bullet train or high-speed train between Ahmedabad and Mumbai.

So, the places or small towns or cities, which were not part of the main stream of the development or the economic growth, they will be there, there will be certain activities. So, the growth, economic growth, employment generation on those particular locations will enhanced because of this activity.

So, there are very positive impacts because of these land use patterns influenced by the transportation system. Similarly, for example, you can see if certain places developed for a tourist purpose, then again economic activities grow, transportation needs also grow. So, all these things are related to each other.

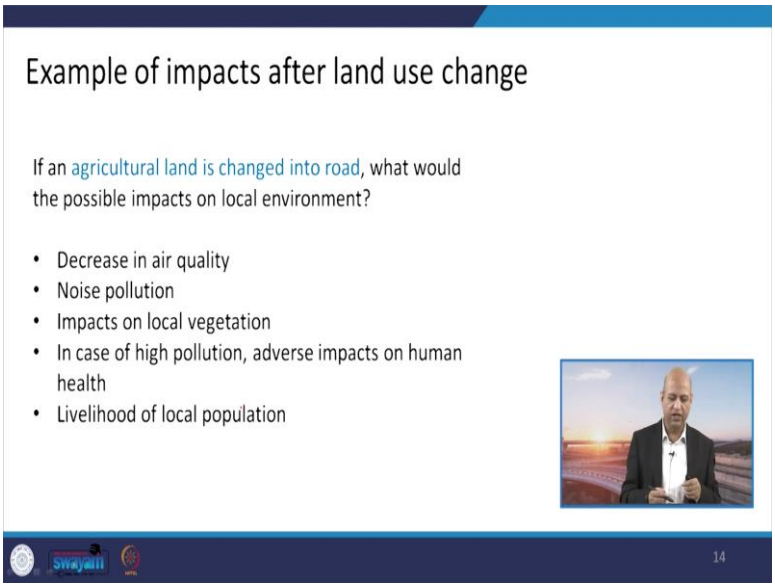
(Refer Slide Time: 12:28)



Well, the impact of land use on the environment which we have seen in detail several times that whenever we do any anthropogenic activity, any manmade activity, whether in terms of industries or the townships or the transportation related infrastructure there are negative impacts in terms of emissions or the watershed related changes in the because when agricultural land is being converted into road, then it will divide certain part of the land from A to B.

Similarly, we have seen in the forest land, when the road goes then it also influences the ecosystem. So, all those systems are influenced by the land use changes and they also impact the environmental components. So, we have to see all these including the climate, human health, which we have discussed, in detail during EIA related issues.

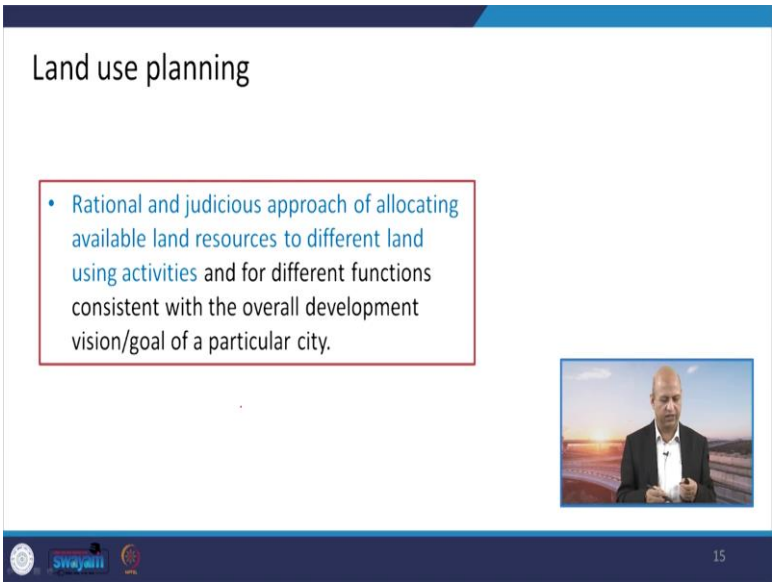
(Refer Slide Time: 13:26)



Well, the impacts again as I said that these are the impacts of negative externalities, because when we change the usage of the land or the practices of the land, like from agricultural land to the road construction, then water flow patterns will change, its topography will change, the noise pollution will be there.

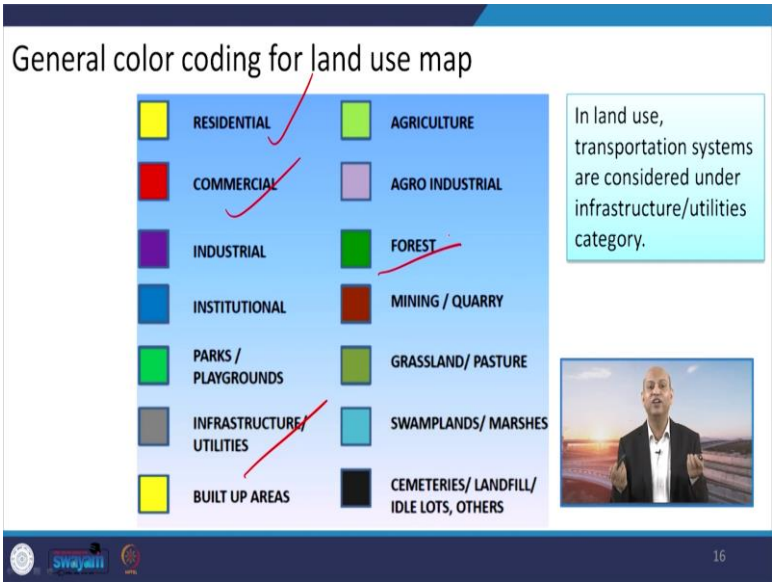
So, natural habitat will be disturbed, and then local vegetation will also be influenced and there may be pollution related issues and the livelihood of the local population may also be influenced positively in that sense, because they will have better access. So, the negative or positive impacts may be there as we have discussed several times in terms of socio economic and environmental impacts.

(Refer Slide Time: 14:09)



Well, the land use planning, if you define, if you try to define, then it is a kind of rational and judicious approach for allocating available land resources for different purposes, for different activities. So, the different functions should be there in synchronicity, for a particular city or a particular township. So, the development must be based on certain vision, to achieve certain positive goals in terms of economic growth, or reducing the environmental impacts.

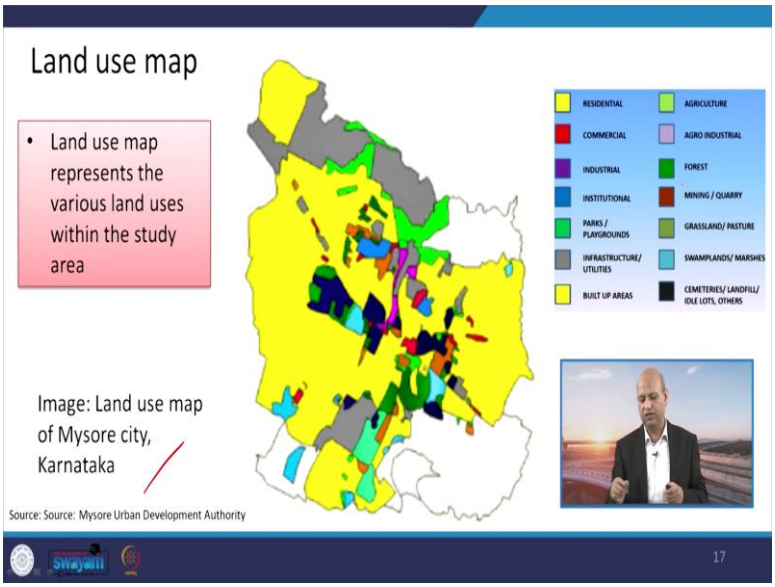
(Refer Slide Time: 14:41)



Well, when we see or do the mapping, when we do the planning, we also do the mapping because we have to represent, we have to communicate what kind of land use patterns are there. So, when we draw a map, we can represent in different colour schemes, different uses. Like for example, residential, in the yellow; commercial, red; industrial, this violet; institutional, blue; then infrastructure utility is grey.

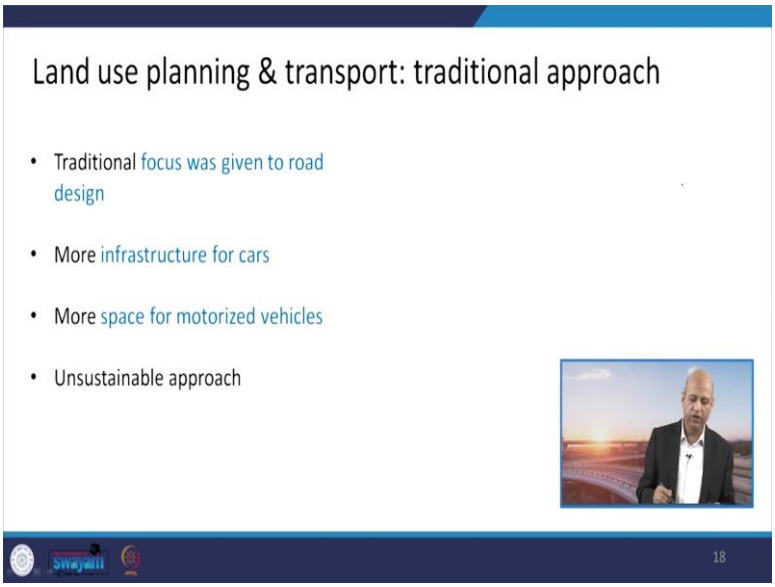
So, the roads and transportation systems will be part of this infrastructure, built up area again yellow type; and agriculture, light green; forests, dark green; those kinds of colour schemes may be there for representing different activities. So, that will be colour code and that will when we you know this colour code then you can easily identify the land use patterns at different locations.

(Refer Slide Time: 15:33)



For example, this is the map for Mysore city, Karnataka. So, the yellow part is you can see residential and built-up area is represented and greyish area is related to kind of different kind of infrastructure facilities which also include related to transportation also and other colour schemes you can identify with these icons or these squares, colour codes.

(Refer Slide Time: 15:59)

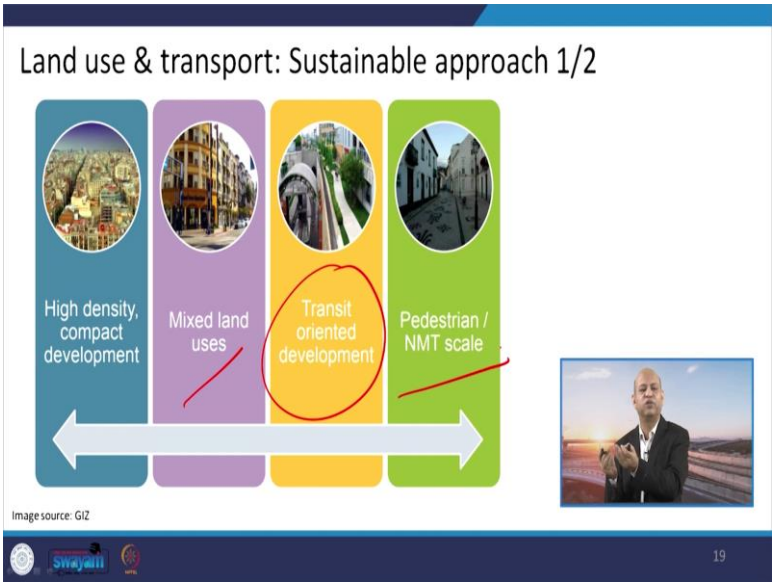


When we talk about traditional approach of the land use planning and transport then we can see that the road designs or infrastructure for cars or vehicles motorised these are the growth which have been seen by developed countries and in several case studies we have identified that this automobile based development or which requires lot of landmass for the road

networks etc., and only few people travel in car and those privately owned vehicles, they are not very sustainable, rather their negative impacts on the environment is more.

And then even socio-economic impacts is also more because congestion happens, traffic jams happens, accidents happens, a lot of things are there. So, and health impacts because of emissions and those issues, greenhouse gases. So, the traditional approach is no more considered as the sustainable approach. So, we should have different kinds of approaches.

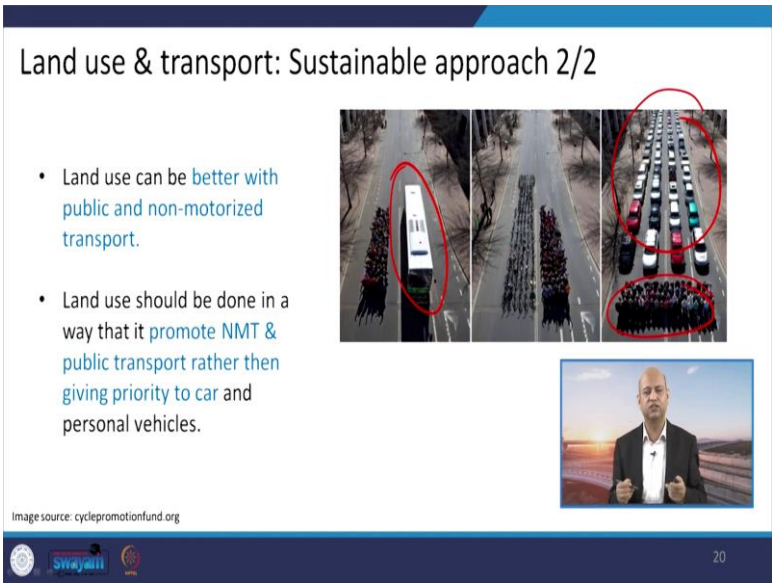
(Refer Slide Time: 17:02)



So, what is the sustainable approach, can we make some balance, can we have some shift from this unsustainable kind of approach to sustainable. So highly dense, compact and these city based, habitats, they have promoted these fossil fuel-based transportation systems, then mixed land use patterns, transit-oriented developments, where different kinds of modes are integrated with each other, and people can travel from one mode to another mode.

And then pedestrian or non-motorised kind of transportation, which is at a local level like a small villages, towns, community level. So, those kinds of things, can we have balance in that, that is the issue with the planners, those transportation related policymakers or planners who think about the sustainable approaches, so, they think in new way, in new paradigm.

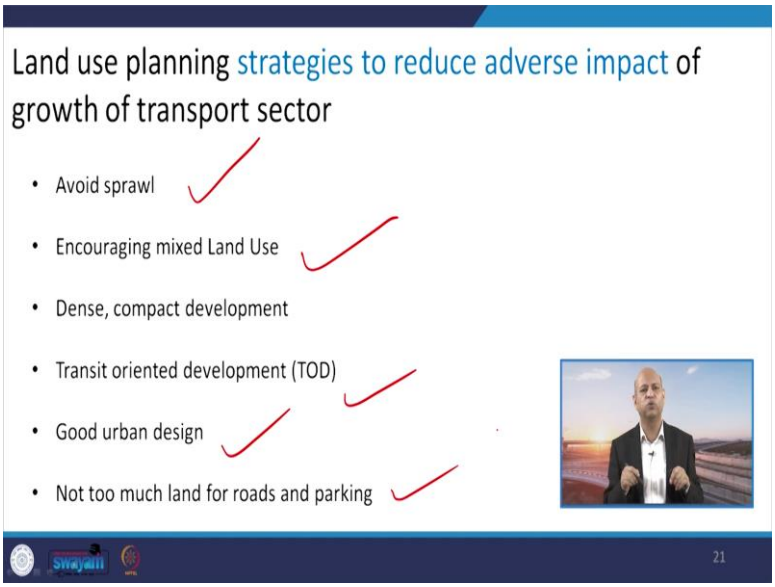
(Refer Slide Time: 17:53)



And these pictorial representations gives this insight that when we have non-motorised kind of transportation, like cycles or at the port, then you can compare how much place is taken by cars and these kind of non-motorised modes of the transport. So, the use landmass is required by automobile-based kind of transportation system and which is also adding lot of emissions to the air and atmosphere greenhouse gases etcetera and if we can promote the non-motorised transportation at certain localities and integrate it to public transportation.

Here also you can see the public transportation only a particular bus or the coach that can cater tens or hundreds of the people depending upon what kind of public transportation we are using. So, that way if we can, promote the integration of non-motorised and the public transportation system in transit mode, that may be good.

(Refer Slide Time: 19:01)



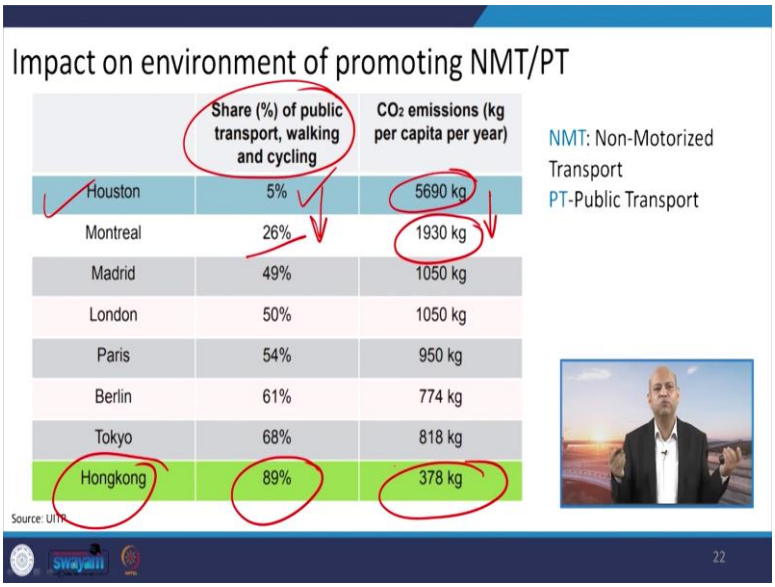
Of course, some people would need a privately owned car when you are travelling longer distances with lot of luggage etc., and you have certain other commitments to make them it may be easier depending upon the family size and your purpose of the travel etc. But in most of the cases, non-motorised kind of transportation at the local level, and then transit transportation for regional and bigger kind of intercity travel can easily be integrated, which we have seen in several cases of the European cities as there were several examples.

Well, the land use planning, the strategy which we use to reduce the adverse impacts or the negative impacts of the growth of the transport sector in traditional way. So, these are the certain points that we should avoid the sprawls because when you are, growing these cities in unplanned way, then you need more time to travel from one place to another.

So, the planning should be proper and rather the needs and their different activities should be at the community-based kind of location. Encouraging mixed land use, so, that people do not need to travel from one place to another longer distances, mixed means there are many activities going on.

So, the various kinds of needs you can fulfil at certain pockets, dense compact development, transit-oriented development, good urban design, not too much land for roads and parking. So, all these points have to be incorporated in better planning to reduce the adverse impact of the growth of this traditional transportation system.

(Refer Slide Time: 20:42)



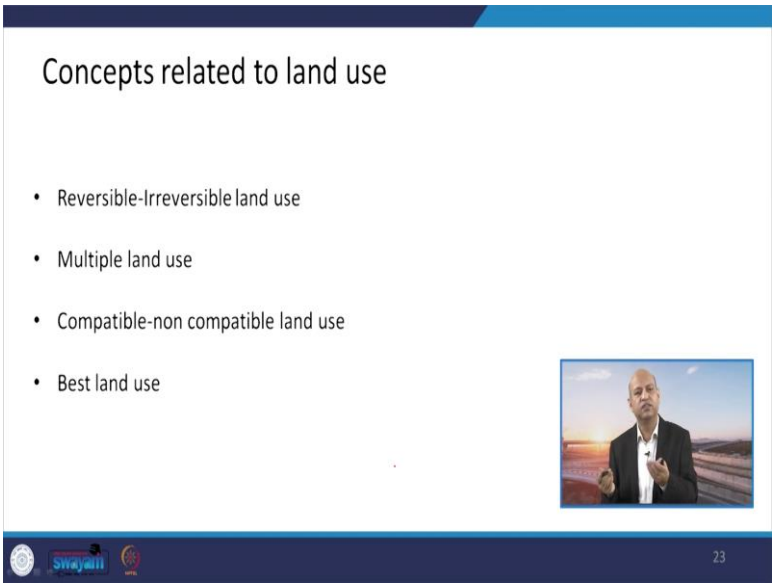
Now, see very interesting example here you can see the impact on the environment by promoting the non-motorised or public transport NMT non-motorised transport or PT that is public transport. So, see the city's Houston, share of the public transport or walking and cycling is only 5 % see and the CO2 emissions per capita per year, kg per capita per year is around 5700 kilogramme, very huge amount.

Now, you go Montreal 26 %, so share of the non-motorised transportation and the public transportation is increasing and this see 1900 kg per person per year. So, that it is decreasing the emission, CO2 emission is decreasing and the public's share, the public transportation share or non-motorised share is increasing.

Similarly, if you go like up to Hong Kong where around 89 % or 90 % of the share of these public transport and the walking and cycling is there in the total mobility and then it is very minimum on the 378 kilogramme CO2 emission per capita per year. So, that way you can see the direct result that if we promote the non-motorised transportation related activities cycling or walking.

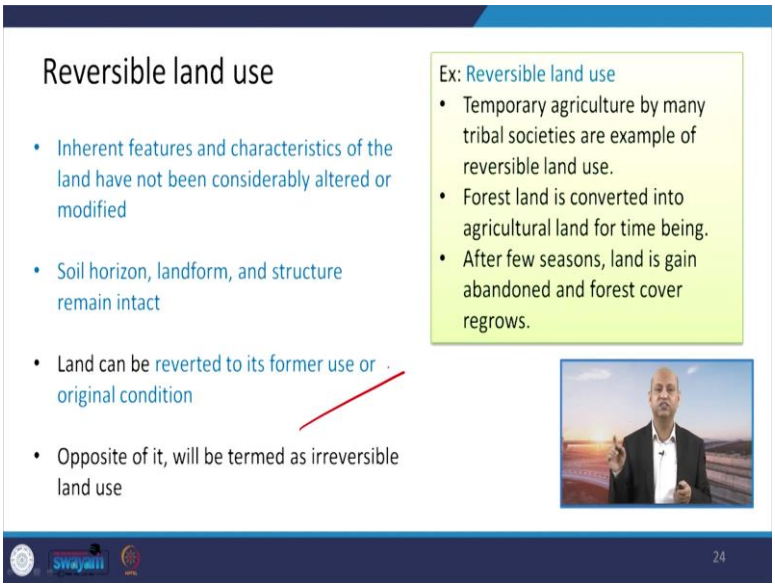
So, it is healthy also and at the same time you promote the public transportation then you really do win-win situation, because you also reduce the emissions which are harmful to the environment and it also contribute into greenhouse gas or they are also harmful for the human health. So, that we it is a win win situation because on one hand it will reduce these adverse impacts of the environment, on the environment. And on other hand, it will make you more agile, more active because of physical activities.

(Refer Slide Time: 22:44)



Then concepts related to land use, if we think about them, there may be like reversible land use or reversible irreversible land use or there may be multiple land use. Then some compatible and non-compatible land use or best land use so that these kinds of concepts, we will discuss now.

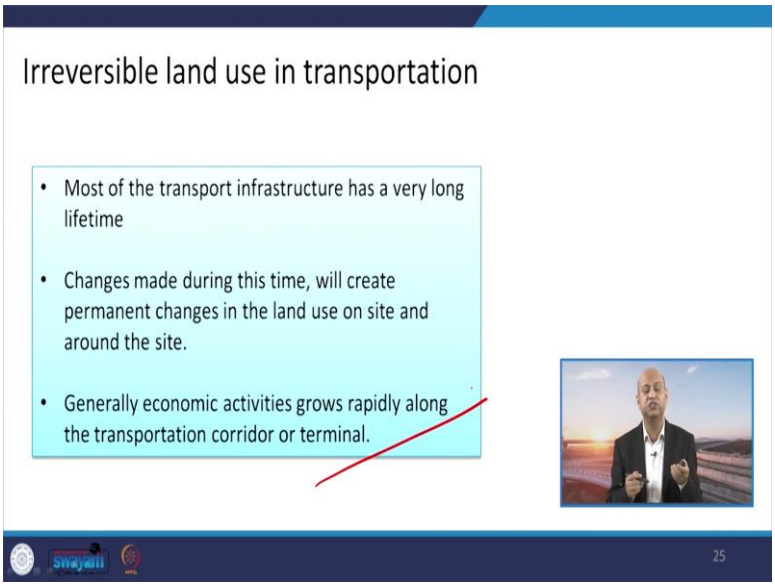
(Refer Slide Time: 23:02)



What is the reversible land use that means, for temporary one particular use is promoted and after that it is left and the original use of the land emerges. For example, in tribal societies or in forest areas, some communities are living they change the forest land for agricultural purposes for some time, then they leave it, and again forest grows there.

So, again it is reversible kind of forest land again it takes care of itself and then, the soil horizon, landform or structure remain intact in that sense in reversible, because after some time it will regain its own original, original structure, original purpose and it can be reverted to former use, original condition as we have seen in this example.

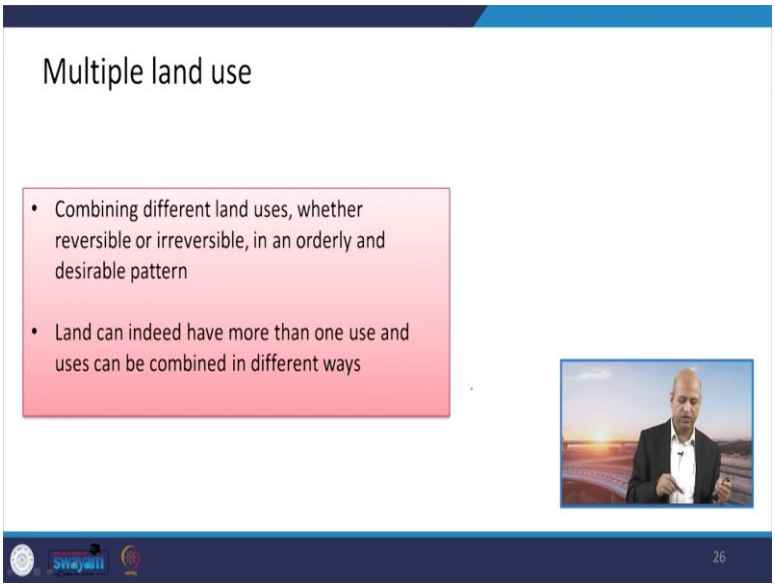
(Refer Slide Time: 23:58)



And then if this is not the case opposite then only irreversible means, for example, most of the transportation infrastructure which we see in terms of roads or railways, all these are kind of permanently land use kind of things because maybe tens or hundreds years before some track was laid and it is there. So, permanently that land use has changed in its structure and the pattern.

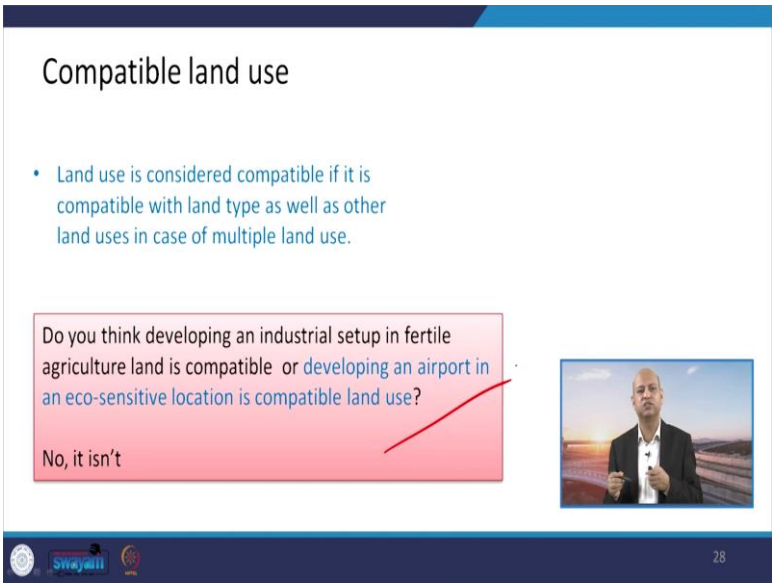
So, these are the irreversible kind of thing, but, at the same time, you can see the economic activities also grows permanently, where there was kind of the land use was completely out of these kind of economic activities, which also get, because of these land use pattern changes in a permanent way.

(Refer Slide Time: 24:44)



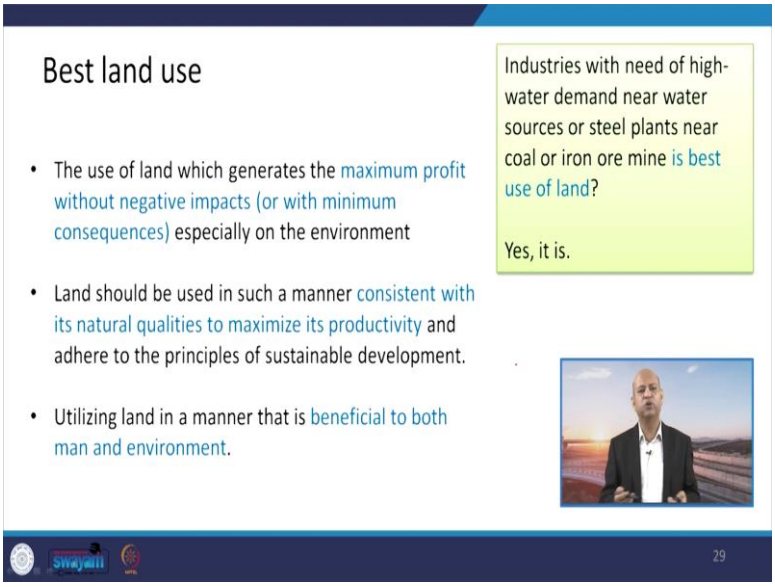
Multiple land uses maybe there so, maybe you can combine. For example, these kind of you can see, malls are there and then you have roads. So different kinds of multiple uses can be there at a particular transportation hubs or commercial centre. So, the multiple uses can also be promoted. Then there are this compatible land use or non-compatible land use in that sense, the multiple purpose land use patterns are more compatible.

(Refer Slide Time: 25:23)



And, for example, if you want to develop a city in a fertile agricultural land, so, it is not a comfortable kind of option, because that will change the purpose of the land in a different kind of purpose which not be, which may not be so productive or airport is developed at this particular land, which is highly fertile, or at the eco sensitive locations, that is not compatible, those kinds of issues are there.

(Refer Slide Time: 25:50)



Similarly, the best land use, what is the best land use? That means, we need to integrate the character of the land, or the structure of the land with the new purposes. For example, if industries are developed, or near the high, the industries which need a lot of water, if they are developed near a water source or river or sea, then it is a compatible kind of thing or best land

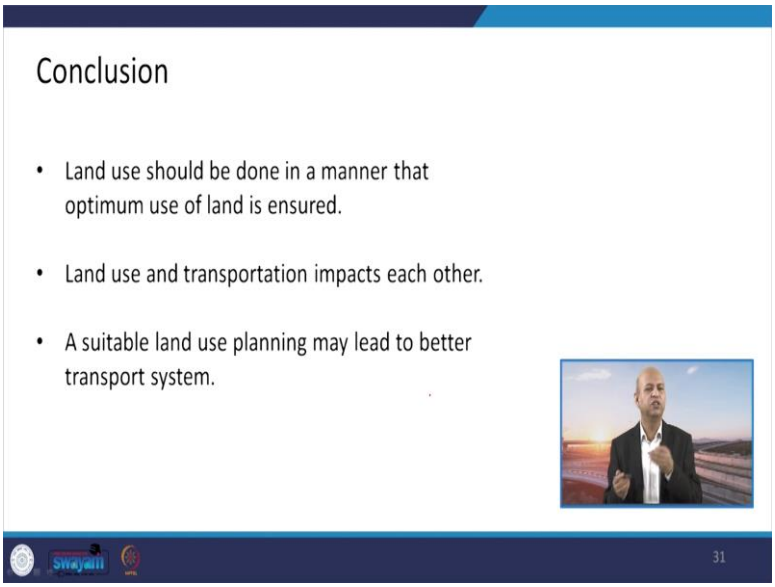
use because they will be helpful, you do not need to transport water from another place for longer distances.

Similarly, they still plants if you establish nearer to the coal or iron ore mining areas, then it is also compatible. So, those kind of things, if you see then productivity is enhanced and it is consistent with the natural qualities of the these land masses.

(Refer Slide Time: 26:45)

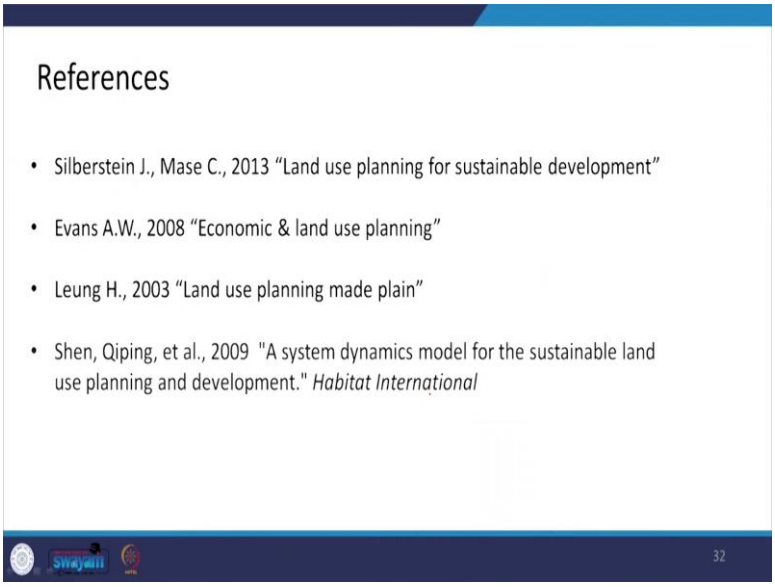
Well, when we see the poor land use examples, then one example is environmentalist, often quote is related to Amravati City, it is said that, this because the new capital of the city of Andhra Pradesh after this bifurcation of state, so it is situated near Krishna river, and the land is very fertile. So if that fertile land is converted into city or those kind of uses, then it may not be so good use, it is a kind of poor land use, as environmentalists argue that because you are shifting that productivity of the agriculture to a different kind of activity, which may be economically good in terms of city as we see that these are the economic engine cities are there, but the purpose, the purpose like to grow the food, it will be kind of negative impact in that sense, because the agriculture fertile land will be converted into residential areas.

(Refer Slide Time: 27:54)



Well, when we conclude to see that the land uses and the planning of the land for transportation system, in what way it should be, and can we integrate the needs of the transportation with the existing of the land patterns. So, the manner in which it is optimised, the usage of the land, we should look at that and the impacts of the transportation on the land and the land characters on the transportation that should also be taken into account. And ultimately, we should see that the land use planning should lead to better transportation system and optimum uses of the resources, only that is the better planning of the land for the uses for particular transportation needs. So that is important to conclude.

(Refer Slide Time: 28:47)



And these are the references which have been used for this particular lecture. Thank you for your attention. So now I hope you are clear about how land use and transportation needs influence each other, that is very important to see. Thanks again.