Introduction to Environmental Economics

Prof. S. P. Singh
Department of Humanities and Social Sciences
Indian Institute of Technology, Roorkee

Lecture - 27
Consumer Demand for Environmental Goods – II

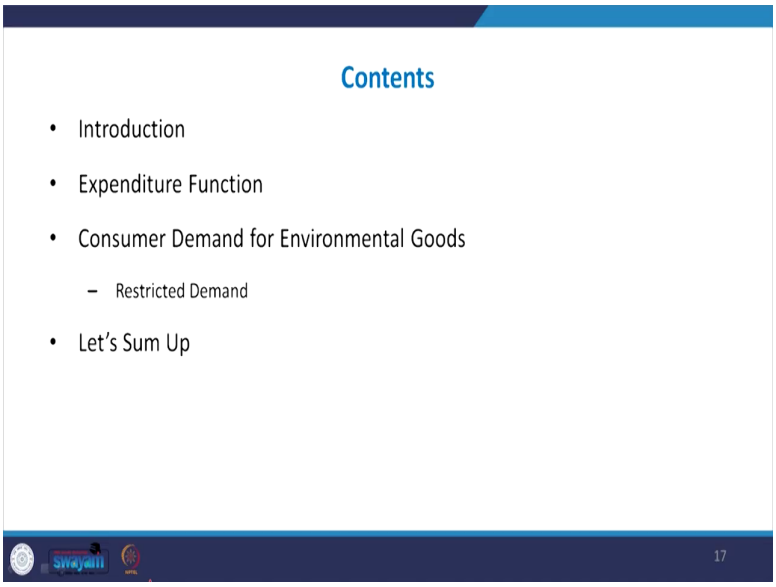
Dear students, in the preceding lecture you guys studied about to the concept of the demand, two approaches of measuring demand; one is revealed preference approach and other is a stated preference approach.

Within the revealed preference approach, we have hedonic price approach and household production approach and in stated preference approach, the most permanent approach is contingent; contingent valuation method and this stated preference approach is applied in those areas, where they know market and we wanted to evaluate the demand for those goods and services which are beyond the scope of that market. Like assessing the ecosystem services, we use a stated preference approach and within the stated preference approach, contingent valuation method is used. So, we had discussed this.

I also explained you the two types of demand; one is ordinary demand which can be drawn from the equilibrium point of indifference current, the price ratios and the other is the compensated demand. In case of ordinary demand curve, when the price of the product declines, the real value of the purchasing power increases and consumer reach or the higher level of satisfaction.

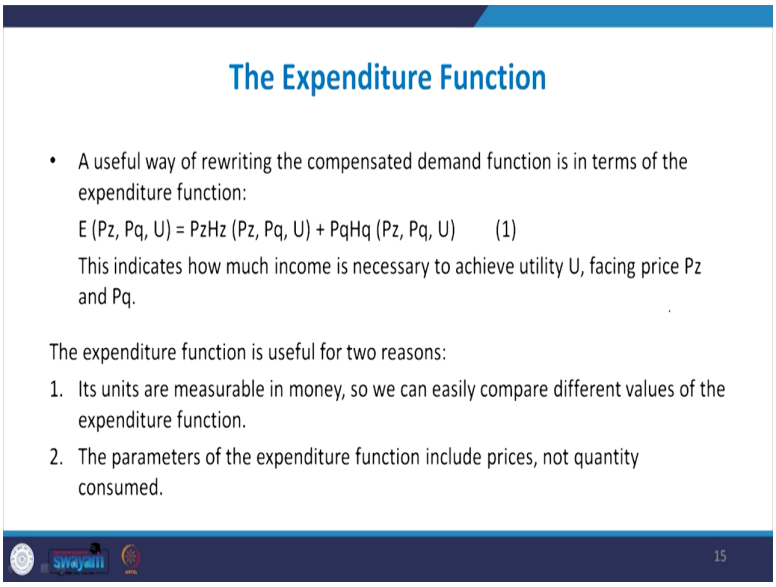
Just on the other hand, in case of compensated demand curve if price of the product is increase or decrease, then income of the consumer is change in such a manner that consumer is neither worse off or nor better off or the given level of welfare of the consumer is achieved. For example, when price of the product is increase, then welfare of the consumer will come down. So, to in order to maintain the same level of welfare, the consumer will be compensated. So, compensated demand curve is used for further analysis of environmental goods.

(Refer Slide Time: 02:50)



And in this lecture, you will study about the restricted demand functions and expenditure functions and you will also study about the derivation of demand curve, when we have two products. One is conventional product and other is the environmental product.

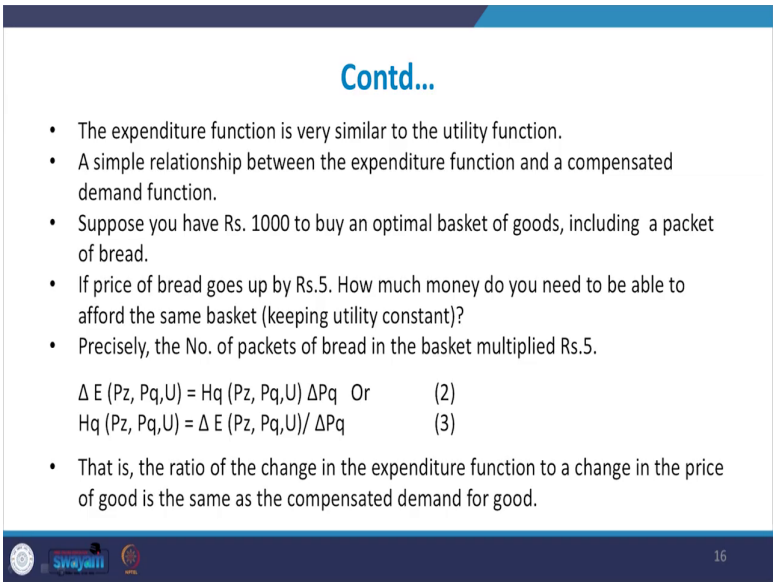
(Refer Slide Time: 03:09)



After understanding these two demand functions, let me now tell you expenditure function. A useful way of rewriting the compensated demand function is in terms of expenditure function and in expenditure function that we take the same product z and q and utility. So, expenditure function with respect to price of the product z q and given utility is equal to how much money is spent on z product and how much is the price of the product. So, PzHz is the amount of the money spent on z product plus PqHq means the amount of the money is spent on q product.

So, this is a total budget of the consumer. So, this indicates how much income is necessary to achieve a given level of utility when the consumer is facing Pz and Pq, the price of z and q product. The expenditure function is useful for two reasons; first, it its units are measurable in money. So, you can quantify, measure its unit in terms of money. So, we can easily compare different values of the expenditure function.

(Refer Slide Time: 04:47)



Second, the parameter of expenditure function includes prices not the quantities. But, this expenditure function is very similar to utility function. So, give if you have a given level of utility, then you can know how much money is required to achieve that given level of utility. So, expenditure function is quite similar to the utility function. A simple relationship between the expenditure function and a compensated demand function can be established through an example.

Suppose, you have 1000 rupees to buy an optimum basket of some grocery items in which packet of bread is also included. If price of the bread goes up by rupees 5, how much money do you need to afford the same basket keeping the utility constant? So, if you want to achieve a given level of utility and you are buying a basket of some commodity in which packet of

bread is also there and you are spending 1000, but now a price of bread increase by rupees 5. Now, can you know how much is the value of the bread?

Of course, without observing the price, you can see that how many breads you packets you have purchased and you can multiply it by 5. So, in this way additional expenditure you are going to make due to increase the price of the bread is if you are buying say 5 packets; then 5 into 5, 25 rupees will be additionally required to achieve the same level of utility. So, this is external extra burden or either if additional income is not given, then consumers welfare will come down when the price of bread declined.

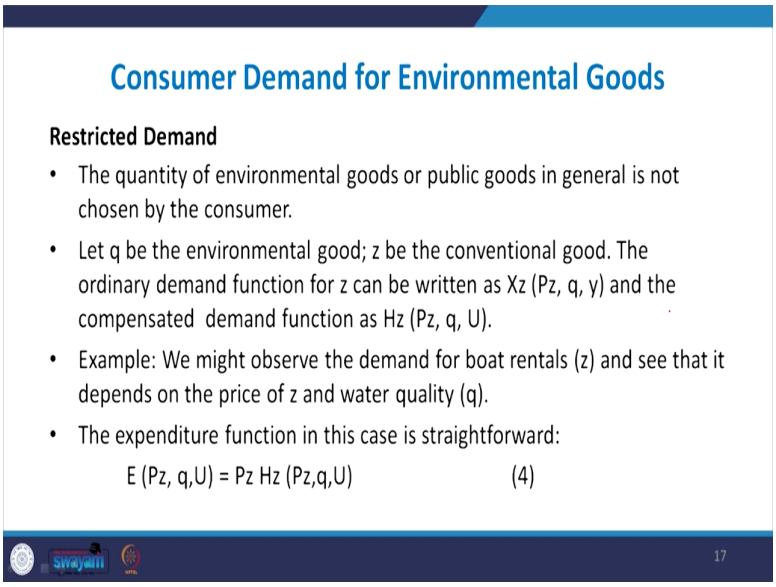
So, this can be done or can be explained by the expenditure function delta E is the net increase in the expenditure that is equal to Hq Pz, Pq, U multiplied by delta Pq. Means, additional expenditure is how much is the quantity of the bread purchased by you and how much the additional price.

So, additional price that is delta Pq and additional quantity multiplied, you will get the delta E. So, delta E is the quantity of the product purchase and the net change in the price. Hq is thus equal to delta E bracket Pz Pq U divided by delta q and this is actually the ratio of the change in the expenditure function due to the change in the price of the goods.

So, it is simply the ratio of expenditure function to the change in the price which is same as the compensated demand for goods. As I already told you if 25 additional rupees are required to purchase the same basket, then you have to compensate. So, this actually compensated demand for the goods and expenditure function are similar.

Now, so far we had discuss this in case of conventional goods. But our main concern is how to construct the demand for environmental products and in case of environment, now we can take two products and one is our conventional product say z and others the q product which is an environmental product. Environmental product maybe improvement in the quality of environment etcetera.

(Refer Slide Time: 08:51)



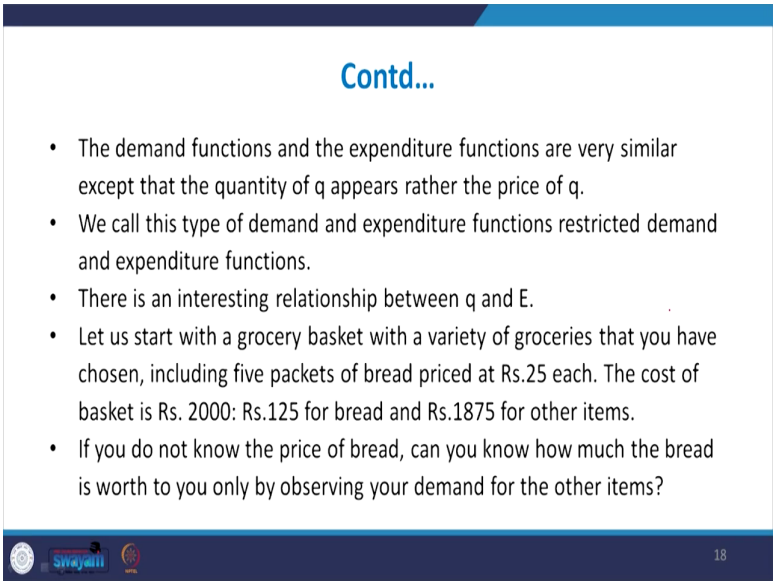
The quantity of environmental product or goods in general is chosen is not chosen by the consumer because it is largely a public good; how much should be the air quality all these things, individual consumer cannot decide. Let q be the environmental good; z be the conventional good. The ordinary demand function for z can be written like X z bracket Pz q and y. The basic difference here is now we are not taking Pq. Earlier in order this conventional goods case, we are taking Pq because price of q is not determined. So, we are taking quantity q. Here is the quantity or quality of the environmental product and y is income.

So, now compensated demand function for z product is depending upon how much is the price of z product; how much quantity of environmental product and how much money is going to be spent by the consumer on z product and compensated demand function now becomes since in case of compensated demand function utilities kept constant. So, here Hz is the compensated demand function and here, basic difference in two function is that in the bracket

for Xz income is given mean income is kept constant. While in case of compensated demand function, U is given in the bracket indicating that utilities kept constant.

So, example we might observe the demand for boat rentals say z. So, boat rental is a conventional product z and see that it depend on the price of z and water quality. So, if water quality in a lake, where the boat is used is very poor, many people will not like to go there. So, the expenditure function in this case is straightforward. E stands for expenditure function equal to Pz Hz; how much money is spent by the consumer on z product, when quantity of environment is given and utility is given. So, when quality of environment is given and utilities is given, how much money is going to be spent by the consumer on z product that is studied by the expenditure function in case of z product.

(Refer Slide Time: 11:43)



The demand function and expenditure function are very similar except that the quantity of q appears rather than price of q. So, this is the difference. In this case, we are not taking Pq, we are taking only quantity of q. So, we call this type of demand and expenditure functions restricted demand and expenditure function. Why they are restricted? Because we do not have price of environmental product; only quantity or quality of the environmental products is there.

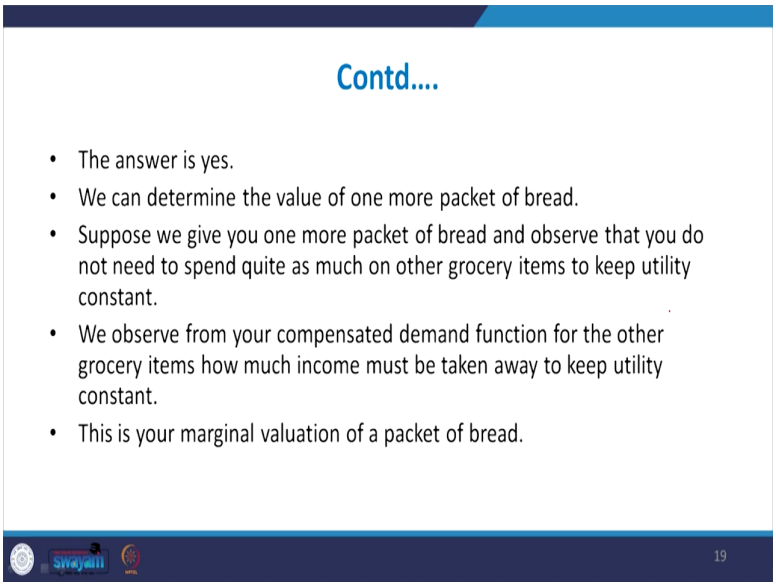
There is an interesting relationship between q and E. So, you can establish the relationship. q here is the environmental product. Relationship between environmental product and e expenditure. Let us start with the same example of grocery basket with a variety of grocery that you have chosen including 5 packet of bread price at rupees 25 each.

The cost of basket is 2000 rupees and here 125 rupees are spent on buying the bread, 5 pieces. 5 multiply 25 equal to 125 are spent on the bread and remaining amount 1875 are spent on other grocery items. If you do not know the price of bread, although we have shown that price of the bread is 25, but if you do not observe the price of bread, can you know how much is the value of bread to you by observing the demand for other items? So, this is very important, when we try to assess the demand for environmental product.

Of course, you can assess how much is the value of bread, in this example without knowing how much is the price of the bread because you know how much you spent on other grocery item and how much total expenditure you made. So, instance you have made 2000 rupees expenditure on different grocery items out of that 1875 spent on other items. So, remaining is spend on bread.

So obviously, you can say the value of bread is 125 on bread. So, and then you can observe the price. So, this is akin all like to assessing the value of environmental product, when you are consuming a conventional product.

(Refer Slide Time: 14:38)



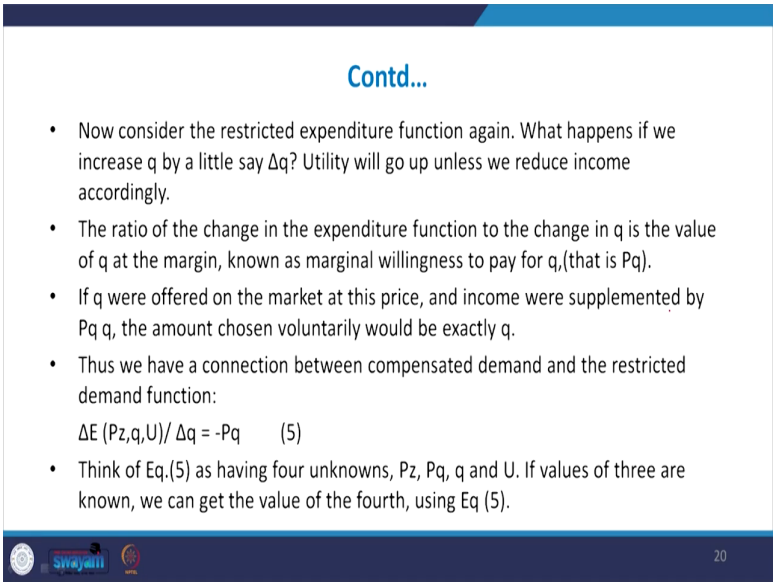
So, you can determine the value of one more packet of bread. Suppose, we give you one more packet of bread and observe that you do not need to spend quite as much on other grocery item to keep the utility constant. So, this is very important, since in a basket utilities kept constant. So, now, you has spend to 1000 rupees on grocery item including bread. Now, if one additional packet of bread is given to you of course, utility will go up. So, so you have to reduce some quantity of other products in order to keep the utility constant.

So, in that case, how much quantity of other product is reduced when one additional packet of bread is given to you is actually the value of bread to you. So, this is actually known as margin valuation of bread. So, now, consider the restricted demand functions, what happened if we in case q buy a little quantity. For example, if quality of environment is improved. So, now, q

becomes q plus delta q. So, there is an additional improvement in the environment. So obviously, consumer will reach out to the higher level of indifference curve.

But in this case, we have to keep the utility constant consumer in either worse off nor better off. So, in that case what you have to do is in order to keep the utility constant, when delta q is there you have to reduce the quantity of z. So, how much quantity of z is reduced, when there is a increase in quantity of q that is actually the value of environment attach by the consumers in this regard.

(Refer Slide Time: 16:37)

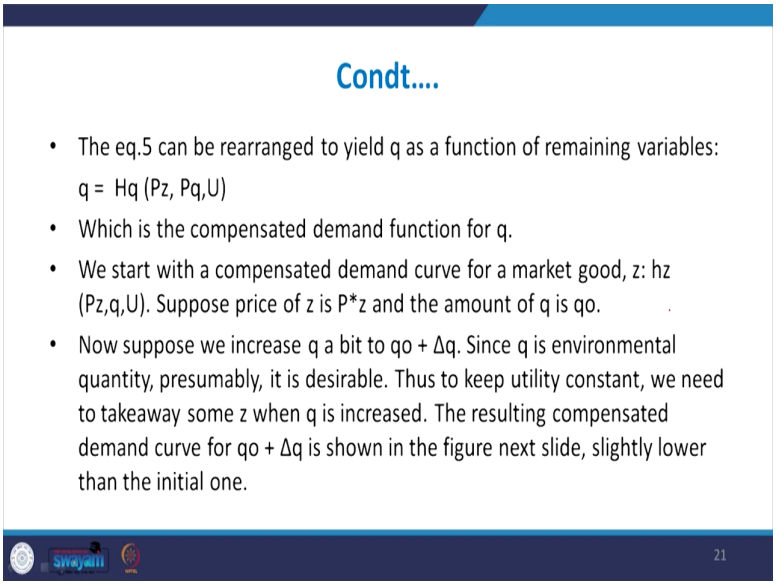


So, if q were offered on the market at this price and income were supplemented by Pq, q; then, the amount chosen voluntary would be exactly q. So, what I am going to explain you is that you can estimate the additional expenditure that is made on a particular product, when there is a change in the quantity of q. q change maybe in a positive direction, change maybe in a

reverse direction. So, delta q may be reduction in environment or delta q may be increase in improvement of the environment.

So, delta E is here Pz, q, U divided by delta q equal to minus Pq. In this equation 5, we have Pz, qz, q and U. So, these are the four parameters and obviously, we know if value of the three are known to you, then you can get the value of fourth one. So, from this equation 5, this equation 5 can be converted in terms of q.

(Refer Slide Time: 17:48)

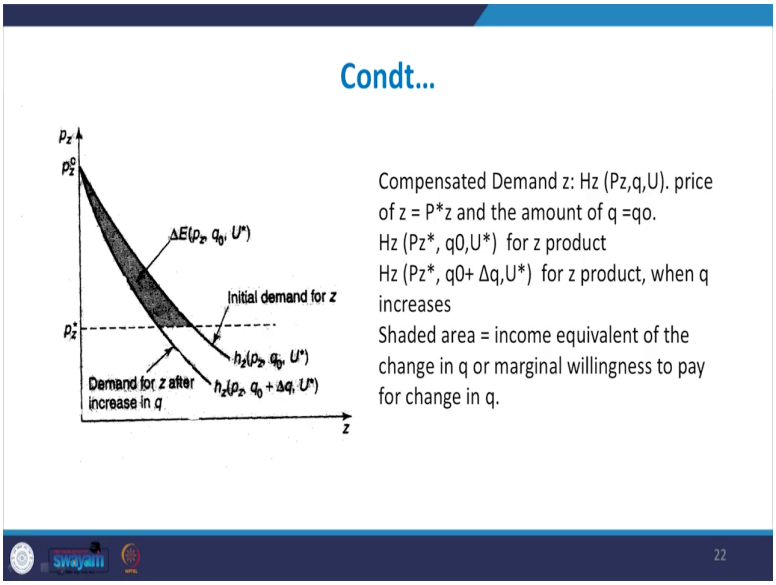


And you can assess the value of q by q equal to Hq P a bracket Pz, Pq, U when utility is kept constant. So, this is actually a compensated demand function for q. We start with a compensated demand function for a market product z and we have the value of q, initial q and like q 0 and q 1 improvement in q and we also know how much is the budget. So, keeping in

the budget of the consumer on z and value of environmental product, we can we can estimate the demand for environmental goods.

So, well, we start with a compensated demand function for a market product. Here we have a z product. So, we know the price of z, we know the quantity of environment and we know the given level of utility. Suppose price of z is P star z and amount of q is q 0. Suppose now, we in case the quantity of q from q 0 to plus delta q or from q 0 to q 1 since q is environmental quantity or you can say quality also and it is desirable. Thus, to keep the utility constant, we need to take away some quantity of z in order to keep the utility constant. So, if there is a improvement in environmental quality, some quantity of z must be reduced in order to keep the utility constant and this can be explained by this graph.

(Refer Slide Time: 19:40)



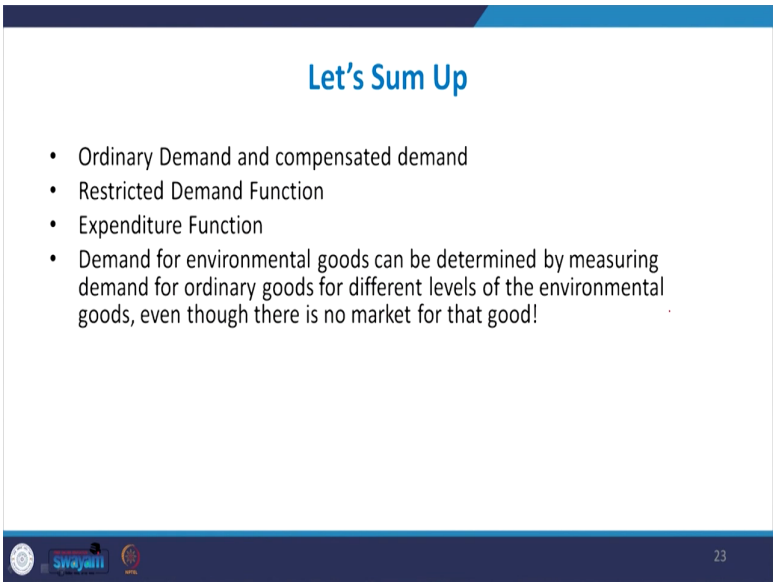
Look at ah, we have the two compensated demand curve for the consumer in case of z product and here, on y axis price of z is taken and on x axis quantity of z taken and this compensated demand curve, you know it done from the indifference curve, where we had two products; one is environmental product and other is conventional z product. So, now, Pz star is the price of the z product. So, given the price and y, then compensated demand for z is equal to H z bracket Pz q U and price of z is equal to p star z and amount here is q0.

Now, if environmental product improves, then the compensated demand curve will shift downward and the new compensated demand curve is now Hz Pz q 0 plus delta q plus utilities star. So, utility is constant in both the graph utilities constant, but since now they are the improvement in quality of environment or quantity of environmental goods improves, then consumer will reduce some quantity of z in order to keep the utility constant.

So, shifting from the initial compensated demand curve, where quantity of q is q 0 and gave level of utility is given. Now, we had to move downward indicating that some amount of money is saved by the consumers because now, consumer on this new compensated demand curve is consuming less quantity of z; how much quantity is reduced and how much is the price? Actually, that is the value attached to the environment.

So, in this graph the shaded area is actually the delta E bracket Pz q 0 U and that is you can say is marginal willingness to pay for change in q. So, you can estimate how much the consumer is willing to pay, if there is a improvement in environment. So, in this way you can estimate the demand for environmental products with reference to the given level of income, given level of utility and given level of or taking the quantity a conventional product. So, let me now sum up this topic.

(Refer Slide Time: 23:17)



What I had discuss here in this lecture is first is I explain you what is ordinary demand and what is compensated demand. Then, after explaining the compensated demand and ordinary demand, we use the concept of compensated demand for further elaboration of demand for environmental goods and we explain the restricted demand function and it is called restricted demand function, because in this case the quantity of environmental product is given not the price of the product.

We do not know the price of environmental product and we also try to establish between the demand functions compensated demand function and expenditure function and then, we try to introduce the concept of compensated demand in environmental products and by taking the compensated demand function under two conditions; one when there is a improvement in environment and second when environment is as it is.

So, by knowing how much the consumer is going to spend, when there is a improvement in environment and how much the consumer is going to spend, when the quantitative environment is already given initial level. So, the difference is actually the value of environmental goods or demand for environmental goods in terms of value. So, demand for environmental good can be determined by measuring the demand for ordinary goods for different levels of environmental goods, even though there is no market for that good.

So, this is a conclusion that demand for environmental goods can be determined by measuring the demand for ordinary or conventional product for different levels of environmental goods, even though there is no market for environmental goods.

Thank you very much.