a straight line.

In the diagram E_1 is efficient effort level where vertical distance between TR and TC is maximum i.e. marginal revenue is equal to marginal cost. Therefore at E_1 level of effort we attain the level of optimum sustainable yield. Em is not efficient, because at this level the marginal revenue is zero and hence for optimum sustainable yield MR = MC become zero which is not possible practically. Hence the static efficient level of effort leads to a larger resource (fish) stock then does the MSY level of effort and MSY does not appear to be a socially desirable harvesting.

Non-renewable Resources:

Optimum Depletion of Non-renewable Resources :

Non-renewable resources will be depleted so long as the extraction rate is positive. But it is not sustainable for the society. For sustainability, we need to extract the optimum level of non-renewable resources. For determining the optimum extraction level same condition as in case of reproducible commodity is not applied in non- renewable resources. How optimum extraction level of non-renewable resources is determined that is discussed as follows :

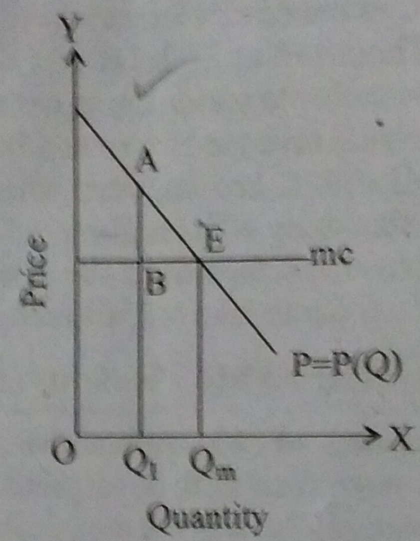
Since an exhaustible resource is limited in quantity and is not reproducible, therefore extraction and the sale of a unit today involves and opportunity cost i.e. the value that might have been obtained in some future time which is called user cost. Thus in case of non-renewable resources the extractor should consider the marginal cost (mc) and the opportunity cost or user cost. Therefore, in case of non-renewable resources the augmented marginal cost is considered which is the sum of mc and user cost (uc). That is –

amc = mc + uc

For a competitive firm the optimum level of non-renewable resource extraction is determined at that level where following conditions are fulfilled :

P = mc + uc where P is the market price.

This is the first condition for optimal depletion. It is explained with the help of following diagram :



In the diagram, E is the optimum situation where Q_m is the optimum level of extraction of resource. But a resource planner will extract Q_1 amount leaving positive difference between p and mc (i.e. AB in the diagram) that indicates positive uc to allocate extraction efficiently over time.

Since the extractor depends not only on the current price, but also on expectations about future prices. Therefore, the decision of the extractor depends on future prices. It derives the second condition for optimum depletion which is discussed as follows :

Suppose for simplicity it is assumed just two periods which is represented by '0' for current period and '1' for future period. If the extractors sells the unit in period 0, he will receive net revenue of P_0–C where c is per unit extractor cost which is equal to mc and remains constant. But forego revenue of P_1–C in the following period. The present value of foregone revenue is P_1–C/1+r , where r is discount rate.

Hence his return from selling a unit today will be :

$(P_0 - C) - (P1 - C) / 1 + r$ .... (1)

$P_1 - C / 1+r$ is the present value of the opportunity cost or user cost. If $(P_0 - C) > (P_1 - C) / 1+r$, the extractor will extract and sell the resources in current period and if $(P_0 - C) < (P_1 - C) / 1+r$, he will sell in future i.e. in following period.

The current extraction is optimum when

$P_0 - C = P_1 - C / 1+r$ $\rightarrow$ (2)

or $P_1 - C / P_0 - C = 1 + r$ $\rightarrow$ 2.1

or $P_1 - C = (P_0 - C)(1+r)$ $\rightarrow$ 2.2

or $P_1 = C + (P_0 - C)(1+r)$ $\rightarrow$ 2.3

The equation 2.3 is the second condition of optimal depletion which is described as fundamental equation of exhaustible or non-renewable resource extraction. This equation represents that along the optimum extraction path, where the resource owner is indifferent between the options of extracting or leaving the resource in ground, the price/ user cost has to rise at a rate equal to the discount rate.

BACKSTOP :