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ECOLOGY AND ENVIRONMENT
Sustainability and Case Studies
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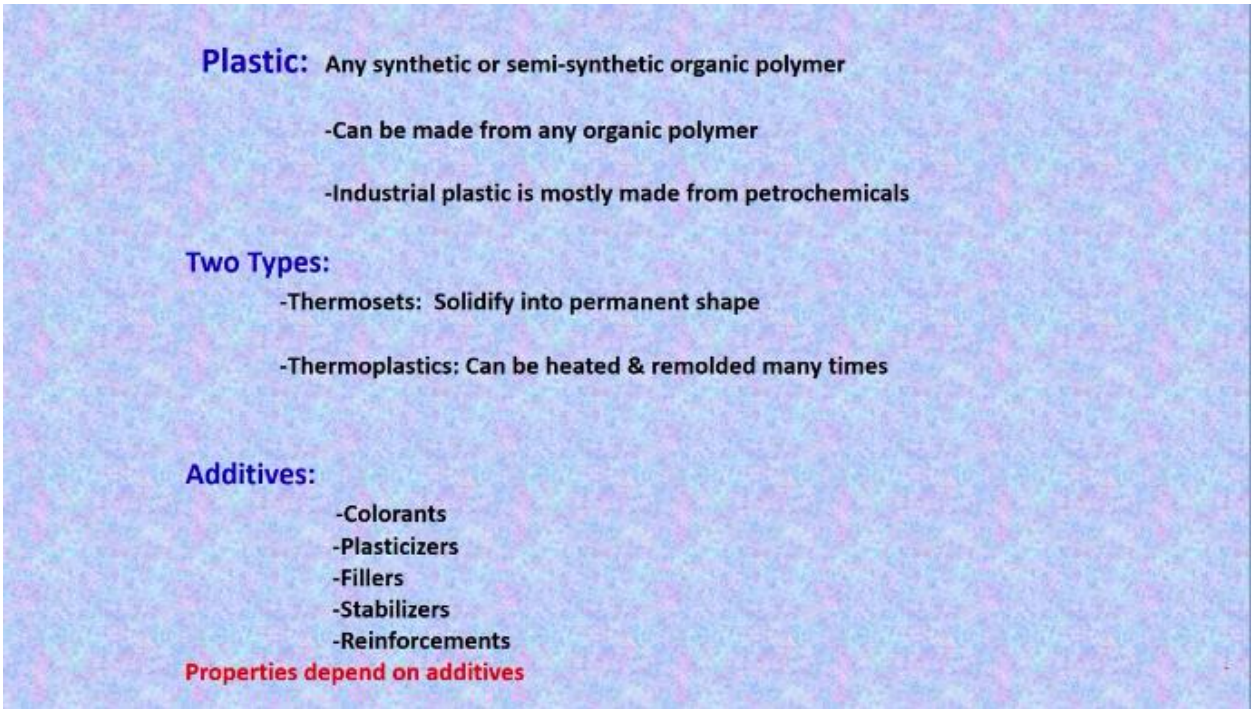
USE AND THROW PLASTIC

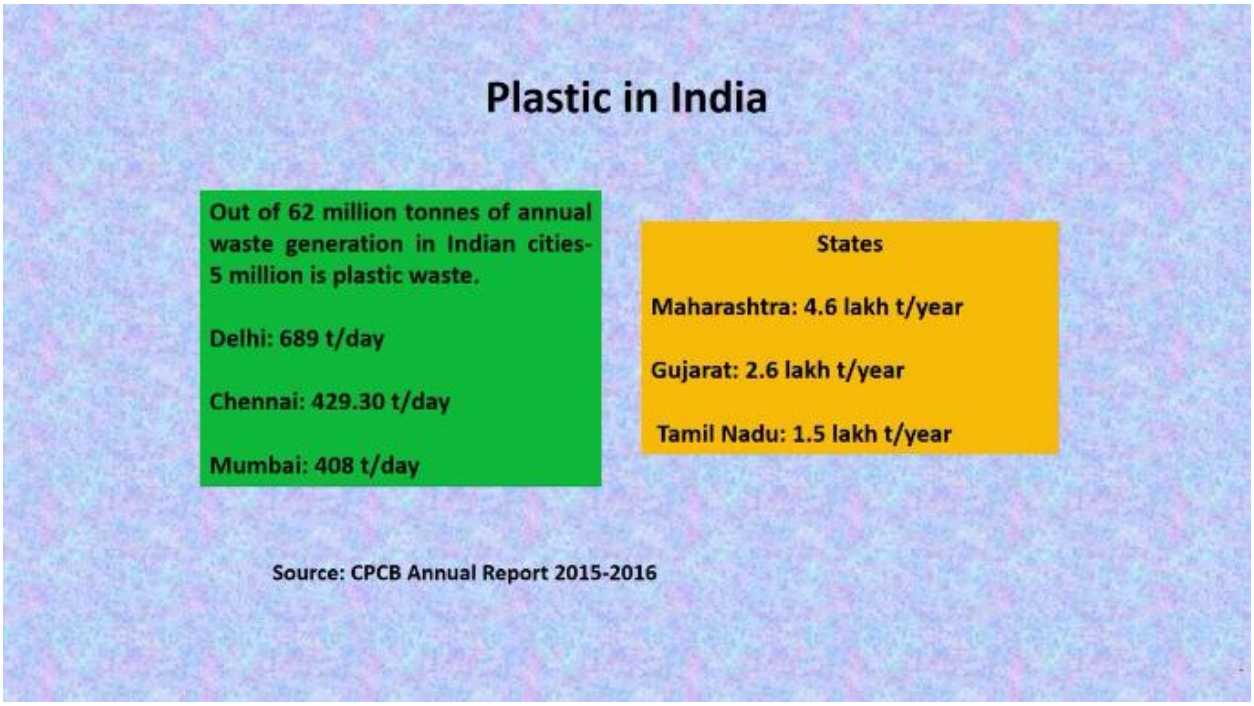
Welcome to the series of lectures on sustainability. The concept of sustainability can best be illustrated in the context of use and throw plastic items. As you all know, plastic is any synthetic or semi-synthetic organic polymer. It can be made from any organic polymer, but the majority of industrial plastic is made from petrochemicals.



As you all know, there are two types of plastic, thermosets which solidify into a permanent shape, while thermoplastics they can be heated and remolded many, many times. When we make these plastics, we also use a lot of additives like colorants, plasticizers, fillers, stabilizers, and reinforcements. The specific properties of any plastic depend on these additives.

Examples of plastic, you have heard these things before, PET that is polyethylene terephthalate, HDPE - high-density polyethylene, of course, PVC that is polyvinyl chloride, and PS polystyrene, these are among the different plastics that are available.

Leo Baekeland was the first person who made a completely synthesized plastic, and it is named as Bakelite. And this was back in the year 1907. Since that time lot of work has been done and a lot of plastics have been introduced.



And now we find plastic everywhere, as far as the scenario for the plastic in India is concerned, out of 62 million tons of waste that is generated in India from the cities per year, plastic accounts for 5 million tons. The City of Delhi produces 689 tons of plastic per day, this is followed by the city of Chennai which produces 429.3 tons per day, and Mumbai 408 tons per day. As far as the states are concerned, the state of Maharashtra produces 4.6 lakh tons that is 0.46 million tons per year, Gujarat comes second, it produces 2.6 lakh tons or 0.26 million tons per year, and Tamil Nadu 0.15 million tons per year.

As I mentioned, plastic is found everywhere. We use the plastic items, and we throw them around. Wherever we find a vacate land you can see this is from one of the cities in the southern part of India. In any vacant land, you find this plastic lying. Then although you may have dumpsters, the capacity is not sufficient, and then many times they are overflowing dumpsters with a lot of plastic around. And a lot of this plastic also has food particles sticking to it, so the animals try to go there and then try to eat that food and along with the food these animals are also taking plastic into their stomachs. We find many animals like deer, even elephants, they have done some postmortems in certain places and found plastic inside their stomachs, a lot of plastic. In fact, they take this plastic and that maybe the cause for their death. Then you find plastics on the beaches, again this is one of the beaches in the Southern part of India on the Eastern Coast, and you see this plastic lying on the beaches. And some of these plastic actually it is not just thrown by the people, it actually washed ashore from the sea. You have shops, in fact, plastic is ubiquitously found in every shop.

Shops

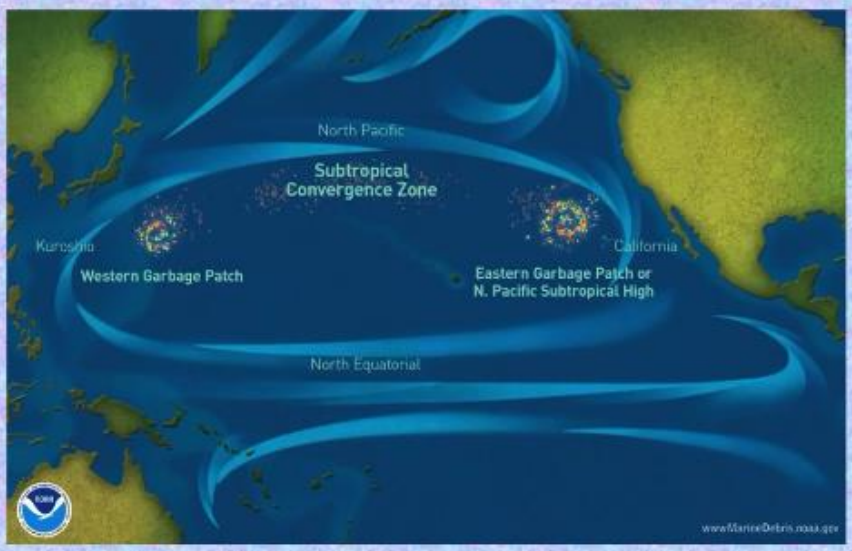
Plastic Water Bottle in Mangrove

Open Drains

This is one of the shops outside a religious place, people come here to buy the material that they want to use in the religious ceremonies, and then they carry that plastic, I mean the material into the religious place using a plastic carry bags and there may be other many plastic items.

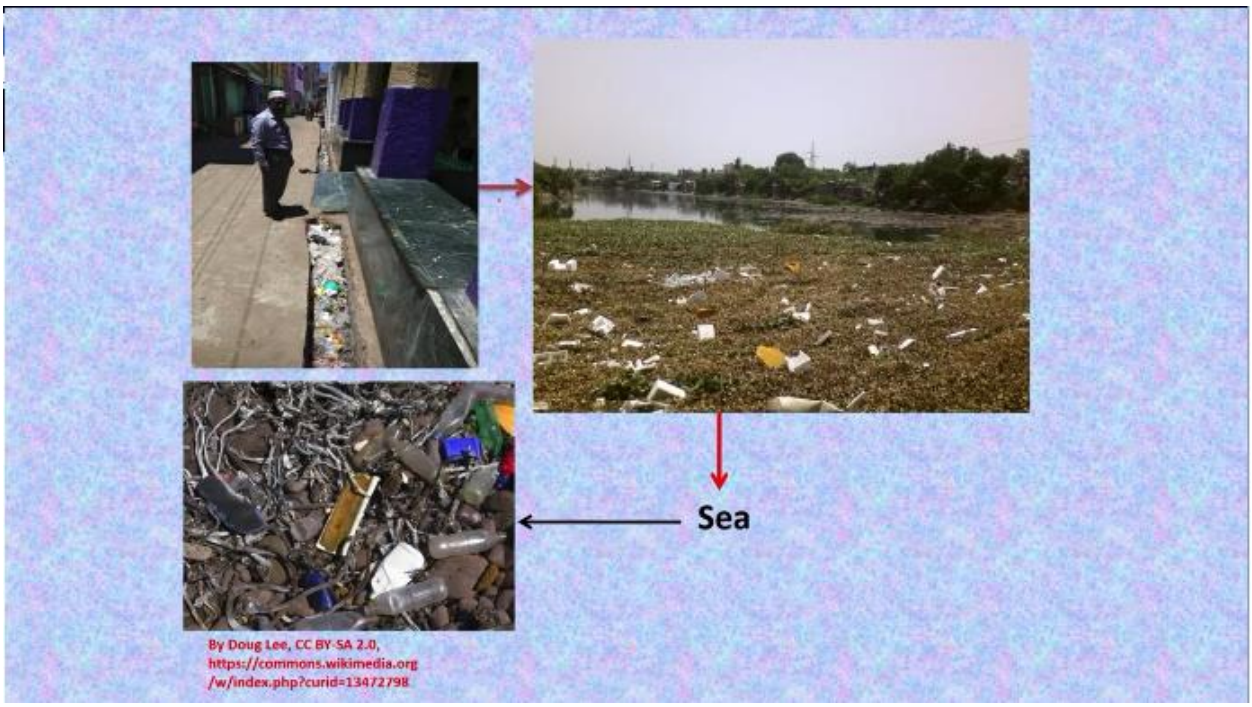
The plastic you can see here, there is a bottle, plastic water bottle stuck in a, it is a mangrove, okay, one of the very sensitive areas. It is a mangrove again, Pichavaram mangrove in the state of Tamil Nadu. We have taken that picture from there, there is a plastic there, of course, plastic is found in many of the drains, choking them. This is a picture from one of the towns in a Southern part of India, but this is typical of many, many towns in my country.

This plastic which is choking these drains, will not let, will not let flood waters flow very easily and then many times even a small amount of rain can cause local flooding because of this plastic in the drains.



By NOAA - http://usresponserestoration.wordpress.com/2012/06/22/how-big-is-the-great-pacific-garbage-patch-science-vs-myth/, Public Domain, https://commons.wikimedia.org/w/index.php?curid=25889730

You also have plastic in the oceans. This is the typical or famous example of plastic found large amounts of plastic found in the Pacific Ocean. You have this is the eastern garbage patch or north Pacific subtropical high. This is the northern Pacific Ocean, and we have the United States and then Japan, and in between you have there is a patch of plastic here, then there is a western garbage patch, and then you also have some plastic there. Nobody is using plastic there, but then plastic finds its way into the oceans.



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How does it happen? First, it gets thrown and then from small, small drains it goes into the rivers. This is an example of a river in the city of Chennai, Adyar River where we find a lot of plastic in the river itself. So from the drains, it goes into the rivers, from the rivers it goes to the sea, and then again from the sea it comes back to the beaches. So, you find plastic everywhere, there are many environmental concerns with this plastic. First of all, there are emissions during manufacturing.

Then there is a dumping of this plastic on land makes it very infertile. This plastic reduces the porosity of the soil medium and then will not let water flow very easily in sub surface and can lead to infertility of the soil.

In many places, the plastic is burnt, at least in developing and then under developed countries many times they burn the plastic, they collect the plastic, and they will burn it. This burning generates toxic emissions such as carbon-monoxide, dioxins, etcetera, among other toxic gases. We also add a lot of additives while making this plastic and these additives are toxic, and many times they are also can leach out. And as I mentioned earlier, there are severe disposal problems for this plastic, many times we do not have enough, you know, places where we can dispose this plastic in a scientific way. Then there is a problem of sub-standard plastic, the sub-standard plastic are very thin plastic, there is a problem in collection, and there is a problem in recycling. So. because of this some plastic maybe left with other garbage or sometimes this plastic is also found along with the biodegradable waste, which one would like to, you know, use it for making composed and so on and so forth. So, it is interfering with our waste processing facilities. And these waste in some places where proper monitoring is not present, it is encouraging unsound recycling processes.

So, in many places, there is a need for, and then many cities, countries, states have found a need for banning the use of use and throw plastics. For example, Bangladesh, China, Denmark, Kenya, Rwanda, and many states in the USA have already banned the use of the use and throw plastics. Here I have given this list, there are many, many countries, I have given this list to illustrate that both developed countries and developing countries across the world are finding the need to ban the use of this plastic.

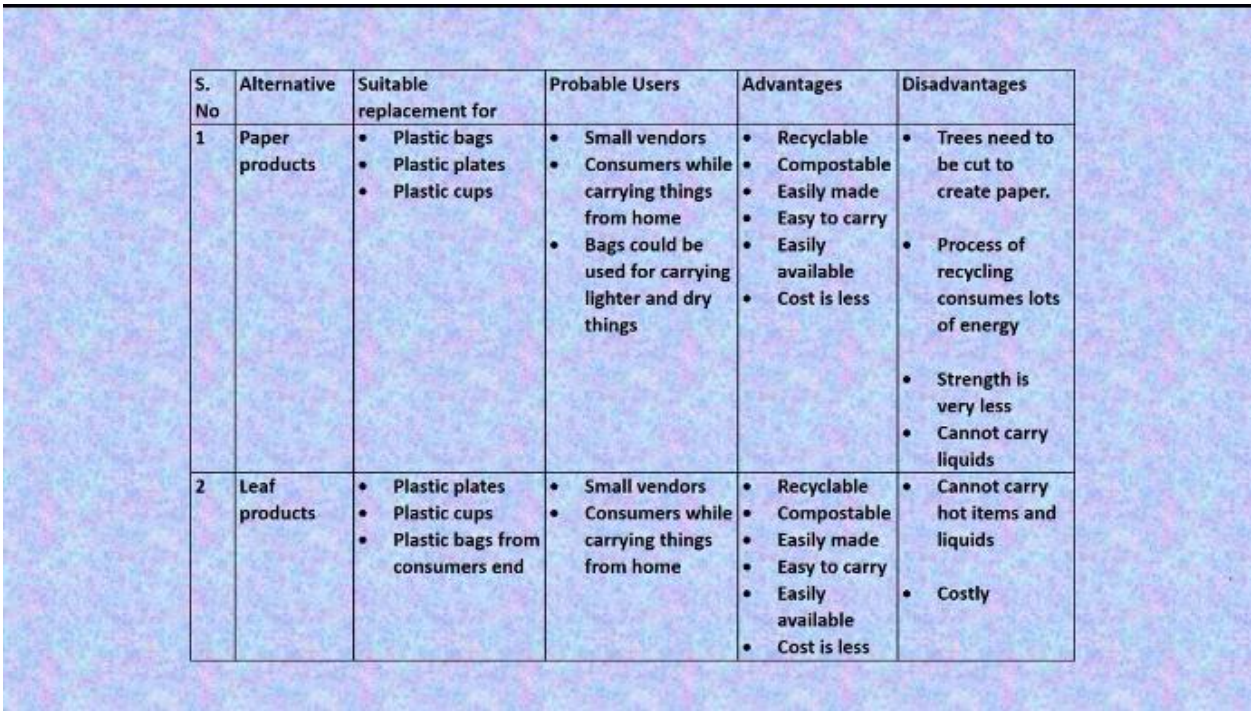
In India, more than 18 states have banned one time use of plastics and particularly these use and throw plastic items such as plates, cups, spoons, and other cutlery, carry bags, banners made of plastic, and material used for making packaging for food which is take away food from the restaurants, water sachets, these are among the items which are banned.

Now, before we go and then ban this daily use items which are made of plastic, we need to find alternative materials. Otherwise, implementation of the ban on plastics would not be effective. So, there are many alternative materials which are available.

Here in this picture, I am showing a carry bag made of jute, which is a biodegradable material and then we also have cutlery these days being made out of biodegradable material. We have spoons, forks, knives etcetera, we can make out of biodegradable material, we don't have to use plastic spoons and plastic knives. A lot of people are now using the plastic carry bags, there is one shop which is selling the plastic carry bags here in India. And then a plastic carry bag that is being used at religious places in India in temples in India.

So, as I mentioned there many alternative materials like we can make material out of paper, leaf products like banana leaf and leaves of many other trees can be used making, can be used for making plates, cups, etcetera.

Then we have biodegradable bags which are made of starch, one can use cloth bags and jute bags for carrying the material instead of using plastic carry bags. Where edible cutlery is being, edible cutlery you can use the spoon and then you can eat the spoon too, this edible cutlery is being made from dough, coconut shells, kora grass etcetera can be used for making many items. Then we can use earthenware in many parts of the northern part of India, in fact, the earthen cups are used for serving tea and coffee. And other materials like glass, stainless steel are always there for making the items or products. And bamboo also can be used for making many products which are right now made using plastic.



S. No	Alternative	Suitable replacement for	Probable Users	Advantages	Disadvantages
1	Paper products	• Plastic bags • Plastic plates • Plastic cups	• Small vendors • Consumers while carrying things from home • Bags could be used for carrying lighter and dry things	• Recyclable • Compostable • Easily made • Easy to carry • Easily available • Cost is less	• Trees need to be cut to create paper. • Process of recycling consumes lots of energy • Strength is very less • Cannot carry liquids
2	Leaf products	• Plastic plates • Plastic cups • Plastic bags from consumers end	• Small vendors • Consumers while carrying things from home	• Recyclable • Compostable • Easily made • Easy to carry • Easily available • Cost is less	• Cannot carry hot items and liquids • Costly

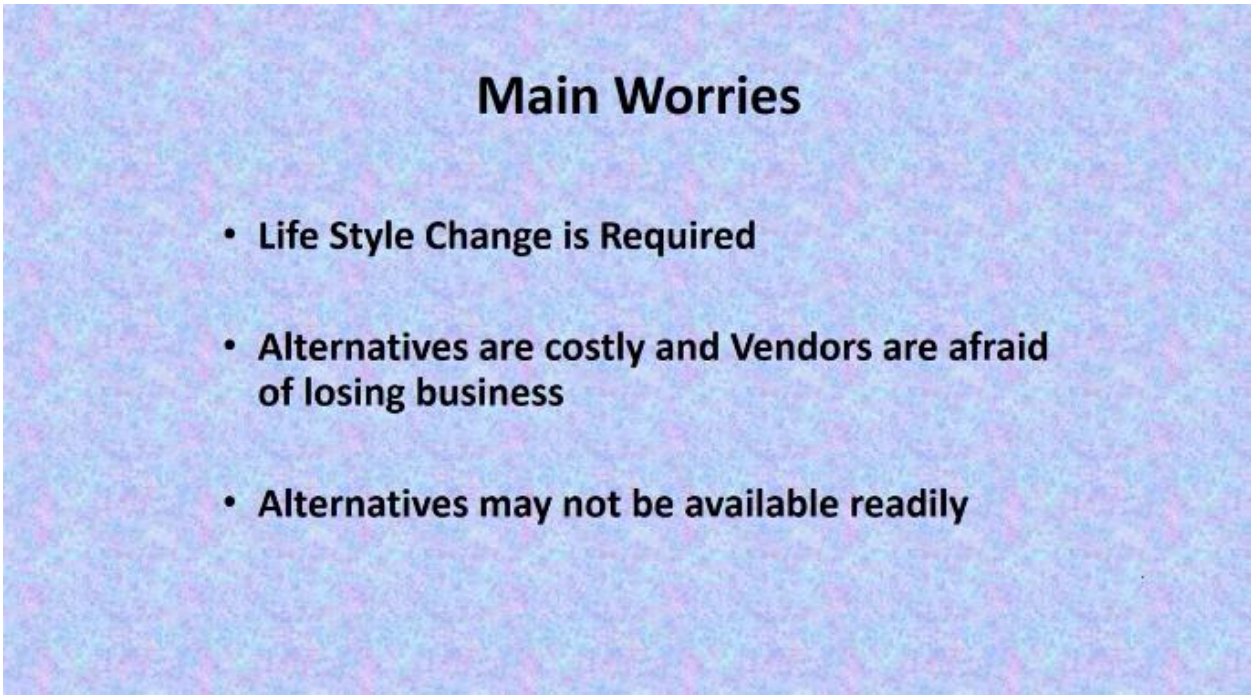
Of course, when we introduce alternatives, we have to see what is the advantage or what is the disadvantage one can make this table as I shown here. Like paper products, we can, they are suitable for making plastic bags, I mean they can use, I mean they are suitable for replacement for plastic bags, plastic plates, and plastic cups. And they can be used by small vendors to sell, I mean the small vendors can sell this items because they are not very costly. And also, consumers while carrying things from home they can be used for carrying lighter and dry things. Advantageous are they are recyclable, they are compostable, they are easily made, easy to carry, easily available, and the cost is not very much. But of course, if you have to make many, many products out of paper, then will be cutting a lot of trees. And the process of recycling consumes a lot of energy and paper bags do not have that much of strength, and they cannot carry liquids.

Similarly, leaf products can be used for making items which are replacement for plastic plates, plastic cups, plastic bags from consumers end. And again, they can be used by small vendors and

consumers while carrying things from home. They are also recyclable, compostable, they are easily made, easy to carry, easily available - this is not correct, they are sometimes costly, and they also cannot carry hot items and liquids. So, like this when you introduce alternative materials for items made of plastic, we have to weigh the advantages and disadvantages. Cost is one of the main factors and where we can use them is another important factor.

6	Earthen products	• Plastic plates • Plastic cups	• Small vendors • Medium to high end hotels/restaurants	• Recyclable • Reusable • Washable • Compostable • Easy to carry • Easily available	• Relatively costly • Clay Tea cups cost around Rs 3 per piece
7	Bamboo products	• Plastic plates • Plastic cups • Plastic bags for carrying small items like puja items	• Small vendors	• Recyclable • Reusable • Washable • Compostable • Easy to carry • Easily available	• Relatively costly • Bamboo plates Rs 4-8 per plate depending on the size • Bamboo basket around Rs 50 for a medium sized basket

So, here we have given another item, earthen products, they can be used as a replacement for plastic plates and plastic cups. But they are relatively costly, they are recyclable, reusable and so on, and they are compostable, but they are relatively costly, approximately a teacup cost around 3 rupees per piece as of now. We can also use bamboo products, again they are recyclable, reusable and compostable, but they are also relatively costly. A bamboo plate cost anywhere from 4 to 8 rupees per plate depending on the size and the bamboo basket costs around rupees 50 for a medium sized basket. So, when you introduce these new materials as an alternative to plastic we have to think about the cost of it, whether the small vendors will be able to stock them up and then sell them, whether the users are willing to pay that extra cost, if we banned the plastic and then introduce this items. These are some of the issues that one has to think seriously while implementing the ban on the plastic items.



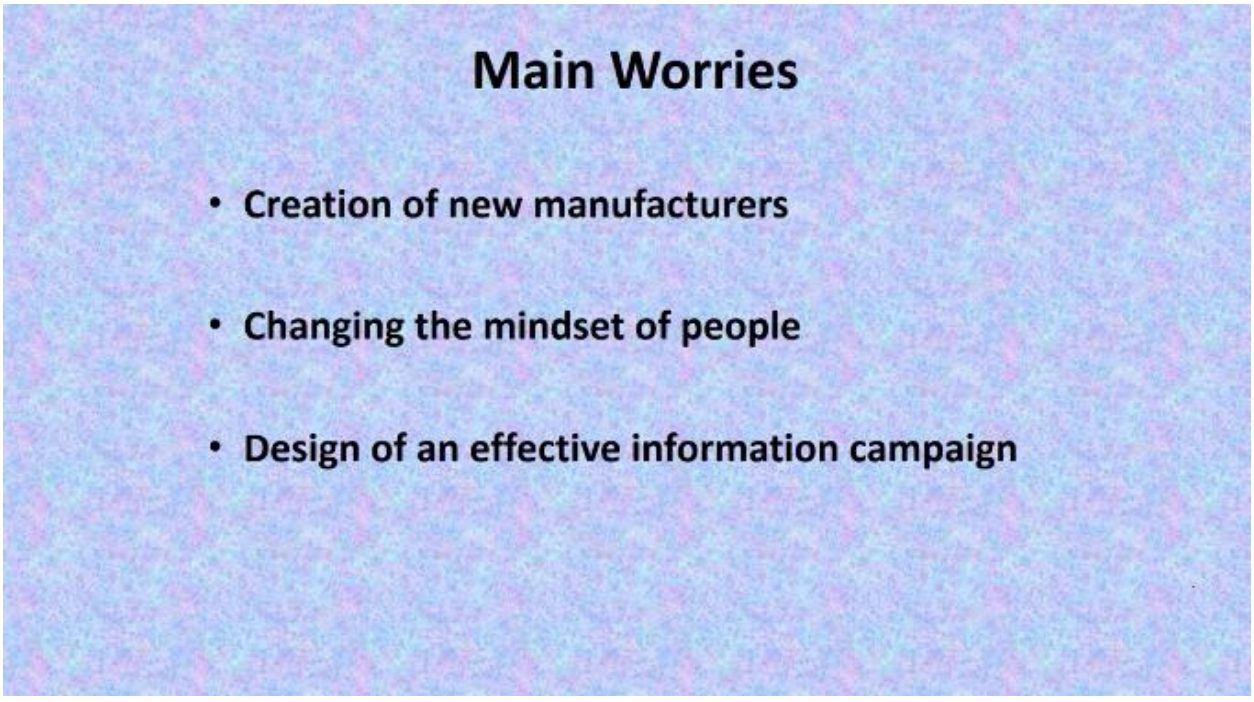
So, there are many worries for the governments who are planning to implement this ban on the plastics. First thing is you are asking people to change their life styles, that is a very big issue. How you take along the people with you? Because if the people are not willing to change, then it becomes very difficult to implement the ban. Alternatives are costly, definitely costlier than the plastic items, and so vendors especially small vendors or marginal vendors are afraid of losing their business. Because if the ban is not implemented uniformly then they are afraid that other shopkeepers who are carrying plastic bags or plastic items would be having all the business.

Another important issue is at each locality we may not be able to find out appropriative alternatives based on the locally available material. Then coordination between many stakeholders when you try to implement this ban on plastics. Particularly in some of the countries, this could be an issue, coordination between many, many stakeholders between the implementing agencies like government or monitoring agencies or manufacturers, the vendors, the users, coordination between all these different stakeholders could be a problem.

And manufacturers of alternative products, they are coming new into the market, so they expect some sort of support, financial support either in terms of interest, I mean low interest rate, loans, or subsidies etcetera. They expect some sort of support from the government. When you implement this ban, initially there will be protest from manufacturers and vendors, and there will be lobbies of manufacturers, would, who would lobby with the government for delaying this ban or diluting the rules for the ban, then implementation of the ban by the government itself could be difficult because of availability of manpower for implementation.

They may not have enough people who can go and then implement this ban, in terms of, know, monitoring, in terms of finding the people who are violating the ban and so on and so forth.

Then the availability of, as I mentioned the availability of manpower for implementation and there is also the government has to think very carefully regarding delegation of authority for implementation.



We have to create new manufacturers because current levels of productivity are not sufficient to meet the demand that would be there for the alternative materials once the ban comes into the implement- I mean once there is an implementation of the ban. The, as I mentioned earlier, the

biggest hurdle would be changing the mindset of people who got used to using these plastic items. So, one has to design an effective information campaign, information, education and communication programs or EC programs, they have to be innovative, and they have to be effective. It is not just sufficient if you put the boards all over the place like I am showing here, many times.

This is required, I am not saying this is not required this is definitely required, but we need to do something more than this like boards here you have one sign here which says avoid plastics.

And of course, you have to make the signs in the signboards in the local language, so all the people will understand what is being said. These things are very important, but beyond this, you need to have some innovative campaigns to educate people like probably one can think of having street plays. Street plays are very effective, you can think of having a street play and then where you educate people regarding the ill effects of plastic and then why they should change over to alternative materials.

And with that, I would like to end this lecture. I have taken a lot of help from my colleagues, Professor Ligy Philip and Professor V R Muraleedharan from Department of Humanities and Professor Ligy Philip is from Department of Civil Engineering at IIT Madras for making this presentation.

Thank you.