

**Conservation Economics**  
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**Module 11**  
**Practical issues in Economics and Conservation**  
**Lecture 1**  
**Consumer choice**

Namaste! Today we begin a new module which is practical issues in Economics and Conservation. This module will have 3 lectures: consumer choice, asymmetric information and behavioural economics and valuation of natural resources. So, let us begin with Consumer Choice. Some of you may have observed this mark on some of the products that you are purchasing. This is an eco mark and this mark designates or certifies that the product that has this mark has been made with the least impact on the ecosystem which means that whenever you see this mark on a product, it means that it has been made in a sustainable manner without putting a very great amount of stress on the environment.

Similarly, if you observe a mark such as this one; this is the mark of India organic. This is telling that the product that has this mark has been made using organic techniques, organic agriculture without the use of things such as pesticides. Now this is important because we have observed that pesticides are back bio accumulative toxins that also magnify when they move up the food chain. And so, when you purchase something that is labeled as organic; it is not just good for your body, it is also good for the ecosystem.

Similarly, we have marks such as these; this is the FSC mark of the Forest Stewardship Council. Now when you have a label like this, it states that 100 percent products are containing the material from FSC certified forest that meet the environmental and social standards of FSC.

100 percent of the material that is having this mark of FSC and when it says 100 percent, it means that the product is containing materials that are from FSC certified qualities that are meeting environmental and social standards. When we say that it is meeting an environmental standard it means that it is being taken out in a sustainable manner. There is no excessive use of chemicals in such a forest. It has been harvested in such a manner that the biodiversity is protected and it also meets the social criteria which means that the benefits are being shared with the community. It is not taken from a forest that is being worked through exploitation of labor.

Similarly if you have this FSC mark with mix it states that it has products with material from FSC certified forest recycled materials or other controlled sources. Here again this label is certifying that the product that is being bought is from a sustainably managed resource. So, it is good for the environment. We have FSC recycled label products containing post consumer material and may include some amount of pre consumer material.

We have labels like these. When we say that we have this 100 percent label, it means that it is only from FSC certified forest. If you have a mixed label, then it is from if this is certified forest FSC controlled wood or reclaimed material that is the recycled material. And when we say recycled, it is from reclaimed materials.

If there is a product that has this label, then it means that it is good for the environment. Similarly, we have the labels of rainforest alliance. Now the rainforest alliance again says that the product has been extracted or manufactured in such a manner that it protects the biodiversity of the rainforest or we can have a label like this ISO 14000 family.

Now, ISO 14000 label means that it is a label for environmental management and there are a number of companies that are highlighting their sustainability. Brands such as Apple making without taking sounds impossible, but it is our goal and it says that 100 percent of our offices, retail locations and data centers have run on 100 percent renewable energy. And if you download this report you will find what all steps are being taken by this company for maintaining and enhancing the level of sustainability. Here for the environment.

If we look at the website of Tetrapak, it says it has this FSC label. So, it says that all our paper-board comes from wood from forest certified to FSC standards and other control sources. You know tetra pak is highlighting the fact that when it is making the products and its products contain paper and good materials.

In that case it is only taking those materials that are being extracted in a sustainable manner. So, it is caring for the environment. So, brands such as Apple and Tetrapak are emphasizing that they are caring for the environment. Or Maruti Suzuki, it says the future begins now with BS6. So, BS6 is Bharath Standard 6 which is an enhanced level of standardization for petrol and diesel vehicles and their fuels that ensures that the amount of pollutants that are released are less.

When Maruti Suzuki highlights it on its home page it means that it wants to highlight that it is a company that is caring for the environment. The question is if we have such standards and when we have companies that are highlighting these standards, is it sufficient?

By that what we mean is it sufficient to have standards and certain companies that show that or highlight that they are following these standards or is there something else that is also involved. After all, in a market economy the prices and the process of buying and selling are the things that give signals to the buyers and the sellers.

Now, on the one hand, there are certain companies that are showcasing that they are environmentally friendly, but then being environmentally friendly will also come at a cost. Because if you say shift from a certified forest, certification takes effort, certification takes cost and also there are certain other sources of unsustainably managed forests from which the wood can be had more cheaply.

Because they are not sustainably managed they are not being managed for a long term perspective. In the short term, they can prove cheaper. Similarly when we talk about things such as BS6 compliance, we also have this news. Last chance to buy BS4 discounted cars TATA Nexon, Renault Kwid selling for less money.

This is an article that is telling people that okay the world is shifting towards BS6, but then we still have stocks of BS4 and this is a golden opportunity for you to buy the BS4 cars because they

are cheaper. Especially because of the more stringent norms after a while, it will be impossible to sell the BS4 cars and so, now, these are available at a greater discount.

Now mind you if somebody buys a BS4 car and is using that car, for the next say 5, 10-15 years; this is one vehicle that will be giving out pollution at a level that is greater than that of the BS6 standard. Now as a consumer how do you decide whether you should go for a BS4 car or a BS6 car?

Because overall if we have the standards and if we have the companies that are highlighting that yes, they are caring for the environment. But when there are certain other companies that probably are not following the higher standards and if people flock to those companies or even in the case of those companies that are following the standards; if there are unsold stocks and people only want to go for those unsold stocks.

In that case will it be possible for the companies to have stricter norms to follow the stricter norms or is the market telling a very different picture? Similarly, this article BS4 Hyundai cars discounts of up to rupees 2.5 lakhs on center and so, many other models. The question for the consumer is whether he or she should go for cost or sustainability.

And this is a very important question when we talk about conservation because if we want to go for conservation; if you want to manage things in such a manner that we are able to extract the resources for a very long period of time. Sustainability just means that we will not just use the resource right now, but we will use it in such a manner that we can extract the resource for many years to come or providing many generations to come

Ultimately if somebody is going for a sustainably produced material, then they are doing something that is best in the long term interest. But then if the unsustainably managed product is available at a lower cost, how does the consumer react?

If the consumer reacts in a manner that would say that no, we only care about the cost; we do not care about the sustainability. In that case probably sustainability will be a lost cause which is why it is important to understand how consumers make decisions.

How does consumer choice work? Now, a consumer is always acting in a budget constraint. A budget constraint is defined as the limit on the consumption bundles that a consumer can afford. Essentially we had begun this course by saying that economics is the science of decision making because our wants are unlimited, but the resources to fulfill those bonds are limited and which is why we need to choose; we need to make decisions.

The limitation of our resources is depicted by the budget constraint because not everybody has all the money that they would need or that they would want. So, there is a limitation on the budget of every person and budget constraint is the limit, then limit on the consumption bundles that a consumer can afford.

Probably a consumer wants to have a consumption bundle that says that let me have the best house, let me also have the best car, let me also have the best clothes, but then probably the consumer is unable to afford this consumer this consumption bundle. So, the consumer will have to make a choice whether he or she wants to go for better clothes at the cost of a better vehicle.

Probably the consumer might say that okay, let me go for a second best vehicle and the money that I save is going to be used for better clothes or the consumer might say that no I am saving

for a house for my retirement and I am going to cut cost in the vehicle as well as on the clothes that I am using.

The consumption bundles can be indefinite, but there is a limit on these consumption bundles that is being put by the budget constraint. The amount of money that a person has and it is determined by how much the consumer can afford.

If the consumer gets more money, then probably the consumer will shift to a very different consumption bundle than what he or she is choosing right away. When we talk about budget constraints, let us look at an example. Let us say that a person has a budget constraint of 100 rupees, it means that this person only has 100 rupees available with them and there are two items in the market. We have samosas and we have lassi. Now samosa is available at 5 rupees per samosa and lassi is available at 10 rupees per glass.

Now, suppose the consumer buys 20 samosas now, in that case the consumer has already spent 100 rupees on samosas. So, this is spending on samosa. So,  $20 \times 5 = 100$  rupees and if the consumer has spent 100 rupees on some users, he or she will have 0 rupees left for lassi because the total spending can only be 100 rupees; it cannot exceed 100 rupees.

Now, if the consumer wants to have one glass of lassi, this glass of lassi will cost him 10 rupees. And if it is costing him 10 rupees, then it means that 90 rupees are available to purchase samosas and in 90 rupees, this person can get 18 samosas. So, this is another consumption bundle. So, the first consumption bundle was 20 and 0, that is, the consumer could have 20 samosas and 0 lassi.

Another consumption bundle is 18 and 1. So, he or she can have 18 samosas and 10 lassies or we can have another consumption bundle which is 16 and 2 and so on till we reach to this point of 0 and 10. Now, at this point the consumer is spending money on 10 glasses of lassi which is  $10 \times 10 = 100$  rupees is being spent on lassies, 0 rupees is being spent on samosas.

And so, the consumer is getting 0 samosas. Now these are all different consumption bundles that are available to the consumer. They can also be a number of other consumption bundles. So, such as in this case the consumer can get 10 of samosas and 5 of lassies, but the consumer can also say that no I do not want so many so, I will only have say 5 samosas and 2 lassies.

Now this can also be a consumption bundle, but then this is a consumption bundle that is less than the budget constraint. Here the budget constraint is 100 rupees and if the consumer is only buying 5 samosas, that is 25 rupees and 20 lassi is 20 rupees. So, in this case the consumer is only spending 25 and 20 rupees. So, the consumer is spending only 45 rupees whereas, the consumer could have spent 100 rupees.

So, we can have any number of consumption bundles. There are some consumption bundles that are within the budget constraint and there are certain others that are outside of the budget constraint. So, probably the consumer might say that no I do not want 5 and 2. I probably want, say, 50 and 20.

Now for 50 samosas the cost will be 250 rupees and for 20 lassies, the cost will be 200 rupees. In this case the consumer would want to have an amount of 450 rupees. But this amount is not available with the consumer; the consumer only has 100 rupees.

If we plot these consumption bundles, we will find that here on the y axis it is the number of lassies, on the x axis we have the number of samosas and there are a number of points that are right

there on the budget constraint things like 10 lassi and 0, samosas or things like 20 samosas with 0 lassi. But you also have certain points that are here and these points represent those consumption bundles that the consumer may have.

But when the consumer has those consumption bundles, then he or she will be saving some amount of money that is they are not using the money to the fullest. At the same time there are certain points that are here which represent those consumption bundles that the consumer cannot afford because they are outside the budget constraint. So, they will require a sum of money that is greater than the budget that they have currently. This is the concept of budget constraint.

The next question is when we have this budget constraint, what determines whether the consumer will go for this point or this point or say ah this point inside? Of course, the consumer cannot have a point outside. This is not permitted, but the points that are inside are permitted and the points on the line are permitted. What determines which point is actually chosen?

This brings us to the concept of indifference curves preferences. Indifference curve is a curve that shows consumption bundles that give the consumer the same level of satisfaction. So, indifference curves are curves that show those consumption bundles that give the consumer the same level of satisfaction.

Basically what we are asking here is that suppose you are very much fond of sweet things, so you are much fond of lassi and you do not like samosas that much. Now suppose you were given the option of having say 5 lassis and then you are given another option.

What we are asking here is that you are very fond of lassis and the money that you have can buy you 5 lassis, but then when you buy 5 lassis the number of samosas that you will have is 0. The question is if you reduce your lassi consumption by 1 so, if you have 4 lassis, what is the number of samosas that you will have that will give you the same level of satisfaction as having 5 lassis and 0 samosas? And that will give you an indifference curve.

I'll probably even say that no, I am more fond of lassi. If the lassi is reduced by 1 ok in that case, I will need three samosas. If I have these 3 samosas then and 4 lassis, then that will give me the same level of satisfaction as 5 lassis and 0 samosas. Now when we have these combinations of 5 and 0 or 4 and 3 and so on and when we plot these, we will get to an indifference curve. So, indifference curve is a curve that shows the consumption bundles that give the consumer the same level of satisfaction.

Here we are talking about the consumption bundles and these are the consumption bundles 5 and 0, 4 and 3 and so on. So, this is an indifference curve. And this is what an indifference curve looks like. So, the red line is showing the budget constraint and the blue line is showing the indifference curve. So, in this case, what we are saying is that if the consumer is at this point; then the consumer gets 2 samosas and 9 lassi and at this point the consumer gets 7 samosas and 3 lassis.

If both of these are on the same indifference curve then both of these consumption bundles will give the consumer the same level of satisfaction. So, whether the consumer has uh 2 samosas and 9 lassis or 7 samosas and 3 lassis, the amount of satisfaction or the amount of subtlety that the consumer will have is the same. So, that is an indifference curve. And when we talk about an indifference curve, we can also have a look at the marginal rate of substitution.

The rate at which a consumer is willing to trade one good for another. That is we are asking the question here if you want to give up 1 lassi, so, here the difference is minus 1. What has to be added to the number of samosas? In this case, it is plus 3. Now the ratio of these is giving us that for each lassi 3 samosas need to be had. So, that is giving us the rate of substitution. The marginal rate of substitution is the rate at which a consumer is willing to trade one good for another and it is given by the slope at any point.

What we are saying here is that if you look at this indifference curve, then the slope at this point which will be given by this line, this slope. At this point is given by this line and the slope at this point is given by this line. So, these 3 lines or these 3 slopes are giving us the marginal rate of substitution. And here we can observe that here the slope is very high, here it is medium and here the slope is very less now.

What will that show? At this point when we have this slope, then this much amount of the good here needs to be had for this much amount of the good here. So, what we are saying here is that for a lesser number of samosas, we need to have more lassis. So, what we are saying here is that so many lassis are equivalent to such a small number of samosas or that the person can give up so many lassis just to have a few more samosas at this point.

This is expected because at this point the consumer is already having a very large number of lassis and a very less number of samosas. Now we have a concept that is known as the law of diminishing marginal returns which means that suppose you do not have any food and suppose the food that you are having is rotis.

So, currently you have 0 rotis now and you are very hungry. When you shift from 0 rotis to 1 roti, you get a certain amount of satisfaction because your hunger is getting filled up. Now after the first roti, you have the second roti, then you have the third roti and probably now you have had 5 rotis. Now when you move from 5 rotis to 6 rotis will the amount of satisfaction that you had here - because here you were adding just 1 roti and here also you are adding just 1 roti.

The amount of satisfaction that you get in this process is much greater than the amount of satisfaction that you are getting in this process because by the time you have had 5 rupees you are not that hungry and so, the amount of satisfaction that you are gaining with each additional roti is going down. So, you are getting a diminishing marginal return with each new roti. And probably after a while you will have a negative marginal return which means that you are now so full that when you are given one more roti, then you just hate to eat.

So, the roti is the same when you are hungry, you are having a very high value for it. As your hunger goes down, your value for the roti goes down and at a level of too many rupees, now you are having a negative feeling for any additional roti that is force fed. This is exactly what we are observing at this point. So, the consumer is having a very large number of lassis. So, now, probably the consumer is not putting that higher value on the lassi, but the consumer has had very less samosas.

So, the amount of satisfaction that the consumer will have with each additional unit of samosa will probably be much greater than the amount of satisfaction that they will have with each additional unit of lassi. And which is why the consumer at this stage you get a very small number of samosas can give up a large number of lassis which is what we are seeing in the case of the slope

as well. So, this is the marginal rate of substitution.

When we have reached this point then the consumer has had so many samosas that now the consumer is ready to give up so many samosas just to have a few units of lassi. This will give a slope like this; a very low slope. And at a point in between the consumer has had a middle number of samosas and an average number of lassis. And so, the consumer is practically ambivalent about whether he or she gets an additional samosa or an additional lassi. So, this is the marginal rate of substitution which is given by the slope of the indifference curve.

Now, indifference curves have certain specific properties. One: a higher indifference curve is preferred to a lower one since the consumer prefers to consume more of both the products. Now, this is an assumption that we are making for a large number of cases. This assumption is also true. What we are saying is that if there are 2 indifference curves, the one that is higher.

In this case, this curve is preferred over this curve. So, the consumer will also always want to have this higher curve and not the lower curve because at the higher curve the consumer is having more of both the things. Indifference curves are downward sloping since if one good is consumed less the other should be consumed more for the same level of satisfaction.

What we are saying here is that remember that in the case of an indifference curve, we are looking at the points that give the same level of satisfaction. Now for the same level of satisfaction if one good is reduced, then the quantity of the second good should be increased. When you have this situation that when one reduces, the other increases you will have a downward sloping curve.

Another property is that indifference curves do not cross, since it would create a situation where more of both goods gives the same level of satisfaction as less of both goods which cannot be there. What we are saying here is that if there are 2 indifference curves and if these curves were able to cut each other, intersect each other at this point, what would that mean? A and B are on the same indifference curve. Basically A and B have the same level of satisfaction; A and B give the same satisfaction B, B and C are on the same indifference of this curve. So, they also give the same satisfaction.

If A and B give the same satisfaction, B and C give the same satisfaction, then it would mean that A and C give the same satisfaction. But now if you look at point A and C, then in the case of C we have more of good 2 and we also have more of good 1 which means that the point C where good 1 is more and good 2 is also more is giving the same level of satisfaction as point A. We began with the assumption that the consumer is getting satisfaction from the consumption of these goods. So, more the amount of goods that is consumed more should be the satisfaction, but in this case we are observing that more of having both the goods is giving the same level of satisfaction as less of both the goods which cannot be true which means that these curves should not be able to intersect each other. So, indifference curves do not cross.

Another property is that the indifference curves are bowed inwards since consumers have more willingness to give up a good that they already have a lot of which is what we saw here that at this point when the consumer has a large number of lassis, then the consumer is ready to give up large quantities of lassis to have a few quantities of samosas. Whereas, at this point the consumer is ready to give up a large number of samosas to have a small amount of lassi.

Now when we have such a situation that you have a higher sloping MRS here, a lower sloping MRS here and at a middle level of MRS here, then this in total will give a curve that is bent inwards that is towards the origin. So, the indifference curves are always having this shape - they are bent.

In this context, we can talk about two specific indifference curves. One is the indifference curve for perfect substitutes two goods with straight line indifference curves. Now substitutes are defined as goods with the same indifference curve. A very good example is whether you have money in the form of rupees or coins.

If somebody gave you a 10 rupee note will you gain more satisfaction than if this was then if you were offered a 10 rupee coin. Well in a majority of cases, you will find I mean we are not talking about an exception where your wallet is so full that you are finding it difficult to hold any more coins.

But in a normal circumstance, you will find that the amount of satisfaction that you get from a 10 rupee note is the same as the amount of satisfaction that you will get from a 10 rupee coin because both are giving you the same power to purchase.

Similarly, a 5 rupee note or a 5 rupee coin will mean the same and this is what we are showing here. On the y axis, we have rupee notes; on the x axis, we have the rupee coins now 10 versus 10. It is a straight line. So, any combination, if you reduce the coins by a value of 1, you should increase the note by the value of 1. So, these are perfect substitutes, they will have straight line indifference curves.

Another specific indifference curve is perfect complements and complements are defined as goods with right angled indifference curves. A good example is shoes.

Now, on the y axis here, we have the right shoe; on the x axis we have the left shoe. Now if you were given this combination of this point 5 and 5. So, you are having 5 left shoes and 5 right shoes. Essentially you are having 5 pairs of shoes. Now suppose in place of this, you were given this combination. So, here you are having 6 left shoes and 5 right shoes.

In this case, what is happening is that here also you are having 5 pairs of shoes and an extra left shoe. Now here is well you get 5 pairs of shoes in an extra left shoe. So, the amount of satisfaction that you get will be the same as the amount of satisfaction when you are having the 5 pairs of shoes because you do not have an extra utility for an extra left shoe. Similarly if you had 7 left shoes and 5 right shoes, here also the number of working pairs is only 5 and you have an extra 2 left shoes which you do not have a use for.

Whether you get this combination 5 and 5 or this combination or this combination it is one and the same you get the same level of satisfaction because you only have 5 pairs of shoes in each case. Similarly if you look at this point, you have 5 left shoes and 6 right shoes here again you have 5 pairs of shoes and then extra right shoes. At this point you have 5 pairs of shoes and 2 extra right shoes.

Now these three points provide the same level of satisfaction. Because in all these three points the number of working pairs of shoes is only 5 and similarly all these give the same level of satisfaction. Combining both of these right - these two straight lines at 90 degrees they give the indifference curve for perfect complements.



Perfect complements means that you cannot substitute one for the other, but you need both of them together. In the case of substitutes, you can replace one with another, but in the case of complements you need both of them for working things such as nuts and bolts. The number of nuts should be equal to the number of bolts. So, these are the indifference curves for perfect complements.

Once we have the indifference curves and the budget constraint, we can now start to talk about the consumer's optimum. Of all the points that are there on the budget constraint and of all the points that are there on an indifference curve which is the point that the consumer actually suggests actually opts for.

So, the consumer's optimum is given by the point on the budget constraint that lies on the highest indifference curve. It is the point on the budget constraint. So, in this red line is the budget constraint. The consumer's optimum is a point on this line, it is not a point above or below this line and this point should be the one that lies on the highest indifference curve because we have seen before that a higher indifference curve is preferred to a lower indifference curve because people want to have more consumption.

In this case the higher indifference curve is preferred and the point on the budget constraint line that is on the highest indifference curve gives the consumer's optimum. This is the point that the consumer would choose if he or she were doing rational thinking. Because this is the point that gives the maximum amount of satisfaction given the budget constraint because what is happening here is that for points above the budget constraint.

So, any point on this indifference curve is not selected because the consumer does not have sufficient budget. And if the consumer selected some point on this curve, then she is left with a certain amount of money which could be spent on having more of both the goods which would mean that the consumer would move towards these indifference curves.

For every curve that is to the left of the indifferent slide, the consumer tries to move towards the right, but for an indifference curve that is away from the budget constraint line then this becomes an impossible combination given the budget constraint. The optimal point is given by the point on the highest indifference curve that is touching the budget constraint.

Here we can talk about two kinds of goods, one is known as a normal good. A normal good is one for which an increase in income increases the quantity demanded. So, what we are talking about here is that if the consumer is having more money, what will the consumer do? If the income increases will the consumer have more of the good or will he or she have less of the good.

There are things that are known as the normal goods; normal goods are everyday used goods that we have a large value for. Now, if the consumer has more income then more is the quantity demanded for this particular budget. That is what we are saying is that the income is represented by the budget constraint.

If we move from this lower budget constraint to a higher budget constraint and if these are indifference curves for good 1 and good 2 so, here we are observing that at this lower budget constraint. This was the optimum point at a higher budget constraint, this is the optimum point and at this point the consumer is having more of good 2 and the consumer is having more of good 1. Both good 1 and good 2 are normal goods because with an increase in income with an increase in

income, the quantity demanded has increased. If we draw these lines and if we say that this is point 1 and this is point 2. Then when the consumer is shifting from this lower income to the higher income, then the consumer is having more of good 2 and is also having more of good 1. So, these goods are normal goods. There are certain other goods that are known as inferior goods: a good for which an increase in income reduces the quantity demanded - things such as bus rides. What is an inferior good? Suppose you have less income in that case, you will prefer to go by a bus, but when your income increases then probably you will think that no in place of going by a bus, I can afford much and so, I should take a taxi - I should take a cab. In that case your demand for bus rides will go down. So, even though you are having more income, you are asking for less of this good less of bus rides. So, bus ride is an inferior good because with an increase in income less is the quantity that is demanded.

We can represent it by these curves. These are the two budget constraints, the earlier low income budget constraint and now the higher income budget constraint. Now what is happening is that in the lower income budget constraint, the optimum point was this. This is the point on the highest indifference curve. For the high income budget constraint, the optimum is given by this point. Now if we move from this point 1 to this point 2 what we are observing is that now less of bus rides are wanted and more more number of taxi rides are wanted

In this case the taxi ride is a normal good because with an increase in income, more is the quantity demanded. But bus ride is an inferior good because with an increase in income less is the quantity that is demanded. So, this is an inferior good.

In this context we can talk about income and substitution effects. Income effect is the change in consumption that results when a price change moves the consumer to a higher or a lower indifference curve. When we talk about these changes, these changes can occur in two ways. One is that you can have an increase in income.

In that case you will move from one budget constraint to another budget constraint, but there is also another option that one of the goods or all the goods become cheaper. Now whether you get double income or the price of everything is halved it means one and the same thing.

When we talk about the income effect it is the change in consumption that results when a price change moves the consumer to a higher or a lower indifference curve. In this case when you talk about the income effect, the income is not increasing. But there is a price change that is leading the consumer to a higher or a lower indifference curve. And we can also talk about the substitution effect which is the change in consumption that results when a price change moves the consumer along a given indifference curve to a point with a new marginal rate of substitution.

In the case of a substitution effect, we move along the same indifference curve to a point with a new marginal rate of substitution. What we are saying here is that when we look at the indifference curves, the marginal rate of substitution here is different; here it is different and here it is also different.

In the case of a substitution effect, the consumer moves along an indifference curve to a point with a different marginal rate of substitution. And within both of these cases it is a price change that is moving the consumer along a curve or to a different curve and we can look at it with the example of again our samosa industry.

Now, here the case is the price of samosa falls. There is a price change that is happening. Now this price change can lead to an income effect or a substitution effect. Let us understand how. Now the price of samosa has fallen and so, the effective income increases because with the same amount of money now you can have more of the good. The samosa rate has fallen and so, you can now have more of the samosas, but you can also have more of lassi.

Because suppose earlier you were having earlier say, you were having 10 samosas and 3 lassis. Now the price of samosas has become half. In this case you can have 20 samosas and 3 lassi. But you can also do one other thing; you can also say that ok the price of samosa has fallen, but I only want 10 samosas, I do not want 20 samosas.

In this case, I will have 10 samosas. And because the price has fallen so, now, I am able to have or afford more lassis. In place of having 3 lassis probably I will have 5 lassis. Now this is the impact that we are studying. If the price of one good has fallen, then the effective income has increased because the same income here has not changed. But with the same income, now you can have more of the samosas or you can have more of the lassis or you can have some other combination.

Let us say that you can also have 15 samosas and 4 lassis. With the same income, now your effective income has gone up. You can have more of good 1 or you can have more of good 2 or you can have more of both the goods that is an income effect. Because of the income effect the effective income increases and. The consumer can now buy more samosas or the consumer can buy more lassis. This is the income effect. In this case the consumer is moving to a different indifference curve.

In the case of a substitution effect, your thought process goes like this. The price of samosa has fallen and so, now, samosa is relatively cheaper. So, let me have more samosas, which is what we are showing here because the price of samosas has fallen. So, let me have more of the samosas.

Let me have 20 samosas. So, that is a substitution effect or your thought process can be that now lassi is relatively expensive and so, I should have less amount of lassi because here we are talking about samosa and lassi. If the price of samosa has fallen, effectively it means that now the lassi is more expensive as compared to the samosas.

Earlier if, say, the samosa was 5 rupees and lassi was 10 rupees so, in this case lassi was equivalent to 2 samosas. But now what has happened is that the price of samosa has fallen. So, now, samosa is available for 2 and a half rupees, but lassi is available for 10 rupees as before. So, now, lassi is worth 4 samosas now if your currency was that of samosas, so you will say that ok, now the lassi has become more expensive because in place of paying 2 samosas for a lassi, now I have to pay for 4 samosas. Now if lassi has become more expensive, what will be your action? Probably you will want to consume less of lassi because it has become more expensive and this is what we are showing here. Lassi is relatively expensive and so, the consumer now buys less lassi whereas, in the case of substitution in the substitution effect the samosa has become relatively cheaper and so, the consumer buys more samosas. Now, what is the net result? The income effect says that more samosas should be bought. The substitution effect says more samosas should be bought and so, more samosas will probably be bought.

But in the case of lassi the income effect permits the consumer to have more lassi, the substitution effect says that the consumer should have less lassi and so, here the result will probably be ambiguous. So, the lassi bought may be more or less than normal. So, this is the income and substitution effect.

Because your one good has become cheaper, so, now you have shifted from this budget constraint to this budget constraint. So, now, you can have a situation where more or less of the goods can be had and with this, we can talk about the law of demand; reduction in price increases the quantity demanded.

This is what we had seen here. In the case of samosas, reduction in price leads to more samosas that are bought, that is, reduction in price increases the quantity demanded. We can represent it by these curves. This is the first budget constraint, this is the second budget constraint.

In the second budget constraint, the good 1 has become cheaper and so, now the consumer can have more on this budget. This is the earlier indifference curve and this is the optimum that was chosen, this is the new indifference and this is a higher indifference curve.

So, the consumer has moved from a lower indifference curve to a higher indifference curve and the optimum point has shifted from this point to this point. Now when the consumer moves from this point to this point, more of the good one is being demanded which means that we can observe the law of demand reduction in price increases the quantity that is demanded and we can explain it using the income and substitution effects.

But then this law of demand is not always followed. There are certain goods for which a reduction in price may also reduce the quantity demanded and good examples are Veblen goods and Giffen goods. Veblen goods are luxury goods whose demand increases with the price, for example luxury cars. Now luxury cars are an expression of the wealth of people. So, people want to have a luxury car to show off that they have a very huge amount of weight.

What will happen if the price of a luxury car goes down? When the price of a luxury car goes down, then it is no longer an expression of the wealth of the people. When it is no longer an expression of wealth, then people would want to have less of those luxury cars whose prices have fallen because they were buying a luxury car primarily because it was costing high, so that everybody came to know that ok this person is having this expensive car and so, this person must be having a great amount of money. But if the price has gone down, then it is not serving that purpose. So, these are Veblen goods, luxury goods whose demand increases with price or when the price reduces the demand also reduces another category is Giffen goods.

So, Veblen goods are luxury goods, Giffen goods are inferior goods whose demand increases with the price, for example potatoes. What we are saying here is that suppose we are looking at two items, potato and meat. Now potato is a relatively cheaper item, but potatoes also form the bulk of food requirements of people, meat is more expensive and meat is a source of protein.

But a person needs to have a certain amount of food to survive. Meat can be considered to be a luxury, but potato or a starchy food. In this case it is a necessity. Now what happens when the price of potatoes increases? Now in this case we are showing an increase in price. So, the earlier budget curve, the earlier budget constraint curve was this the blue one. Now the price has increased and so, less number of potatoes can be had for the same income.

Earlier the person was able to buy these many potatoes, but now the price has increased and so, the person can only buy these many potatoes. This is showing an increase in the price of the potatoes. So, now, less number of potatoes can be had. Now earlier this indifference curve was chosen and this was the optimum point. Now this indifference curve is being chosen and this is the optimal point.

What is happening here is that with an increase in price the effective income of people is going down with a fall in effective income and because everybody needs to satisfy their hunger, they will want to have more of the cheaper goods. And in this case the cheaper good between potato and meat is potato.

With less effective income people will want to have the cheaper goods to satisfy their hunger and so, now, people will demand more of the potatoes which is what we are observing here. Earlier this quantity of potatoes was being demanded so, the earlier demand was this the new demand is this. There is an increase in the demand for potatoes. So, this is a Giffen good.

So, the salient points in consumer choice is that it is the branch of microeconomics that analyzes how consumers maximize the desirability of their consumption and people are trying to maximize the desirability. And this desired variability is represented by the indifference curves and the consumption is limited by the budget constraint.

What does that tell us? One is that because people want to maximize the desirability of consumption. If we can make environmentally friendly options more desirable probably through education or awareness or advertisement, then we can shift people towards those options. So, we need to make environmentally friendly options more desirable.

But when we do that, then we have to ensure that even those environmentally friendly options are within the budget constraints because the consumption is always limited by the budget constraint. And so, if the cost increases too much then probably the consumers will not go for the environmentally friendly option.

So, these are two things that need to be kept in mind and when we talk about consumer choice we are making several assumptions. One is that operational behavior, the consumers are seeking to maximize their utility, preferences are complete, consumers fully understand his or her preferences, permitting unambiguous decisions.

Preferences are reflexive that is if good A and B are identical, then the consumer will be indifferent with regards to A or B, they are transitive it means that if A is preferred over B; B is preferred over C then A must be preferred over C. Preferences exhibit non satiation which means that more is always better.

Now, this is not true in a number of cases as we have observed that when you are already full, then if you are given an extra roti to consume then probably that is not better for you. Indifference curves exhibit diminishing marginal rates of substitution resulting in the bow in the indifference curves and that goods are available in all quantities including parts.

These curves are continuous curves so they can show even parts of things. So, this is 10.5 apples. These are all different things, but an important thing is that the first thing is that people exhibit rational behavior. So, this is a rational model to explain the consumer choice, but then the thing is humans are not always rational which will bring us to the concept of behavioral economics

that we will analyze in the next lecture.

That is all for today. Thank you for your attention. Jai Hind!

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**Module 11**  
**Practical issues in Economics and Conservation**  
**Lecture 2**  
**Asymmetric information, Politics and Behavioural Economics**

Namaste! We carry forward our discussion on the Practical Issues in Economics and Conservation and in this lecture, we shall have a look at Asymmetric information and Behavioural Economics. Now, when we talk about behavioural economics, it is prudent to recap what we have seen so far.

When we talked about consumer choice, we talked about a number of assumptions in the model. Now, these are the assumptions that we normally make whenever we are making any economic analysis because these assumptions simplify things. So, in an earlier lecture, we had looked at what a model is.

So, a model is a simplified depiction of reality. If you look at the reality, reality is very complicated and so, to make a sense of the reality to look at what are the underlying principles or laws of economics, we need to make certain assumptions and some of these assumptions include things like rational behaviour.

When we talked about rational behaviour, we said that consumers are always trying to seek to maximize their utility. And throughout this course, we have said that the buyers try to maximize their utility; the sellers try to maximize their profit and that everybody is a rational behaviour, which means that everybody is using all sorts of information that they can have access to and are actively processing that information to come up with a decision.

But then, this assumption is not always true because in a number of cases, we do not have the information at all or if we have the information, then also, we do not have sufficient time to process that information and in certain cases, even if we have the time, we may not have the ability to process because the processing power of our brains is limited.

So, rational behaviour is an assumption that can be violated in certain points of time. Then, in the consumer choice model, we had said that preferences are complete and the consumer fully understands his or her preferences, which permits an unambiguous decision. But then, if you visit any restaurant, you will have the idea that in a number of cases, we cannot be in an unambiguous decision.

Because at times, we get confused; at times, we start to think - 'ok, should I have a mango ice cream or should I have a pineapple ice cream'; whereas, when we were talking about the model, we were saying that the preferences are complete and the consumer fully understands their pref-

erences. But that is not always the case. We said that preferences are reflexive. If goods A and B are identical, the consumer will be indifferent with regard to A and B.

However, in certain cases, people do attach an emotional sense to things and so, even if two things are identical, people might want to prefer one and not prefer the other one. We said that preferences are transitive. If A is preferred over B, B is preferred over C, then A must be preferred over C; but this again is not always true. We said that preferences exhibit a non-satiation, which means that more is always better; but then that again is not true in a number of cases.

For instance, if you are given an option to eat ice cream, you cannot just go on eating ice cream. There will be a point, where you will say- 'oh I am full now, I cannot have any more', but then when we were making the model, we were saying that more is always better. There are a number of cases in which our assumptions do not always hold true.

We also said that indifference curves exhibit diminishing marginal returns of substitute, marginal rates of substitution resulting in a bow. This is generally true, but then goods are available in all quantities including parts, this is not always true. But the bottom line is most of these assumptions do not apply in the real world.

How do people make decisions in the real world is the next question. We began with a simplified understanding of economics by making use of models to simplify the reality; but then, we also need to understand, what are the lacunas in our simplified models; how are they different from the real world and how do people in the real world make their decisions and we will explore this by using an example.

In an earlier lecture, we had looked at the production function. The production function tells that the output per hour when the number of workers increases, it goes on increasing; but then it starts to reach a plateau. The output does not just go on increasing, it will reach a plateau after a while. And so, if you have any more workers, then the marginal productivity of those workers will be less.

But then, if we concentrate on this section, is this always true? If you have 1 or 2 labourers, can you be assured of this output per hour or is there something else that you need to be concerned about. Let us say that in this firm, 2 labourers were hired. Will these 2 labourers give this output at all times or is there something else that we need to look at.

This is important because this is the basis of the understanding of the marginal product. Marginal product of labour as we had seen is the increase in the amount of output from additional units of labour. We had seen that the marginal product of labour, it goes on decreasing, which is another way of explaining the production curve.

In this context, we had said that there is this law of diminishing marginal product, which says that the property whereby the marginal product of an input declines as the quantity of the input increases because of crowding, insufficient access to equipment, chit-chats and so on. But is it possible that even when we are having just 1 or 2 labourers, they are not putting up their best? Now, we will see this is true in a number of cases.

We have used this property of diminishing marginal product to compute the value of the marginal product, which is the marginal product of an input times the price of the output. And here, we are seeing the value of the marginal product of labour and we saw that this is also going



down.

Because in the case of a fixed price, this will go down; so, the curve will look very similar to that of the marginal product. So, the value of the marginal product looks very similar to the marginal product. And we had used this to find out what is the profit maximizing quantity of workers that we should be hiring in a firm?

We have said that the profit maximizing quantity is given by this point, where the value of the marginal product of labour intersects with the wage rate and this value in this case the 4 labourers is the number of workers that the factory should be hiring. The question is does this hold true in the real world?

Because in the real world, workers often do not perform when they are left unsupervised. So, in this case, we are talking about 4 workers that should be hired to make the product. But in the real world, what we observe is that we do not only need these 4 workers, but we probably also need a supervisor and probably, also a supervisor to look after or supervise the supervisor.

Why is that so? So, this is because of things such as moral hazard. Moral hazard is "the tendency of a person, who is imperfectly monitored to engage in dishonest or otherwise undesirable behaviour". It is the tendency of a person and a person who is imperfectly monitored.

When we were making these models, we never talked about monitoring. So, this is something that we had left out throughout our understanding of economics, because we were taking people to be rational beings, we were taking everybody to be honest people. But in the real world, things are a bit different; sometimes things are very different because of things like moral hazard.

If people are not perfectly monitored, then it is possible that they will engage in dishonest or otherwise, undesirable behaviour. In other words, what we are saying here is that even when you have these 2 workers and in theory, they should be giving out this output of 90 units of products in an hour. In a number of cases, if they are not properly supervised, they will not make this.

There will be a number of situations in which workers might try to steal or workers may just spend their time or waste their time and do nothing. And when a worker does that? That is not because of economics because the worker would or if we consider that the worker is a rational person making rational decisions, then in that case, this person should not loiter away his or her time. Because time is money.

The time that is spent on loitering could perhaps be spent on a more productive thing. And we all have a dearth of time in our lives, we all have a particular life expectancy. So, any time that we waste is a time that we are losing out of our life. It is a loss. Now, a rational person would never lose his or her time, would never waste his or her time.

But in the real world, we find that quite a number of people waste their time and this may result in things such as moral hazard. Now, when we are talking about moral hazard, we are trying to bring in the behaviour of people into our understanding. So, this is behaviour and economy.

We are not just talking about a mathematical model of economics or a scientific model of economics, we are also taking into account what is the behaviour of people? So, moral hazard is the tendency of a person, who is imperfectly monitored to engage in dishonest or otherwise undesirable behaviour.

Why do people engage in such behaviour? This is because the worker knows more about how

much work he or she is putting in, than his employer. Which means that, if the worker was to put up an effort and bring out 50 items of product per hour and if the worker is not doing that, if the worker is wasting away his time, in that case if the monitoring is not perfect or the monitoring is inadequate; then, the employer would not know by how much amount the the worker has shrugged in his responsibility.

Now, this is the information that the worker has. This is not information that the employer has. Why? Because if the output is less, the worker can always say- 'oh sir, the machine was not working or sir, there was a power cut'. Now, if the supervisor is not there, if the owner of the firm is not doing an adequate amount of monitoring, if he does not have access to the electricity logs or does not have a CCTV camera put in, then the owner might just not know what has happened.

And in such cases, the owner will have to take whatever the worker is saying at the face value. If the worker says- 'oh sir, I was working very hard, but what to do, this machine was not working'. The owner will have to take that in good humour; but the worker actually knows whether it was the machine that was not working or whether he was just passing away his time.

This is information that is with the worker only, it is not there with the owner or the supervisor. And this permits the worker to engage into dishonest or undesirable behaviours. So, the primary cause is that the worker knows much more about how much work he or she is putting in, than the employer.

The uninformed party, that is the employer would like to know, but the informed party or the employee may have an incentive to conceal the information. Why? Because if the owner comes to know that this particular worker is a lazy person, he does not work properly, then this worker may get fired. So, in this case, it is in the best interest of the worker to hide this information and he will do all sorts of things to hide this information.

This is a moral hazard and moral hazard is occurring because of asymmetric information. "A difference in the access to knowledge that is relevant to an interaction". Asymmetric information is the difference in access to knowledge, which means that one person has more knowledge or more access to knowledge and another person or another party has less access to knowledge or has less information less knowledge. And what sort of knowledge?

A knowledge that is relevant to an interaction. That is, in the case of things such as the principal agent relationship, which occurs between an employer and an employee. The relevant information here is how much amount of effort the worker or the employee or the employee is actually putting up. Now, this is a relevant information because this can be used to find out how much amount of wage should be given to this person; does this person deserve an increment or does this person ah deserve a punishment.

Now, this is very relevant information. But then one party, the employee himself, has more access to this information, because he knows how much effort he is putting up and how much time he is wasting. But the second party in this interaction is the relationship between the employer and the employee, so the second party which is the employer does not have access to this information and this results in an asymmetric information.

That is, one party has more information; the second party has less information. And whenever

we have a situation of asymmetric information, we start to observe problems. Problems such as moral hazard or problems; such as adverse selection: a situation where a buyer is at a risk of being sold goods of low quality; such as a used car market.

Now, if somebody goes to a used car market to buy a car, then the sales person in that used car market has much more information about the car that he is selling than the person who has gone to buy the car. Now, whenever somebody goes to buy a car, this person will not spend say ages to find out each and everything about the particular vehicle. Now, some things may be obvious, but some things might not be that obvious.

Perhaps there is some malfunction in the vehicle; but the sales person knows about this information that there is a malfunction in this vehicle in such and such a portion. But then, the buyer or the prospective buyer, who has gone to see this vehicle does not know that and so, this ah buyer is at an adverse situation, when it comes to the information. Here again, there is an information asymmetry.

The salesperson knows more, the sales person has a greater amount of information; the prospective buyer has a lesser amount of information. So, there is an information asymmetry. Now, this information asymmetry may result in an adverse selection, which means that the buyer may choose not the best vehicle; but may choose an adverse vehicle, that is not that good.

And the buyer is not choosing an adverse vehicle because he wants to have a not so good car. But the buyer has got less options because he has a dearth of information. Even if he wanted to check everything, he would not have sufficient time or would not have sufficient expertise to check each and every part of the vehicle.

So, things such as these are related to asymmetric information and may result in adverse selection; a situation where a buyer is at a risk of being sold goods of low quality. And when we have these situations in a number of cases, they increase the cost of the transaction. Now, remember that when we talked about the surplus, when we talked about the total surplus, we had said that the cost should be low.

Because when the costs are low, then the welfare is maximized, the surplus is maximized. But the problem with Edward with asymmetric information is that it increases cost because the uninformed party has to put in effort to get the information out. Such as go for better monitoring, install a CCTV camera, employ more number of supervisors.

Now, supervisors are something that we had not considered, when we were looking at the microeconomics of the firm. Because we just said that ok one person is giving out so much output and so, so many people must be hired for it. But then, to make a way for this point that the person might not be working to their fullest or maybe engaging in an undesirable behaviour, the employer might have to install a CCTV camera.

Now, when the employer installs a CCTV camera, then it increases the cost of production because somebody will have to pay for this CCTV camera installation and run. And so, these costs will be recuperated from the sale of the thing because this is an addition or an additional input that the owner has to make.

Similarly, the owner may employ a few supervisors. Now, the salary of those supervisors is a cost that is being added to the cost of production and so, the surplus of the producer would go

down because his costs are increased. Another option is to pay above equilibrium wages such as efficiency wages.

So, paying of above equilibrium wages is another way to solve the moral hazard; but then, this also increases the cost or the owner might say that, 'ok, we will go with for a delayed payment', which means that ah the owner might say that, 'ok we will give you ah a year-end bonus'.

This year-end bonus would ensure that the person has got more to lose. If the employee does not work that hard, then the employee might not know currently; but then, at the end of the year, the owner might always say that, 'this year, you did not work hard and so, I am not giving you the year end bonus'.

These are all ways to counter the problem, but all of these are also increasing the cost, they are also increasing the complexity. Similarly, we have measures to control the adverse selection; things such as avoiding the used car market. But then, if the market is avoided, it means that the market is being shut.

The market is not working and so, the surplus that this market could have provided is lost. That increases our deadweight cost to society because the market is not working. Another thing is that the prospective buyer might try to get the vehicle inspected by a third-party and especially, a third-party that is a prominent manufacturer.

Now, in this case also, the third-party might give out the correct information; but then there is a cost involved. The prospective buyer will have to pay to the third-party to get the vehicle inspected. So, all of these measures are increasing the cost, the cost of transaction and when the cost of transaction increases, it means that the surplus reduces.

In this context, we can always talk about signalling and screening. These are two ways to counter the problem of asymmetric information. Signalling, we have seen it before as well. It is "an action taken by an informed party to reveal private information to an uninformed party".

The difference between signalling and screening is that signalling is an action taken by an informed party, screening is an action taken by an uninformed party. And in both the cases, the motive is the same to get the private information out to the uninformed party or to induce the informed party to reveal the information.

In both the cases, the aim is to take the information out of the informed party and give it to the uninformed party so that this situation of asymmetric information gets solved. Now, signalling because it is done by the informed party, it can take forms of advertisement, good grades on the CV and so on.

When you make your CV and when you have good grades on your CV and when you give it to an employer, in that case you are giving a signal to the employer that yes you can have a look at my CV and I have had so good so many good grades; it means that I am a hard worker, I am a punctual person, I am an honest person.

A person who is not hard working will not be having those good grades and so, this acts as a very good signal. We had also seen that there are two characteristics of a good signal; 1 is that it should be costly to prevent rampant usage and it should cost less for the high-quality product and more for the low-quality product.

And which is why good grades become a very good signal, because a person who is not that hard

working will find it very difficult to have good grades; whereas, a person who is hard working will find it very easy to have good grades. So, it is costlier for a not hard-working person to have this good grade on his CV to use as a signal; whereas, it is less costly for the hard worker to have good grades on his CV and use them as a signal.

Now, because of the differential costing that is involved, the differential amount of effort that is involved, grades become very good signals. In the case of screening, it is "an action taken by an uninformed party to induce an informed party to reveal the information". In this case, the uninformed party is doing something and that something is to induce the uninformed party to give out information about itself. So, I am just asking for a third-party check of a vehicle.

Now, if somebody goes to a used vehicle market, finds a vehicle that he likes and then asks that he wants to go for a third-party checking of this vehicle. Now, if the salesman says 'no, no, no sir; you do not require a third-party check, do not you trust me' or things like that, then it gives out information that there is something wrong with this vehicle.

Because of which the salesman does not want to go for a third-party check; whereas, if the sales person says, 'ok sir, you can call any mechanic and you can have a third-party check', then that would mean that the salesperson is much more honest with you or with the buyer. Now, another example is the medical examination of a person, who is coming for insurance.

When somebody comes to get medical insurance or life insurance, the insurance company generally asks that person to go for a medical examination, get a medical certificate about, how fit you are? So that the person, if he or she is having any underlying diseases that should come up and that would influence the rates at which the insurance will be provided to the person.

If somebody is healthy, then ah this person would not have any hesitation to go for a medical examination; but if the person is having an underlying disease that he or she is trying to hide, so in that case, when the insurance company says that you should go for a medical examination, this person would say, 'no, no, no, why should I go for that; do not you see that I am a healthy person'.

If somebody tries to say that, 'no I do not want to do this, I do not want to go for a third-party examination or a medical examination', then this party is giving out an information because if everything was right, then why would this party ah want to avoid the examination and so, this becomes a form of screening. So, screening is an action that is taken by an uninformed party.

In this case, the buyer who is going into the used car market or the insurance company because they do not have the information and this action is to induce an informed party to reveal the information. Now, all these things come under the habit of behavioural economics. Behavioural economics is the subfield of economics that integrates the insights of psychology.

What we are doing in the case of behavioural economics is that we have certain insights from psychology about how people think, how people make decisions and we are incorporating those insights into our models to understand how people make decisions. When that is done, we say that we are doing behavioural economics and some psychological insights, that are incorporated are things like people are not always rational.

In our classical economics, we had assumed that people are always rational; but in this case, we know from psychology that people are not always rational. So, we have to make space for that.

Instead of going for maximization, they go for decisions that are 'good enough'.

That is, people do not try to maximize their welfare, they try to have a welfare that is good enough for them. So, till now, we had been concentrating on the maximization of welfare, maximization of surplus; but that is not something that always happens. Most of the time, people want to have a value that is good enough for them. The Reason is people are overconfident.

So, people do not want to go with lots of computations, to come up with the maximum; but they would say ok this is the amount that is good enough or just do this and you will get a good result. Because there are people who are over confident, they do not want to go into the computations because of their confidence or people give much weightage to a small number of vivid observations.

If there is a person who has observed that a particular vehicle did not perform that well. Perhaps, it was a friend's vehicle and this vehicle was not working that well. Now, this is very vivid information because this person has observed this vehicle from close quarters and the person might give an over emphasis to this piece of information.

When that happens, people might not go for the maximization of their welfare; but they would want to say that, 'ok this ah this vehicle I know that this vehicle it does not work well and so, I am not going to consider this vehicle at all'. Even though it is possible that it was just an isolated case, it was an isolated example and, on average, this vehicle performs very well; but still people go for decisions like that. People are reluctant to change their minds.

So, if somebody goes and tells a factory owner that, 'ok you are working in a region, where your marginal cost is greater than the marginal revenue; you need to cut down on production'. The person might react vehemently. The person might say, 'oh no, who are you to tell me' because people are reluctant to change their minds. People assume that whatever they are doing is the correct thing to do; people forget.

When we were talking about rationality, we were saying that people are taking all sorts of information and they are doing all the processing that is possible to come up with a rational decision. But then when people forget, then it is possible that some of the earlier inputs are not just taken into consideration at all. People are at times impulsive or confused or emotional.

So, people might just say that, 'ok, so such and such a person had told me that this is the right course and ah this person has always been guiding me very well. And so, I will just follow it. I will not do any sort of computation because I am very emotional, when it comes to the advice that is given by this person' or at times people make decisions when they are in anger, when they are feeling depressed.

In all these different situations people might not be in the best state to do a rational computation. People at times are impulsive, confused. When they are confused, they might not make rational decisions. People are often short sighted, they look for quick benefits, they look for ways to avoid the harms that are there in the near future. So, if there is a person, who is ah say smoking a lot.

So, this person knows that smoking is bad for health, smoking is injurious for health; but still this person will not be able to quit because this person is looking only for the short-term benefits. In the short term, it gives a very good urge. It gives a very great amount of energy; people feel ener-

getic when they have a cigarette.

In the long run, well, it does have its health consequences; but then people take decisions on the short-term basis because they are often short sighted. Another insight is that people care about fairness. Now, in a number of situations, we have observed that we can compute what is the wage that should be given to a person.

We can look at the supply of workers, we can look at the demand for workers and compute what is the equilibrium wage that should be provided to a worker. But then, people might even think, 'oh no, this is too less. How will this person survive on such a less amount of money' and so, people might want to give a higher wage.

This is not because people are doing a profit maximization, but because people are looking at fairness; is it fair enough to give such a small amount of wage to this person? People are inconsistent over time. They prefer instant gratification over sacrifice such as not saving enough for retirement.

In this case, people when they are getting money, when they are getting their wages, they can use it for an instant gratification to buy something or they can put it into a retirement corpus. But most of the people put a very small amount of money into their retirement corpus.

Even though they know that a time will come, when they will not be earning anything because they will be retired and at that time, these savings will be the largest source of support for them. But still, they do not do that. They do not put money into the retirement corpus.

This is because people prefer instant gratification; 'what can I have now because retirement period is after a very long period of time, so we will see what will happen at that time' is the sort of thought that people will have. So, people are inconsistent over time.

And the rationality is bounded which means that when we talk about rationality, when people are even doing all sorts of computations, they are trying to get all sorts of information, even then there is a limit to rationality. So, even when people are trying to do everything to get to a rational decision, they will not be able to or they might not be able to.

For example, how many times have you computed utility to rigorously maximize utility? Hardly anybody does such a sort of computation. Now, bounded rationality is "the theory that people can understand only a limited amount of information within a limited amount of time, and for this reason, they do not always make the best choices, especially in complicated situations", that is rationality is bounded by limited thinking capability.

Well, our brains are not evolved to make mathematical decisions in a majority of cases. Our brains are evolved to get food, to protect ourselves from predators, to get shelter and so on. Our brains are not evolved to do computations about what should be the surplus and so, we might have a limited cognitive capability to process the information.

So, even if we have all the information, we will not be able to process it. And especially, when the time is limited because a number of decisions have to be made in a short period of time and in that short period of time, it is possible that our processing capabilities are overwhelmed.

Rationality is also bounded by limited information because in certain cases, people are able to do the computation; but then, they do not have the raw materials, they do not have the raw data on which to base the computation. If you want to go to say Dehradun or you want to go to Siliguri

to spend your vacation, if you want to make this decision, you would want ah you would probably require all sorts of information that is there about Dehradun and Siliguri, but then you might not have access to that information. In a number of cases, people just make a decision out of their hunch because they have limited information and also, people have a limited time.

So, when time is limited, that can also limit rationality. And to solve the issue of bounded rationality, people make use of heuristics. Now, heuristics are rules of thumb. They are simple strategies or mental processes. The key point here is simple. A heuristic is something that is simple that is used to quickly form judgments, make decisions, and find solutions to complex problems. When we are using heuristics - and we use heuristics a lot. Heuristics are rules of thumb that for such a question, we should approach through such a manner. So, these are simple strategies or simple mental processes, things such as divide and rule. When you come up with a very big sort of a problem, what you do is you divide the problem into smaller bits and you try to solve each and every small bit one by one.

This sort of a decision-making process, this sort of a strategy that you take to solve a complex problem by dividing it into a number of smaller problems, this is heuristics. Because this is a simple strategy, this is a simple mental process used to quickly form judgments or make decisions or find solutions. Now, here the key point is quickly. They are used because they are fast and in a number of situations, we do not have sufficient time to make a decision.

Heuristics help us. Example, things like affect heuristic. Affect is emotion. So, affect heuristic is a heuristic or a rule of thumb that is based on emotions. It is a "mental shortcut using emotion or gut feeling to influence a decision". So, you are not doing the computation, you are just using your emotion or the gut feeling to make a decision such as a person buying an SUV, just because he or she feels an attachment due to its look.

People use this because they might not have sufficient information or processing capability or time to make a rational decision. So, while a rational person would have done a thorough cost benefit analysis; but a person who is making a decision based on the emotion or the gut feeling, does not do this cost benefit analysis, but just buys whatever he or she feels an attachment due. This is an affect heuristics.

Another example is availability heuristic. It is a rule of thumb or a shortcut based on availability of information. A "mental shortcut using ease with which examples come to the mind to influence the decision". Example, a person not buying a particular car just because he or she has a friend with this model and the friend's car gives problems. A rational person would have done a thorough cost-benefit analysis, for this could be just an isolated example.

Another example is the effort heuristic; how much amount of effort do you put into doing something. It is a "mental shortcut using perceived amount of effort to determine the worth of something" and an example is that 100 rupees earned is perceived to have much more value than 100 rupees found, or gifted and spending decisions reflect this perception.

A rational person would have determined that these are perfect substitutes. What is happening here is that if you are earning something, if you are putting an effort into doing something, you put a larger value on it; but if you were given this thing, the same thing by somebody or you found it lying somewhere, then you do not put that higher value to it.



For example, a 100 rupees that is earned is perceived to have a much greater amount of emotional value because of which people will try to hold on to this 100 rupees, they will not be spending it that easily; they will be spent thrifts; whereas, a 100 rupees that has been gifted by somebody will not be having that high and emotional value. So, people will spend it much more easily.

They will not do a very large amount of rational decision making when it comes to that 100 rupees that is gifted. Now, this is an example of an effort heuristic. Another example of heuristics or heuristic decision making is escalation of commitment. It is a "mental shortcut justifying increased investment in a decision because the prior investment was made".

Now, here again people are not doing rational decision making, they are just using a mental shortcut to justify increased investment in a decision. Example is a person buying a used car for 2,40,000 rupees, spending 40,000 on it for repairs and still allotting 50,000 rupees more for repairs, when a new car could be bought for 3,00,000 rupees.

Now, in this case, the person bought this car for 2,40,000 thinking that it is less than 3,00,000; the person has already spent 40,000 rupees. So, now, the amount that has been spent is 2,80,000. But now, the person is still allotting 50,000 rupees more for the repairs. So, if this amount is spent, the total amount will be 3,30,000 more than the price of a new car.

But still the person is justifying this investment because a prior investment was already made. So, the person would think that because I have already spent 2,80,000 rupees. So, 50,000 more is not that high a price or that high an investment. Now, a rational person would have determined that the earlier investment is a sunk cost, which means that it is a cost that was incurred and cannot be recovered back.

So, when you are spending the next 50,000 rupees, you should think, 'oh should I spend this 50,000 rupees on a second hand car or should I just sell this vehicle off and buy a new car. Because at least in that case, I will not have to do this spending again and again and again, because a new car will not give me that amount of problems and even if some problem comes, it will come under warranty'. But you do not take that decision.

People just think that, 'ok because I have already spent 2,80,000 rupees, so let me spend just 50,000 rupees' whereas, they could have sold this earlier vehicle and got a new car. Now, this is an example of escalation of commitment heuristics. Now, in this case people are not doing the computation about what is best for them; but they are just thinking that because an earlier investment was made, we should do the next investment.

This is a shortcut. Now, remember that when we talk about shortcuts in certain cases they help; but in a large number of cases, they also harm us because they give us a solution that is fast that does not involve a lot of information processing, but that at times also does not give us the most efficient outcome. It does not maximize our surplus that could have been possible, if we went for rational decision making.

Another example is a familiarity heuristic. A "mental shortcut preferring familiarity over unknown". Example, a person buying a particular car just because he or she has had a car of this make at home during childhood. Now, a rational person would have done a thorough cost benefit analysis; but what a number of people do is that, 'ok my dad bought a car from this company. So,

I should also buy a car from this company because I am familiar with this car'.

Now, it is possible that with time, new technologies have come up and a car of some other company is now giving a much better safety, much better service, much better mileage than a car of the previous company. But still people take the car of the previous company because they know this car.

This is a familiarity heuristic. It allows for a quick decision making without a lot of computation, but being a shortcut, it does not give the most optimum results. And because of these bounded rationality and heuristics, we have cognitive biases. Cognitive bias is "a systematic pattern of deviation from the norm or rationality in judgment".

In all of these cases, what we are observing is that there is a deviation from the norm or rationality. That is, the optimum was something else; but because of our way of thinking, we chose something else. This is an example of cognitive biases. Cognition refers to the process of thinking. So, this is a bias in thinking, a systematic pattern of deviation from the norm or rationality in judgment.

Because of bounded rationality, we have evolved several cognitive biases, they distort our thinking process and lead to more irrational decision making. Now, in this case, we are asking the question that if people have these cognitive biases, what kinds of impacts do they have on the decision?

Now, this is something that is not inside the purview of classical economics; but here, we are making rules from our insights from psychology to understand how people are making decisions. Because remember that economics is the science of decision making. So, what are these cognitive biases? Confirmation bias: favouring information conforming to existing beliefs, and discounting evidence that does not conform to it.

Example, if A thinks that B is a bad person, he will only consider that information about B that shows him in a bad light, while ignoring or discounting the good traits. What happens in the case of confirmation bias is that we already have a preconceived notion about something and whenever we see something, whenever we get new information, we see the new information in the light of our preconceived notions.

A very good example in the case of conservation is that there are people, who think or who have this preconceived notion that we can either go for development or we can go for conservation. Now, if you tell these people that, no if you go for conservation, this will also help in your development.

A very good example is underpasses. So, if you construct underpasses, you will also make your roads much safer and people will also be able to drive on the road at much higher speeds because there is no risk of a wild animal getting on the road and hitting the vehicle.

Now, rationally, if you think about it, yes it makes quite a good sense because the cost that is involved in making an underpass is not that great. But then, people with this preconceived idea that no conservation is anti-development would just say, 'no, no, no, no, we are development people, we are not conservation people'. As if conservation and development are two very different things.

This is a confirmation bias. Whenever they see an information that through conservation, people

led to development that if in an area when a national park was built or constructed, the people in the locality had a very large jump in their median incomes. If they get, if they see such information, they will just discount it; they will just think, 'oh, this is one of them, this does not always happen'.

But if they get any information about conservation and especially that conservation that was not well executed, that led to some difficulties; then, they would always keep this in mind and say 'oh, this is why we should not do conservation'. So, this is a confirmation bias.

Favouring information conforming to the existing belief and discounting everything else. Another is halo effect; tendency for positive impressions in one area to positively influence one's opinion or feelings of one in other areas. Example Apple's iPod is good, so Apple should be good for other devices as well.

What is happening is that because somebody has a positive impression about something in one area, this person thinks that 'oh this is the thing that is true for every other thing as well'. A good example is that again if you talk about roads. Now, if some person saw that ok a road was built between two cities and that increased the welfare of the people because they were now able to move from city A to B and back in a much quicker manner.

Now, these people would think that no roads are good for people. Let us make roads everywhere; even if it is a national park, let us make a road inside it. In a number of cases, we can observe that there are roads inside national parks that nobody is using; but still there was some person who made this road because they thought that, 'ok roads are good for people, so let us make roads', that is the halo effect.

A positive thing in one aspect is taken to be a positive thing for everything else. Horn effect: tendency for a single negative trait to negatively influence one's opinion of feelings in other areas. A person is not wearing clothes properly, so the person must also be lazy. Well, it is possible that this person is just coming out of a train with a very long journey.

So, this person is not looking very sharp, but that does not mean that this person is lazy. But what people do is they just take one thing and put the same feeling to every other trait so, in the case of the horn effect, the tendency for a single negative trait to negatively influence one's opinion or feelings in other areas.

In the case of conservation, we have observed examples in which when a national park was built and there were say in a village of say 1000 of 100 families, 95 families wanted to move out. Because in any case who wants to live in the center of a jungle surrounded by animals.

So, everybody wants to be a part of the mainstream and whenever a national park is made, then people are given a very large sum of money as compensation to move on and we have ah this thing that ah moving out has to be voluntary. You cannot force anybody to move out. It is a voluntary decision that people made. Now, 95 ah families decided that they wanted to go out and they made use of this opportunity. But there were 5 families who for some reason wanted to stay inside.

Now, a person who is using the horn effect would just look at those 5 families and flash it on the media and say that, 'oh see, these are the 5 people and they wanted to live inside, but everybody has left them'. And so, conservation is bad, we should not be making any national parks. That is

a horn effect. This is again a cognitive bias. Because in this case, we are not looking at the benefits that the national park is providing to people.

We are not looking at those 95 people or 95 families who wanted to move out voluntarily and at least got this option through the construction of the national park. No, we just look at one negative thing and we spread that negativeness everywhere, negativity everywhere. Another is fundamental attribution error: a tendency to differentiate situational and innate attributions for self and others.

That is, "if I came late, it is because of the heavy traffic" which means that if I am doing anything late, if I am not doing anything good, then it is because of the situation; it is not because of me. I am good; but the situation was bad. But "if he came late, it is because he is lazy." So, for other people, we say that if anything negative has happened, it is because those people are lazy people, those people do not work properly.

But if we are not doing something properly, we will say oh this is not because of me this is because of the situation. This is a fundamental attribution error, a cognitive bias. Priming: exposure to one stimulus influencing response to another stimulus, which may or may not be related. The look of a well-set restaurant enhances the taste of food.

Now, what is a well-set restaurant look, what to do with the taste of food? But then, this one stimulus influences the response to another stimulus. Affinity bias: bias towards people like ourselves or people with the same language or from the same region. We have observed that this is a major reason for discrimination in the labour market.

But still people do it. Self-serving bias: a tendency to claim more responsibility for success than for failures. "I topped because I worked hard; but then, if I failed it was because the examiner was biased". So, we are always self-serving. Framing effect: people decide based on whether the options are presented with positive or negative connotations.

"A treatment with 30 percent probability of saving lives" is preferred over "a treatment with 70 percent probability of death". Now, look at both of these, both of these mean the same thing; 30 percent survival is 70 percent death. But then, if you present it in a positive sense, then people like it more. This is the bias.

Hindsight bias: a tendency to perceive events that have happened as having more predictability than they actually had. So, in hindsight, people would say "he should have known that doing this would damage the machine". He should have known, but then they discount the fact that this person - had they known that it would destroy the machine - they would not have done that.

Because in hindsight, it is easy to see things; but in the foresight, it is difficult. Gambler's fallacy: a tendency to perceive that certain events occurred more frequently than normal in the near past, then they will occur less frequently than normal in the near future.

"I lost five times in a row, so now, I will win". Now, in such cases, people and in a number of cases, they lose out like anything. Because a gambler always thinks that, 'ok five times, I have not won, the sixth time, I will win; the sixth time when he again loses, he will think, oh I have lost for six times, in the seventh time, I will win' this is a cognitive bias.

Optimism bias: a tendency by persons to perceive that they will be spared from the negative events. So, people are very optimistic. "I won't suffer from a car crash, so I do not need to wear a

seat belt" as if the person is something out of the world, then they would not suffer from a car crash. This is an optimism bias. Herd mentality: a tendency to perceive certain decisions to be correct, just because many people are making those decisions.

So, "everybody is buying this company's stock, so I should also buy"; everybody is buying a car of this particular make, so I should also buy. Now, when we look at all these sorts of psychological attributes to decision making, it also has an impact on economics and it also has an impact on conservation.

In a number of cases, if people just sat down for two minutes and thought about things rationally, things would improve. People would come to the conclusion that 'yes, we have to work for development and we have to work for conservation', but without rational thinking, what people do is whatever has been happening, let us do that only. When that happens, that leads to a number of wrong decisions.

This is something that needs to be kept in mind. Rationality is bounded and if you know that rationality is bounded, you will be working more towards ensuring that no you are not taking everything for granted, you are not working in a herd mentality that because everything, because everybody took this decision, so I should also make this decision. So, this is something that needs to be kept in mind.

That is all for today. Thank you for your attention. Jai Hind!

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**Module 11**  
**Practical issues in Economics and Conservation**  
**Lecture 3**  
**Valuation of natural resources**

Namaste! We carry forward our discussion on the Practical Issues in Economics and Conservation. And in this lecture, we shall have a look at the valuation of Natural Resources. Now, natural resources are defined as those resources that exist without the action of humans.

What this means is that these resources are not man made resources; they exist naturally without the need for human beings such as the rainforest. Now, these resources can be threatened by human beings through over exploitation or through things such as pollution.

But for them to be maintained in a pristine state, no action from human beings is needed. So, these are the natural resources that exist without the action of humans. And natural resources can be divided into several categories. On the basis of origin, we have biotic resources and abiotic resources.

Now, bio means life. So, biotic resources are those that are coming from living matter such as timber. And we can also include things such as the wild animals under the biotic resources, or things such as the seaweeds or the corals. Now, all of these play a very important role in the maintenance of our planet earth.

Because they play a very big role in the modulation of the climatic cycles. And these resources that are living resources or derived from living things are known as biotic resources. Abiotic resources are those resources that come from nonliving matter such as iron ore. On the basis of the stage of development, natural resources are divided into potential resources, actual resources, the reserve resources and stock resources.

Potential resources are those resources that may be used in the future, for example oil that has not been drilled. So, these resources exist, but we are not using them, but we may use them in the near future or in the far future. So, these are potential resources. The resources that exist but that may be used in the future.

Actual resources are those resources that are currently being used. And generally they are used after surveying, quantification and qualification, such as timber from the forest. These are actual resources because we have done an exploration, we have done a quantification and qualification of these resources, and we are actually using those resources.

When we talk about oil that is being extracted from an oil well, that is also an actual resource. But if we know that there is oil somewhere, but we are not using it, but we can use it in the near

future whenever we require it, then we say that it will be a potential resource.

Potential versus actual depends on whether it is currently being used or it may be used in the future. Reserve resources are the part of actual resources that can be developed profitably in the future such as low concentration ores. So, when we talk about the actual resources we are actually using those resources.

But in the case of iron ore, there will be certain portions of iron ore that will be having a very high concentration of iron. And the current state of technology makes it possible to extract iron out of that iron, but there could also be certain other iron ores that are also getting extracted, but they do not have a high concentration of iron.

The current state of technology does not permit us to extract that iron ore in a profitable manner, but in the near future when the technology develops further we are going to use it. Now, these resources are actually being extracted. So, people when they are doing the mining, they will be extracting these iron ores and probably dumping it near the mine site itself.

These are known as the reserve resources because they are part of actual resources, we are actually taking them out, but we are not able to extract them profitably or use them profitably using the current technology and. We call them reserve resources that can be developed profitably in the future. We still have methods to use these resources, but they are not profitable currently.

The fourth category is stock resources. Those resources that have been surveyed, but we lack the technology to use them all together such as hydrogen for nuclear fusion. Now, we know that in the fusion reactions as happens in the stars or in our Sun, hydrogen is fused together to form helium.

Now, because we know that such a reaction exists and we have used this reaction in thermonuclear weapons, this is a resource that can also be used for the generation of electricity. If we could control nuclear fusion, we could use it in the generation of electricity, but currently we do not have the technology to do that.

Even though we know that we have plenty of hydrogen in the water in our oceans, we currently lack the technology to do this fusion reaction in a controlled manner. And so we will call them stock resources. These are resources and these resources have been surveyed. We know how much hydrogen we have, but we lack the technology to use them.

Similarly, on the basis of renewability, we have renewable resources and non-renewable resources. Renewable resources are those resources that can be replenished naturally such as sunlight. Now, what happens in the case of renewable resources is that the natural processes ensure that we will continuously get these renewable resources things such as forest.

Now, in the case of a forest, if the extraction is done in a sustainable manner, we do not do an over exploitation of the forest. What happens is that the trees will produce seeds, these seeds will fall down, they will germinate, and they will produce the next generation of trees. And so these are renewable resources that get replenished naturally.

On the other hand, we have certain non-renewable resources, those resources that either form slowly or do not form at all in the environment. So, the process is so slow that it is as good as that these resources are not being produced at all now things such as coal or petroleum. Now, it takes millions of years to produce coal or petroleum under conditions of high temperature and

pressure.

Now, the rate of the formation is so slow that if we use up the coal and petroleum that is with us, we will no longer have any more coal or petroleum. And so resources such as these are known as non-renewable resources. They are not renewing themselves naturally, they are not replenishing themselves. And so we have to be extra careful whenever we are using these resources.

When we talk about resources, we also do an economic valuation of resources which is suppose you have a forest you may ask the question what is the value of this forest? When you do an analysis to find out the economic value of the forest meaning that ah how much is this forest worth, is it worth a few lakhs of rupees, is it worth a few crores of rupees or more?

When you do such a valuation, it is known as an economic valuation. You are putting a value to the forest and this is not a religious value or a social value, but you are putting a rupee value or a dollar value to the resource, so that is an economic valuation of resources.

We do economic valuation of resources primarily for three functions. One is to aid the cost benefit analysis when the natural resource is being diverted, for example a forest that is being diverted into mining. Now, these sorts of situations arise again and again, we have limited forests and the land over which the forests are standing can also be used for several other purposes like mining, or things like making a road, or things like even agriculture or making up residential areas or industrial areas.

Whenever we get a proposal like that, we need to do a cost benefit analysis which means that we ask the question that ok if this forest is getting diverted, and suppose we will divert it and form a mine, now when that happens what is the loss that we are incurring because once the mine has been developed, we no longer have the forest. Which is what we are seeing here is that you have a forest and the proposal is to divert it into a mine.

Now, suppose the forest is worth rupees 50 crores, and the mine is worth rupees 30 crores. Now, in such a case, once you have the mine, you no longer have the forest. So, you are giving up a thing that is worth 50 crores to get something that is worth only 30 crores. And so no rational person would say that we should be diverting such a forest. So, this cost benefit analysis is very important.

Once we know the value of the forest, in a number of cases the people who come up with the proposal to develop the mine, they would have done all sorts of computations about how much is the amount of ore that we are going to extract from it, and what is the market value of that ore.

They would even come up with things like ok how many man days of employment are we going to generate with this mine. But they will only be presenting their side of the picture, that is that the mine will develop so many days of employment and it will add so much rupees to the GDP.

But then when we look at the forest the forest in itself is also giving a number of advantages to society. It was giving a large number of things such as biodiversity benefits. It was controlling pollution; it was making the rivers flow; it was a storehouse of biodiversity.

And this biodiversity is very important whenever we get a new disease for instance because if there is a new disease, you have to look for a cure. And in a number of cases, we get cures from the secondary metabolites that are there in several plants. So, if you have the plants you can extract the secondary metabolites and probably in a short while also make them chemically.



But then to test these chemicals we need these chemicals. And these chemicals will only be there in the plants. So, a storehouse of biodiversity is important because we may use these bio resources in the near future or in the distant future. Now, when this forest is diverted into mine, all of these things and probably a lot more are gone.

There is no longer a tourism potential in this area because people want to visit forests to watch tigers, nobody wants to go to a mine and see how the mining is done. So, the tourism potential of a forest is very large, probably this tourism potential was also providing employment. Probably it was a potential resource but it is not an actual resource which means that if the forests are beautiful if they have wild animals like tigers, then these are potential resources. Maybe we could have developed them into a tigerism. But once you take this decision to convert them into a mine, then you no longer have the forest. And once you do not have the forest, it is not no longer an actual or a potential resource from the forest point of view.

So, we need to make these computations about what is the worth of the forest and what is the worth of this mine, and only then will we be able to make a correct decision. So, economic valuation is important to aid the cost benefit analysis when the natural resource is being diverted, for example a forest being diverted into mining.

It is also important to provide evidence to aid the habitat conservation policies by highlighting the economic value that is associated with conservation, for example watershed benefits. Now, the thing here is that the forests are very important to ensure that the rivers flow.

Now, what happens in the case of forest is that suppose you have mountains and there is a river that is flowing. Now, when it is the rainy season, when it rains, now in our country we have the rains only in very few months in a year. In most parts of our country, we get rains only in the monsoon season; in certain areas we also have winter rains, but that is all.

In most cases, we will not have rain in the month of March or in the month of April. Now, what happens is whenever you have the rainfall, the water that is falling down; if there are no trees, then this water will just flow over the surface of these hills and reach into the river. And whenever it is raining, then we will have a huge amount of water in the rivers which means that we will be having a flood like situation.

And when it is not raining, then there is no water that is getting into the rivers, and so we will have a situation of drought. Now, in such a scenario, when you have consistent floods and droughts, then that river is not very useful for human beings because we are not assured whether these rivers will be flowing or not.

What happens with the case of trees is that when you have trees on these mountains, then these trees act as stoppages for the water that is coming down in the form of rain. So, the rain droplet that falls on the tree canopy will be stored in the tree canopy for some period of time. And then slowly and steadily it will come down. That is, when you stand beneath a tree after it has rained, after the rain has stopped, you will find that some amount of water is coming down trickling down.

Now, that was the water that was intercepted by the leaves and was stored in the ah canopy itself. Then slowly and steadily what happens is that this water makes its way through the surface of the trunk. So, this is known as a stem flow. So, this is a stem flow. Which means that if you stand

beneath a tree after it has rained and if you touch the stem of the tree, you will find that it is wet because of all that water that was collecting in the canopy.

It is now slowly trickling through the stem of the tree, and then it is reaching to the ground. Now, once this water reaches to the ground surface that is the earth surface, now what does it find? It finds the roots. So, what is happening here is that you have this tree and this tree will also be having roots, and suppose this is the ground layer.

What is happening is that first of all the water was intercepted by the canopy. So, it was stored in the leaves, that is, on the surface of the leaves. Then slowly it starts to trickle down through the surface of the stem in the process of stem flow, and then it reaches into the ground because the roots have already made a hole in the ground.

And when this water has entered into the earth what happens now is that this water suppose ah so we have this water here now this water will slowly move inside earth, and then it will come out at some point. Similarly, the water that was falling on this tree makes way and then it comes out at some point. So, it is moving inside the earth.

Now, what happens is that water takes time to move from point A to point B. When it was just falling on the surface of the earth and when it was flowing on top of the surface, then it was moving very fast. But once it is inside the ground, then it has to negotiate its way between different soil particles.

So, its speed slows down. So, what happens now is that the water that started here will probably take say 4 months to reach this point. The water that started here will probably take say 3 months. The water that started here will probably take 1 month. And so in the water that started here will probably take a very long period let us say that it takes 7 months.

What is happening through this process is that the water that is falling on the ground, it does not move very rapidly into the streams, and slow in this process the streams are not getting into a flood like situation because this water is now being retained by the canopies, the water has been retained by the soil. And these hills now act as sponges because all of this water is now inside these hills, and so they act as a sponge.

In the case of a sponge, the water is retained inside the sponge, and then it slowly moves out which is what we are observing here. And in this process the floods are avoided because all the water does not reach into the stream at the same point of time. But even more important is that because different waters take different time periods 7 months, 1 month, 2 month and so on.

At all points of time, there is some water that is entering into the rivers which means that even after the rainy season has ended even when we are not having any more rains, we will find that there is certain water that is entering into these speeds through the ground. This is known as ground flow water.

And once that happens, it would ensure that even in the dry seasons the stream will have some amount of water which means that what is now available for the drinking of humans, for drinking by animals, for irrigation purposes, for navigation purposes and so on. Now, these kinds of benefits are known as watershed benefits.

In the case of watershed benefit, we include things like ah the avoidance of flood and also maintaining the streams in a perennial state that is all throughout the year, the streams will be having

water. Now, these kinds of benefits are because we have the forest there and so we need to do habitat conservation.

Now, habitat conservation is being done by the government, it is being done by different societies, and a number of societies do this because of a religious purpose or because of a social purpose. But once we do a cost computation, once we figure out that ok if we did not have these hills, if we did not have these forests, in that case we would have an excess of water that will come in the rainy season.

Now, that excess would have caused floods. And to avoid the floods, you would have to construct a dam. What is the cost of that dam? Similarly, when you have the hills in the forest, the rivers are flowing throughout the year. Now, if we did not have that the dam would have to release the water in a consistent manner.

Now, how many dams would you require so that everybody gets water? What is the cost of that? Once you do these cost computations then these cost computations aid in the conservation policies, they provide support to the conservation policies. This is another importance of doing an economic valuation.

It provides evidence to aid the habitat conservation policies by highlighting the economic value associated with conservation. So, even if we did not have this economic valuation, we would still have been doing the conservation, but with the economic valuation it gets a huge amount of force.

And to evaluate the economic compensation legally required for damage to natural resources through the polluters pay principle, for example an oil spill. Now, if there is an oil spill in an area and the habitat is destroyed, then in the legal process you need to ask the person who spilled this oil the polluter to pay for the damages.

How will you ask this person how much to pay if you yourself do not know the value of your resource. Probably your forest was worth 50 crores of rupees, and the polluter is saying that ok sir I will pay you 5 lakhs of rupees. Now, will you agree or not? How do you figure out what is a good amount of compensation?

The compensation should be such that it should be sufficient to bring your forest back into the original state only then will it be a compensation because a compensation is being done so that the society when it has lost its resource it is able to recuperate the losses, and have the same resource back only then we will call it a compensation.

But if you do not know the value of the resource, how will you ask for compensation? What is the amount of compensation that we need? This is another reason why we do the economic valuation. Now, in economic valuation, the total economic value of a natural resource is given as the sum of its use value and the non-use value. The total economic value is use value plus non-use value.

What is the use value? Use value is a value that arises out of the use of a resource. When you are using the resource, then the value that you are generating because you are using the resource is known as the use value. But then even when you are not using a resource, even then the resource has certain values because we have seen that there are certain resources that are potential resources.

In that case, you are not using the resource currently, they are not actual resources. So, you may use them in the future. And when we talk about those values we say that those are non-use values. Values arising even though the resource is not being used. So, the total economic value is the use value that is arising from the use of resources, and the non-use value which is arising even though the resources are not being used.

And the use value consists of the direct value, the indirect value, and the option value. So, these are the three categories of the use value. Use value is direct value plus indirect value plus option value. What are these three? Direct value comprises consumptive and productive values, and non-consumptive values. What we are saying is that direct value is consumptive value plus non-consumptive value.

Now, this is use value. We saw here that the direct value is a use value. So, these values are arising because we are using the resource. Now, we can use the resource in a consumptive manner or in a non-consumptive manner. When we say consumptive manner, we had seen in an earlier lecture that there are certain resources that are rivals in consumption, and there are certain resources that are not rivals in consumption. Here in the case of consumptive values, we are talking about those values that are rivals in consumption. And when we talk about the non-consumptive values, they are not rivals in consumption.

What are consumptive values? How do you use a forest in a way that you are consuming the forest things like timber or firewood? Now, timber and firewood are consumptive values because if I consume the timber that is I extract the timber out of the forest, then less amount of timber is available for you to extract or for anybody else to extract.

So, the total amount is limited and the more any person takes out, the less is available for everybody else. So, these are consumptive values. People are consuming their influences. Consumptive values are timber, firewood, medicines or medicinal plants. Grazing because even in the case of grazing, the forest has a fixed capacity to accommodate the animals.

So, if I bring in more animals, then for a sustainable use you can bring in less number of animals because if I also bring more animals, you also bring more animals, in that case the resource will be gone. And so when we talk about grazing it is also consumptive use because we are consuming the resources in such a manner that if I use more, then less is available for you to use.

Non-timber forest produce or NTFP, now non-timber forest produce includes things like fuel wood, or fodder, or fiber, or fruits that we are getting out of the forest. So, when we say that we are collecting things such as mango from the forest or we are collecting honey from the forest. So, these things are non-timber forest produced.

So, NTFP is non-timber forest produce. So, this is a forest produce that is not timber. So, everything that is other than timber is a non-timber forest produce. And here we include things such as honey. Now, honey is a forest produce because we normally collect honey from the hives that we find in the forest. So, this is a forest produced, but this is not timber.

Similarly, we have a large number of fibers that we collect from the forest; we have a number of medicinal plants that we collect from the forest. There are a number of aromatic compounds or aromatic oils that we collect from the forest. We also have things like mushrooms that naturally grow in the forest, and we collect them from the forest. So, all of these things are non-timber for-

est produce.

And these are all consumptive values of the forest because if I consume more of the honey, if I extract the honey, then less honey is available for anybody else to extract. Water, water is another consumptive value that we derive from the forest. Non-consumptive values include things like recreation or ecotourism.

Now, in the case of recreation or ecotourism it is a non-rival in consumption which means that if I go to the forest and if I watch a tiger I feel happy about it. Now, here I am using the forest to see a tiger. So, this is a used value. And I am directly using the forest.

So, this is a direct value. But when I see the tiger then it does not reduce the value of the tiger. So, when you see this tiger then the quantity or the quality of the tiger has not gone down because I have seen it before. So, this is a non-conservative use. So, things such as recreational purposes.

If I go to a forest and I find that this forest is very beautiful and I enjoy the surroundings, I enjoy the peace and tranquility in the forest that I am seeing. And when you come to this forest later on then if I have not used the forest in a way that if I have not littered into the forest.

If I have not spread waste into the forest then there is no change in the value; and when you go to the forest later on, you will also enjoy the forest. So, things like ecotourism or recreation are non-consumptive values. Similarly, we have education and research. So, if I go to the forest, and if I do a research project about how tigers regulate the population of deer. I do this research. Now, when I do this research, I am just going into the forest and counting how many tigers are there, how many deer are there, when they hunt, how they hunt and so on. Now, in this process I am neither reducing the quantity of tiger or deer nor am I reducing the quantity of tiger or deer.

Now, later on suppose you come up with another research proposal that how does tiger regulate the growth of say some birds in the forest. So, while I have used the forest to do my research work, it has not reduced the quality or quantity of the forest for you to use it as a research area. So, this is again a non-consumptive use of the forest.

Similarly, human and wildlife habitat. If I am using the forest as a wildlife habitat or if I am using the forest as a human habitat, so if there is say ah a rest house in the forest I go into the forest and I use that rest house because it has a very beautiful surroundings.

Later on if you go into the forest, you stay in the rest house then it does not matter whether I have stayed before or not as long as I am using it sustainably and I am not destroying it. So, these things are known as the non-consumptive values that we derive from the forest.

And direct value is the sum of consumptive values and the non-consumptive values, because in both of these whether we are talking about consumptive usage or non-consumptive usage we are using the forest directly. There are also indirect values that we derive from the forest. Indirect value means that we are still using the forest, but the values that we are deriving out of it are indirectly.

We are not directly deriving these values. So, this includes things like watershed benefits including agricultural productivity, soil conservation, groundwater recharge, regulation of stream flows. We have seen before that the watershed benefits that the forest provides lead to protection of soil, they lead to availability of water throughout the year.

But when somebody gets an enhanced income because of the presence of soil and because of the presence of water throughout the year, this person will not say that I am getting this value or this amount of money because of these forests because they are not directly using it. It does not come to their mind that they are directly getting these values, but they are still getting these values indirectly.

It includes things like ecosystem services: nitrogen fixation, waste assimilation, carbon sequestration and storage, microclimatic function, now all of these things are also indirect values that people are deriving because of the presence of forest the climate is kept much more moderate.

The global climate or global warming is kept under check. Now, the benefits of these things will be derived by everybody, but they will not say that oh ah this year I am I did not get a drought situation because of this forest. It just does not come to mind, but it is still a value that people are deriving indirectly.

Or things like evolutionary processes such as global life support and biodiversity. Now, when we talk about the organisms that we have on earth and we are deriving values from different organisms, these organisms also require a place to live. When we talk about polar bears.

When we talk about tigers, when we talk about leopards, leopards require a place to live. Now, we derive a benefit out of seeing a tiger, but then the forests are the areas that provide it with the habitat the forest are the areas which ah which provided an opportunity for a tiger to evolve into what it is today. So, these are also benefits that people derive indirectly.

So, these are the indirect values. And we also have the option value. It is an option for the future direct and indirect use of biodiversity. Now, what is an option? Suppose, there is a forest and we have got two options. One is that we can go into the forest. We can cut all the trees and extract the timber out. Now that is one way of using this forest.

But you may also say that no this forest has certain biodiversity and I might use it in the future. So, I am not currently using it, but I might use it in the future. So, let us keep it as a forest. Now, this value that you derive for a future use is an option value. You can make a correlation by saying that suppose there is a house.

And you want to purchase this house. Now, you can buy this house for, say rupees 60 lakhs, but there is also another house that you think that ok this is also a good house I might purchase this house again. So, we are not sure whether you will buy this house and suppose this house is worth 65 lakhs, and this house is 60 lakhs.

Now, you are not certain which house to buy, probably you will ask a few of your friends, you will ask a few of your family members, you will do a bit more research, you will do a bit more feel with it, to make up your mind which house to buy.

But then when you are in this process the seller of the house might say that ok sir you are taking so much time, so let me sell this house to somebody else because there are so many people who want to buy this house. Now, the thing is you have not decided which house to buy, but you are sure that you are going to buy a house.

What you can do is you can tell these sellers that ok I want you to keep this house for me for say the next two months. By the end of these two months, I will make up my mind. Can you please keep this house and not sell it to anybody. The seller would say sir why should I do that because

as soon as I get a buyer, I will sell this house.

So, you tell these sellers that ok, I am going to pay you 20000 rupees. And I am paying you to these 20000 rupees so that you do not sell these houses in the next 2 months that is what you are doing is that you are paying rupees 20000 for this house, and you are paying a rupees 20000 for this house just to keep it like that for the next 2 months till you are able to make up your mind.

Now, this amount that you have paid 20000 here and 20000 there is an amount so that you retain your option. You are paying this amount, so that these houses are not sold before you make up your mind, and you retain an option on both the houses. This is an option value.

Similarly, when we say that there is a forest and we are not extracting this forest, we are not taking out all the resources because we might use it in the future. Now, we do not know when we are going to use it or whether we are going to use it, but we still want to maintain an option in the forest.

Then later on should we decide that we are going to use this forest for say um getting a particular drug then this forest should remain. Now, this is a value that we derived from the forest just by keeping it as such. So, this kind of a value that you derive is an option value, an option for the future direct and indirect use of biodiversity.

So, these are the three different use values: direct values, indirect values, and option values. Similarly, we have the non-use values: value that is arising even though the resource is not being used. And here we have existence value, altruistic value and bequest value. So, these are three non-use values. What are these?

The first is existence value: this is the value deriving from the knowledge that the resources continue to exist. What we are saying here is that we know that there are polar bears, and a lot of us would have probably seen polar bears on the television. Now, suppose one day you get to know that all the polar bears have become extinct, how will you feel about that? Probably a lot of us will feel very bad that polar bears are now extinct.

But now if you think about it, you are not using a polar bear, you are not using a thing like the pandas, you are not using the whales that are there in the ocean, but even then if these animals become extinct you will feel bad that you now no longer have these animals on the planet. Now, you have lost the chance to ever watch these animals, or your children and your grandchildren have lost the chance to ever see these animals.

When we say that we feel bad, the other thing is that when the resources continue to exist we do not feel that bad or we feel good. We feel good that yes on this planet we still have polar bears.

Even though we are not going to the arctic regions and watching the polar bears, still we feel good that yes we have the animals. Probably someday we might go and watch these polar bears, probably we will never go and watch these polar bears, but still we feel good that yes the polar bears continue to exist.

Now, when we talk about these values these are the existence values. This is a value that we derive from the knowledge that the resources continue to exist. So, if there is a forest and you get to know that the forest is burnt that is ah every year we get to know that there are huge forest fires and so many millions of ah acres of forest are getting burnt.

Whenever we see such a news, we feel bad; or the other way around this if this forest had contin-

ued to remain as it is they would have been good. So, the value that we derived just because the forest continues to exist is the existence value. So, this is a non-use value because we are not using this resource.

Another is altruistic value, the value derived from the knowledge of use of resources by others in the current generation. So, when we find that there are rhinoceros in the Kaziranga National Park and because there are rhinoceros in the Kaziranga National Park so many tourists visit Kaziranga National Park.

And because they visit, people in the surroundings get employment. Now, who are these people? These are our own country people, they are our own brothers and sisters, they are the citizens of the same country. Now, these people are there in the same generation as we are.

And we feel good that ok because of the rhinoceros there are certain people in our country who are getting employment. So, we feel good that yes even though I am not getting a value out of these rhinoceros directly because the tourist is not paying me, but at least there is somebody in my country who is getting employment because of the rhinoceros.

Now, this value that we'll derive because we are getting the knowledge of the use of resources by others in the current generation. Now, in this case we are not talking about our children, we are not talking about our grandchildren, we are seeing that yes today there is somebody in our country who is getting employment because of rhinoceros.

Now this kind of value that we derive because we are feeling good that there is somebody who is getting employment - this is known as an altruistic value. Now, this is a non-use value because we are not using those rhinoceros, but we still feel good that yes there are certain people in our country who are getting employment for using these resources. So, this is an altruistic value.

And when we leave these values for our offsprings or future generations then we will say that we are having a bequest value. So, the bequest value is when you ask the question, ``Ok, today if I am generating a waste, today if I am polluting the environment, what am I giving for my children and for my grandchildren?''

Everybody wants to leave the world in a better place for their children and their grandchildren than they are currently living in. And when we have this kind of a thought when we say that ok we are leaving these forests for our children and our grandchildren.

We are ensuring that we still have tigers so that our children and our grandchildren can watch tigers. When we have such kinds of thoughts then the value that we derive because we have tigers for our children and our grandchildren is known as a bequest value. So, this is another non-use value.

Now given that we have so many values we can now talk about the methods of valuation. How do we put a rupee value or a dollar value to all of these different values? There are three accepted approaches for valuation of the natural resources. The first one is known as market prices or the revealed willingness to pay.

In the case of market prices, we have three main methods. One is the market price method, the hedonic pricing method, and the travel cost method. The market price method asks the question that ok if we use these different values what is the market price for each of these? That is when we talk about the market price method for a forest we will say that this forest has timber.



Now, if we extract all of this timber, what is the amount of money that we will get by selling this timber? So, let us say that the amount that we will get is 30 crores of rupees. This forest also has water. Now, if we extract all of this water and we try to sell it off, what is the amount that we will get?

Suppose, we will get 10 crores of rupees. In this forest we have a number of animals such as fishes. Now, if we extract all the fishes what is the total value that we will get when we sell it in the market? Suppose, we can sell it off for 25 crores. And similarly we can make a list of all the other birds that we are getting from the forest.

And what we are asking is if we extracted all of these out and if you sold it in the market what is the price that we will get. Suppose everything else is going to give you 15 crores. Then the market price method would say that the total value of the forest in crores is 25 plus 15 is 40, 50, 60, 70, 80.

So, this forest is worth 80 crores of rupees. This is the market price method. You make a list of water and things that are there in the forest, find out their current market prices, add them together, so that is the market price method. Another is hedonic pricing method, hedonism is the value of feeling good and the feel good factor.

Now, the thing is, suppose there is a tower. And this tower has different flats. And on one side of the tower, you have a forest; on another side of the tower, you have a road. So, here you have a road. And on this road, there are vehicles that are flying, and there is a huge amount of noise that we get and it does not look good.

But if you look at the forest, it looks good, it is a beautiful forest. Now, when that happens and when the flats are put up for sale, suppose we have these two flats A and B. Now, the person who gets flat A will get to see the road, and the person who buys flat B will get to see a forest.

And typically what we observe is that the flat BB is sold at a premium because it gives a very good view. So, it is very similar to having a sea facing view. So, sea facing plots or flats cost much more than a non-sea facing flat. And similarly here a forest-facing flat will cost much more than a non-forest facing flat.

Now, the hedonic pricing method asks this question that people are paying this premium because they are deriving a benefit in the form of happiness in seeing this beautiful forest. And so if we did a computation of the prices of all of these and the prices of all of these, the difference is because these portions are towards the forest.

The difference in prices between both of these will give us a certain amount of value that is coming from these forests. So, that is the hedonic pricing method. Another is the travel cost method. Now, the travel cost method is based on the idea that people put a value on things. And if the price is less than the value that they are putting only then will people be purchasing that particular item.

That is if I put a value to this pen of 50 rupees, and if I am getting it for 30 rupees, I will buy this pen. But if I am getting this pen for 100 rupees, I will probably not buy this pen. So, the amount that I am paying can give a very good idea about the minimum value that I am putting to this thing. That is if I am paying 30 rupees for this pen, then that would mean that the value is greater than or equal to 30 rupees only then I am paying for it.

So, when we talk about the travel cost method, it asks the question that if there is a forest let us say there is the Kanha tiger reserve. And people are coming to Kanha tiger reserve from different areas. So, let us say that there is a person who is coming from Delhi, there is a person who is coming from Mumbai.

Now, the person who is coming to this forest is spending money on transportation, this person is spending money for entry fees, this person is spending money for ah paying for the accommodation and food at higher prices than what he would he or she would have paid at home. Now, if a person from Delhi is spending say 30000 rupees to come to this forest; a person from Mumbai is spending say 40000 rupees to come to this forest.

So, the person from Delhi is putting the value of at least 30000 rupees because of which he is spending this amount the person from Mumbai is spending is putting a value of at least 40000 rupees. And so in the case of the travel cost method, we make a list of the people who are coming to the forest, and we make a computation of how much they have spent.

When we add them up together, then it gives us an idea of the value that these people have come to the forest, so that is the travel cost method. Another approach is the circumstantial evidence or the imputed willingness to pay such as a replacement or substitute cost or damage cost avoided. Now, in this case what we are asking is suppose there is a sea and we have a mangrove forest near the shore.

Now, if there is a tsunami, then all these areas will get inundated with water. And there will be a loss of life, there will be a loss of property. Now, when we talk about the damage avoided. We are asking the question that if our ah mangrove forest were not here, because mangrove forests protect against the impacts of the tsunami they act as barriers to the water that is coming in.

Now, if we have the mangrove forest, then they are protecting the inland areas. If it did not have these forests, then there would be damage that would be caused to the inland areas. What is that damage? And when we do a computation of what would be the damage caused if we did not have this natural resource.

And we put that value to this that this forest is giving us a protection that is worth 1000 crores of rupees then that is a damage cost avoided method of valuation. On the other hand, we could ask another question: if in place of having this forest we removed all the trees and if we constructed a wall along the shore.

Now, this wall would also protect us against the tsunami. But the construction of this wall will cost us money. So, what is the cost of construction? What is the cost of maintenance? So, that is the cost that we would have to spend to have the same level of protection if the mangrove forest was not there.

When we ask that question we are asking about the replacement or the substitute cost, how much does it cost for the replacement of the natural product or the natural resource? If we did not have the forest, we would have to construct structures to prevent soil erosion, how much would those structures cost?

If we did not have the forest, we would not have clean water. And we would have to start a plant to clean the water. What would be the cost of constructing and running that plant, so that is the cost of the replacement. So, this is also a method of valuation of the natural resource. And a third

method of valuation is surveys or expressed willingness to pay such as the contingent valuation method.

In this case you ask people the question that ok, there is this forest and you give them a hypothetical situation that the government has decided that this forest should be cut down. But if the ah and the government is cutting down this forest to sell off this land, but if we pay to the government in the form of a tax, then probably the government will not cut down this forest. What is the maximum amount that you are willing to pay?

Now, the people who are deriving value from the forest will put up a certain amount ok, I am ready to pay 20 rupees or I am ready to pay 1000 rupees, or I am ready to pay 10,000 rupees. So, depending on the amount of value that they are putting to the forest, they will come up with a certain figure.

Now, this is a completely hypothetical situation, but we are getting an indication of the amount of value that people are putting into the forest by the amount of money that they are expressing that they will be willing to pay for the continued existence of the forest. So, that is known as a contingent valuation method through service or express willingness to pay.

Now, different methods of valuation are used for different areas. And we can choose between these different methods depending on the situation that they are addressing. So, in this lecture, we had a look at the total economic value. Total economic value is use value plus non-use value. Use value is direct value plus indirect value plus option value; non-use value is existence plus altruistic plus bequest value.

These are all different values that we derive from the forest. And we can make a computation of their rupee values or their dollar values by using different methods of valuation. And this is used so that we get an idea of the resource that we are protecting.

We get an idea of how much it will cost somebody if this resource is to be diverted, we get an idea of computing the damages, and it also helps us in reinforcing our policies for conservation. So, in this case, economics is a very good tool to aid conservation because it helps us make choices in a rational manner.

That is all for today. Thank you for your attention. Jai Hind!