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Lecture Notes

Part 2

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ECONOMIC CONCEPTS AND APPLICATIONS WITH SPECIAL REFERENCE TO CLIMATE CHANGE

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Introduction

Economics is the social science, which examines how people choose to use limited or scarce resources in attempting to satisfy their unlimited wants. Alfred Marshall defined economics as "a study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing". Thus it is on one side a study of wealth; and on the other, and more important side, a part of the study of man. Most contemporary definitions of economics are based upon choice and scarcity. One of the earliest definitions in this category is by Lionell Robbins in 1935: "Economics is a science which studies human behavior as a relationship between ends and scarce means which have alternative uses." Unlike the physical scientist, the economist cannot carry out controlled experiments under laboratory conditions. The subject matter of economics deals with "man in the ordinary business of life". Broadly, economics may be divided into macro and microeconomics. Macroeconomics deals with aggregate picture of the economy and deals with indicators such as Gross National Product, Inflation, Unemployment, Exports, Imports Taxation policy etc. Microeconomics deals with individual actors in the economy such as firms and individuals.

Fundamentals of economic decision making

Economic problem exists for allocating scarce resources which have alternative uses amongst different desired ends. The economic problem is invariably that of how to get the most out of resources available to any person, group or society, or conversely, how to attain a specified end with the use of minimum quantity of those resources. Every allocative problem involves three main ingredients

i. a statement of the end it is desired to achieve (objectives of the decision maker)

ii. a technical relation between the quantities of resources (or inputs) used for the given purpose and the product resulting from that use (or output)

iii. a limitation imposed by circumstances on the quantities of inputs available (budgetary constraint)

Decision making in economics is mainly dependant on the trade off i.e. costs and benefits are compared to make decisions.

Some Basic Concepts in Economics

Costs must be considered in various ways, depending on the decision at hand. All the cost concepts need to be considered in such a way so as to help make sound decisions. The decision maker should try to discover the "relevant" costs by asking what cost are relevant to a particular decision at hand, and the decision maker is not necessarily bound by traditional concept constructed for other purposes. Some of the important cost concepts that are relevant for managerial decision are briefly discussed below.

Actual costs and opportunity costs

Actual costs are those, which a firm incurs while producing or acquiring a good or service like raw materials, labour, rent etc. Suppose, we pay Rs.150 per day to a worker whom we employ for 10 days, then the cost of labour is Rs. 1500. Sometimes the actual costs are also called acquisition costs or outlay costs.

Opportunity cost is defined as the next best alternative use of any factor of production. For example

Mr. X is currently having Rs. 2 lakhs for investment. He decides to start his own small business. The opportunity cost here is the alternative sources of investment that might have reaped fixed returns, for example, fixed deposit in a bank which could have earned an interest rate of 11.5 % per annum. Therefore, the opportunity cost is the earnings foregone by starting an enterprise. One may ask you that whether this opportunity cost is really meaningful in the decision making process. As we see that the opportunity cost is important simply because, if Mr X cannot expect make a profit of more than 11.5 % per annum from his new business(after the gestation period), it is better to invest the money as fixed deposit with a bank.

Explicit and implicit costs

Explicit costs are actual payment to other parties. An explicit cost is the monetary payment made by a firm for use of an input owned or controlled by others. Explicit costs are also referred to as accounting costs. For example, a firm pays Rs. 100 per day to a worker and engages 15 workers for 10 days, the explicit cost will be Rs. 15,000 incurred by the firm. Other types of explicit costs include purchase of raw materials, renting a building, amount spent on advertising etc.

On the other hand, implicit costs represent the value of foregone opportunities but do not involve an actual cash payment. Implicit costs are just as important as explicit costs, but are sometime neglected because they are not as obvious. For example, a person who runs his own business foregoes the salary that could have been earned working for a firm. The implicit cost is not generally reflected in accounting statements, but is required in rational decision-making. Therefore, an implicit cost is the opportunity cost of using resources that are owned or controlled by the owners of the firm. The implicit cost is the foregone return; the owner of the firm could have received had they used their own resources in their best alternative use rather than using the resources for their own firm production.

Private cost and social costs

A further distinction that is useful to make especially in the public sector is between private and social costs. Private costs are those that accrue directly to the individuals or firms engaged in relevant activity. Social costs, on the other hand, are passed on to persons not involved in the activity in any direct way (*i.e.,* they are passed on to society at large) consider the case of a manufacturer located on the bank of a river who dumps the wastes in to water rather than disposing it off in some other manner. While the private cost to the firm of dumping is zero, it is definitely harmful to the society. It affects adversely the people located down current and incur higher costs in terms of treating the water for their use, or having to travel a great deal to fetch potable water. If these external costs were included in the production costs of a producing firm a true picture of real or social costs of the output would be obtained. Ignoring external costs may lead to an inefficient and undesirable allocation of resources in society.

Fixed and variable costs

Fixed costs are that part of the total cost of the firm which does not change with output. Expenditure on deprecation, rent of land and building, property taxes, and interest payment on bonds are examples of fixed costs. Given a capacity, fixed costs remain the same irrespective of actual output. Variable costs, on the other hand, changes with output. Example of variable costs is wages and expenses on raw material.

However, it is not very easy to classify all costs into fixed and variable. There are some costs, which fall between these extremes. They are called semi-variable costs. They are neither perfectly variable nor absolutely fixed in relation to changes in output. For example, part of the depreciation charges is fixed and part variable. However, it is very difficult to determine how much of depreciation cost is due to the technical obsolescence of asset and hence fixed cost, and how much is due to the use of equipments and hence variable cost. Nevertheless, it does not mean that it is not useful to classify costs into fixed and variable. This distinction is of great value in break-even analysis and pricing decisions. For decision-making purposes, in general, it is the variable cost, which is relevant and not the fixed cost. When the output goes up, the fixed cost per unit of output comes, down, as the total fixed cost is divided between larger units of output.

Total, average and marginal costs

Total cost (TC) of a firm is the sum-total of all the explicit and implicit expenditures incurred for producing a given level of output. It represents the money value of the total resources required for production of goods and services. T.C. = TFC + TVC.

Average cost (AC) is the cost per unit of output. That is, average cost equals the total cost divided by the number of unit produced (N). If TC=Rs.500 and N=50, then AC = Rs.10.

Marginal Cost (MC) is the extra cost of producing one additional unit. At a given level of output, one examines the additional costs being incurred in producing one extra unit and this yields the marginal cost.

The total cost concept is useful in break-even analysis and finding out whether a firm is making profit or not. The average cost concept is significant for calculating the per unit profit. The marginal and incremental cost concepts are needed in deciding whether a firm needs to expand its production or not. In fact, the relevant costs to be considered will depend upon the situation or production problem faced by the manager.

Depreciation

In economics depreciation is the decrease in the economic value of the capital stock of a firm, plant and machinery or other entity, either through physical depreciation, obsolescence or changes in the demand for the services of the capital.

Climate change impact assessments

Uncertainty is inherent in marine fisheries and the phenomenon of global climate change originated by both human and natural factors compounds the inbuilt vulnerability of stakeholders in fisheries. Over the past three decades, since 1970 or even earlier, the scientific evidence for human induced climate change has become steadily stronger. The Intergovernmental Panel on Climate Change (IPCC) stated that "the balance of evidence suggests that there is a discernible human influence on the climate" (IPCC, 1996). In 2001 it was observed that human activities are responsible for more than 50 per cent of the global warming. During this century, the estimates of global warming suggests an increase of mean sea level and changes in weather patterns including increased frequency and severity of occurrence of natural disasters. This will pose severe threat to the important townships in the world which are lying on the coastal belt. In India, Mumbai, Chennai and Kolkata are metropolitan cities on the shore, supporting vast majority of urban population (20.71 million), increasingly prone to the threat of increase in sea level. The most likely impact upon stakeholders in marine fisheries can be caused due to increase in sea level with frequent and severe natural disasters.

All seafaring fishers are subject to risks and seasonality and hence there arises problem of uncertain livelihoods. Sea surges, soil erosion, environmental pollution and tsunami are some of the disasters that add to the vulnerability of fisherfolk. Outbreak of natural disasters destroys the livelihood and assets and the restoration of the same takes long period during which the condition of the affected turn pathetic. The recent tsunami of the Indian Ocean withered destructive impact mainly on the coastal community leaving them deprived of their belongings in addition to loss of lives. Rehabilitation and restoration processs is still in progress even after three years after its occurrence.

Climate change impact assessment refers to research and investigations designed to find out what effect future changes in climate could have on human activities and the natural world. This is frequently coupled with the identification and assessment of possible adaptive responses of the population to a changing climate.

Impact assessment methods

Five approaches which measure the potential impacts of future climate change proposed by the Handbook on Climate Change: Impact Assessment and Adaptation Strategies are:

1. Historical climate impacts: How climate changes and climate variations in the past have affected human and/or natural systems?
2. Analogue impacts: Studies of short term climatic events which are analogous to the kind of events that may be expected to occur with human induced climate change, such a droughts, and floods. This approach (the use of climate analogies) has been developed into a formal method called "forecasting by analogy".
3. Contemporary climate impacts: Studies of the impact of present day climate and climate variability.
4. Model building: often quantitative of the relationship between climatic variables and selected impacts sectors to try to answer the "what if" kinds of question.
5. Expert judgment: which refers to a variety of methods whereby especially well informed and experienced specialists are brought together to develop a consensus view.

Vulnerability Assessment Framework

Vulnerability is a new way of looking at an old problem. Instead of focusing just on what has been going wrong in the past its effects, vulnerability gives us the opportunity to focus on getting things right for the future. It focuses on using strengths and strategically improving weaknesses. The framework encompasses the following:

- ❖ Identifying populations likely to be affected by uncertainty (rainfall, temperature, sea level changes) with relevant characteristics (age, gender, class, race, ethnicity, region)
- ❖ How are they affected and to what extent?
- ❖ What are the influencing factors that enhance / reduce risk?
- ❖ Existing and potential coping mechanisms

Concepts

- Vulnerability is the tendency for an entity to be damaged.
- Resilience is the opposite of vulnerability and refers to the ability of an entity to resist or recover from damage.
- Entities can be physical (people, ecosystems, coastlines etc) or abstract concepts (societies, communities, economies, countries etc) that can be damaged (responders).

Vulnerability management is emerging as a critical part of any sustainable development strategy. It focuses not only on conditions now, but also on likely conditions in the future. It examines risks of hazards; and natural and acquired abilities to resist damage (natural resilience and acquired vulnerability), giving us the opportunity to balance strengths and weaknesses.

Overall vulnerability (OV) is the result of many vulnerability factors working together. It may be worked out comprising inherent characteristics of a country, forces of nature, human use and climate change. Some of these factors can be influenced by our policies and actions. However, forces of nature cannot be directly changed by our choices. Where we have no power to change a factor, such as the weather or volcanoes, we can still improve our overall position by increasing resilience or reducing vulnerability in seemingly-unrelated aspects of our environment.

Model for developing Vulnerability Index

The development of a vulnerability index provides a way to identify pressures from natural hazards as well as from human activities and helps in vulnerability management/building resilience. The dynamics

of vulnerability are captured by relating it to climate change, adaptation, impacts, natural hazards and responses and social indicators. The Vulnerability Index in fisheries sector can be calculated comprising the effect of the following variables (Table 1).

Table 1. Variables for constructing vulnerability index (modified from Feenstra *et al*., 1998)

Sector/system	Variables needed for scenario
General	Population growth, economic growth (GDP, exports, employment etc)
Coastal zones	Population density and occupancy in CRZ Demographic structure Socioeconomic variables: Investments Land use Housing patterns Coping mechanisms for disasters Adaptation capacity (economic, technological, institutional)
Climatic Vulnerability	Variance in annual rainfall Increase in sea level and displacement ENSO (El Nino Southern Oscillations) Incidence of natural hazards
Human health	Food and water accessibility Health care Adaptation capacity (economic, technological, institutional)
Fishing	Use of common property resources Fishing (practice and intensity) Fish production and potential (Bio physical and economic estimations) Adaptation capacity (economic, technological, institutional)

The methodology used by Narayanan *et al* (2006) to calculate the vulnerability index follows the basic approach developed by (Anand and Sen, 1994) for the calculation of the human development index (HDI)

Step 1**:** Calculate a dimension index of the each of the indicators for a district (X) by using the formula

(Actual X – Minimum X) / (Maximum X – Minimum X)

Step 2: Calculate an average index for each of the sources of vulnerability viz. general, coastal zones, climatic, human health and fishing vulnerability. This is done by taking a simple average of the indicators in each category.

Average Index i = [Indicator 1 +……. + Indicator J] / J

Step 3: Aggregate across all the sources of vulnerability by the following formula.

$$\text{Vulnerability Index} = \left[\sum_{i=1}^{n} (\text{Average Index i}) \right]^{1/n}$$

Where,

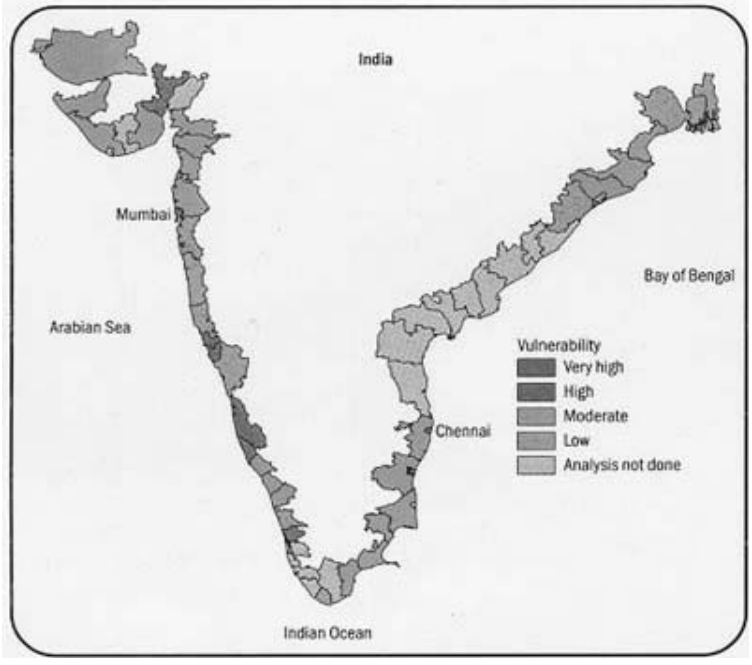
J = Number of indicators in each source of vulnerability

n = Number of sources of vulnerability

This computation can be repeated for different time periods in order to see how the vulnerability profile has changed over the years for the different geographical locations in terms of the indicators used to measure the vulnerability.

Vulnerability to sea level increase

Many major cities in India, including Kochi are below mean sea level which supports vast number of population. The places in coastal belt of the country lying below mean sea level are shown in Fig. 1. In the absence of protection, one meter rise in sea level will affect an area of 5763 km^2 and put 7.1 million people at risk. Damages because of land loss will be 83%, but the extent of vulnerability will also depend upon physical exposure and the level of economic activity in the region (Asthana, 1994). The estimated economic costs of one-meter sea level rise range from Rs 2287 billion in the case of Mumbai to Rs 3.6 billion in the case of Balasore (Orissa) (TERI, 1996).Fig. 1 Vulnerability to one-metre sea level rise in India (source: TERI, 1996).



The method of developing a vulnerability index is explained considering the problem of increasing mean sea level as a result of climate change. In order to assess the combined effect of insularity and population, a simple "Vulnerability Index" (or VI) is defined (Gommes *et al*, 1998), as the product of the Insularity Index and population density:

Vulnerability Index = (Insularity Index) * population density

Where "Insularity Index" is the ratio between the length of the coastline (km) and the total land area (km^2) that it encloses:

$$\text{Insularity Index} = \frac{\text{Coastline}}{\text{Land area}}$$

The Insularity Index quantifies the proportion of coastline in the total land area that may be affected by a potential sea level rise. However, this index is not free from the deviations that might occur due to actual shape of countries, the fractal nature of coasts and the distribution and extent of low-lying areas within each country.

A one-metre rise in sea level is expected to inundate about 1700 km^2 of agricultural land in Orissa and West Bengal (IPCC, 1992). Estimates of sea level rise along the selected points on the Indian coast is in the order of 1.14 mm/year in Kochi (period observed: 1939-97), 0.78 mm/year in Mumbai (during 1878-94) and 0.75 mm/year in Visakapatnam (1939-94) (Unnikrishnan *et al*, 2006). Population scenario vulnerable to sea level rise causing displacement has been worked out (Table 2). By 0.25 sq. km intrusion of sea towards the landward side, about 6.6 lakh people living on the coastal belts are under threat of displacement, about 13.2 lakhs by 500 sq. m intrusion and 26.4 lakhs by 1 sq. km intrusion. The density of population being high in Kerala, 1 sq. km intrusion can cause large scale displacement of people.

Table 2. Population (projected) under threat of displacement due to rise in sea level

Sl. No	**State**	Length of coastline (km)	Number of people		
			0.25 sq.km displacement	0.5 sq.km displacement	1 sq. km displacement
1	Andaman & Nicobar Islands	1923	20,672	41,345	82,689
2	Andhra Pradesh	974	67,450	1,34,899	2,69,798
3	Daman & Diu	27	9,538	19,076	38,151
4	Goa	104	9,464	18,928	37,856
5	Gujarat	1600	1,03,200	2,06,400	4,12,800
6	Karnataka	300	20,700	41,400	82,800
7	Kerala	590	1,20,803	2,41,605	4,83,210
8	Lakshadweep	132	62,535	1,25,070	2,50,140
9	Maharashtra	720	56,700	1,13,400	2,26,800
10	Orissa	480	28,320	56,640	1,13,280
11	Pondichery	45	22,838	45,675	91,350
12	Tamil Nadu	1076	1,29,120	2,58,240	5,16,480
13	West Bengal	158	35,669	71,337	1,42,674
	India	8129	6,60,481	13,20,963	26,41,925

While this presents a general overview of the situation, a focused prediction can be developed on the basis of elevation of land above the sea level. Variations in climatic patterns are expected to result in an increase in the frequency and intensity of disasters. These will greatly affect the poor population in coastal areas as in the case of cyclone that hit Orissa in 1999, killing about 10 000 people. The Indian Ocean Tsunami of 2004 also withered disastrous impact on the coastal population taking off their lives and livelihoods.

Conclusion

The observed or expected variability in climate and its implications demand adaptation in terms of ecological, social or economic systems. The existing potential threats in marine fisheries adding to the vulnerability of fisherfolk include excess capacity of fishing fleets, over capitalisation and rampant disguised unemployment in the inshore marine fisheries sector. This warrants withdrawal or diversion of substantial labour force into value addition segment of marketing to enhance their marginal productivity. The price behaviour of marine fish over the years and the increasing sales value indicates enormous potential for employment opportunities in the post-harvest sector. Also taking up alternative avocations to diversify the risks in marine fisheries can be helpful in serving as buffer to climate variability affecting the livelihood. All the more, the marine fisheries harvesting strategies should be capable of developing sustainable pathways to conserve marine resources maintaining the natural balance of the ecosystem and thereby minimizing climate variability effects. Another factor requiring concern is the efficacy of preparedness, management and coping mechanism on occurrence of natural disasters caused by climate variations. In the event of disasters, the most affected are the vulnerable lower strata of the community. The worst affected due to climate changes will be the coastal people. Hence the disaster preparation and crisis management should be focused not only for its prevention but also on reducing its ill effects and on rehabilitation and rebuilding of the livelihoods of coastal poor people. The adaptation strategies should be designed with people's participation and involvement and implemented effectively to reduce the adverse effects of climate change.

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