UNIT 3 MARKET FAILURE*

Structure

3.0 OBJECTIVES

After reading this unit, you will be able to:

- identify the sources of market failure stating the assumptions necessary to have efficient markets;
- define the concept of 'market failure' in the context of environmental goods;
- classify the goods into their four broad categories;
- establish the conditions under which government intervention in provisioning goods for larger public consumption is socially desired;
- illustrate the concept of 'free riding' to bring out how it lowers efficiency;
- discuss the concept of 'negative externality in consumption' with the conditions necessary for arriving at an efficient outcome; and
- explain the concept of 'negative externality in production' with the conditions necessary for arriving at a socially optimal outcome.

3.1 INTRODUCTION

In the previous unit, we described how markets achieve allocative efficiency. In this context, we presented the conditions that characterise production

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efficiency, consumption efficiency and product-mix efficiency. These conditions ($MRTS_X = MRTS_Y$, $MRS_A = MRS_B$ and $MRT_L = MRT_K = MRS_X = MRS_Y$ respectively) were derived under a set of assumptions necessary to achieve an efficient allocation. In this unit, we will see that several of these assumptions are quite restrictive (or ideal), and may not hold in the real world. It therefore follows that the efficient allocation may not be achieved if the assumptions are violated. This departure from the 'ideal' is termed as **market failure** which is the subject matter of the present unit. In short, markets 'fail' when the price mechanism does not work well enough (or cannot be relied upon) thereby producing a Pareto-inefficient allocation. The existence of market failures, especially in the allocation and/or use of environmental resources, provides the rationale to find non-market solutions in the form of government intervention or community participation. Thus, the task of environmental economists is to identify market failures resulting in inefficiencies so as to be able to recommend policies to correct the source of such failures to minimise welfare losses to society.

3.2 SOURCES OF MARKET FAILURE

Let us begin by recalling the assumptions necessary for markets to produce an efficient allocation. The eight assumptions can be categorised under three broad heads as follows.

Market Characteristics: These lay down the conditions for existence of desirable organised markets. The absence of (i.e. missing or imperfect) such markets can be said to be the main cause of the complications of real-world economies. More specifically, these can be stated as follows.

1) *Markets should exist for all goods and services produced and consumed.* As long as there is no market for a commodity, the price mechanism cannot work to produce an efficient allocation.

2) *All markets should be perfectly competitive i.e. no market power (like monopoly or oligopoly) should exist.* Markets with imperfect competition distort economic outcomes. Recall that the condition for a typical monopolist's profit maximising condition is $MR = MC$, which does not satisfy the condition $P = MC$ in general. Perfectly competitive markets, on the other hand, maximise total economic surplus in an efficient manner.

   Economic Agents: These are assumptions of microeconomics on persons or agents involved in economic transactions on their conduct or behaviour like:

3) *All agents are rational and utility (or profit) maximisers.*

4) *Preferences are 'well-behaved' (i.e. convex and continuous) and production functions have the correct form (i.e. concave and differentiable with non increasing returns to scale).*

5) *All economic agents should have perfect information.* In the absence of perfect information (i.e. with imperfect, asymmetric or missing

information), problems of adverse selection and moral hazard would result leading to welfare losses.

Nature of Commodities: It is the nature of commodities that introduces market failure. This is because external effects by consumption and production are often unavoidable due to lack of institutions and incentives. To avoid this, we need well defined property rights. So, the assumptions made are:

6) *No external effects or externalities.* This means that the production or consumption decisions of economic agents are not adversely affected.

7) *All goods and services are private goods.* Commodities which fulfil two criteria viz. non-rivalry and non-excludability are termed as public goods. In the case of public goods, free riding (i.e. enjoying a resource without paying for it) is possible. Thus, the assumption made here is that all goods and service are non-public goods so that the concept of willingness to pay (WTP) can be taken into account in providing a good for the larger public consumption.

8) *Property rights are complete and well-defined for all resources.* In the absence of well-defined (and enforceable) property rights, economic agents cannot exercise their right to buy or sell. This results in missing markets and inefficiency. Hence, defining property rights is one way in which market failures arising due to externalities and public goods could be corrected.

The following Table (Table 3.1) briefly summarises the above assumptions and their violations.

Table 3.1: Assumptions for Market Efficiency and their Violations Leading to Market Failure

Assumption	Violation Resulting in Market Failure
Markets exist	Markets are missing/thin for certain goods. Hence price mechanism cannot work.
Perfect competition	There are only a few firms exerting market power.
Rational, maximising agents	Agents are not utility-maximising or profit-maximising.
Well-behaved utility and production functions	Non-convex or discontinuous preferences or production function with increasing returns to scale.
Perfect information	Asymmetric or incomplete information.
No externalities	Production or consumption of one agent affects the utility or production possibilities of other agent without any compensation. In short, externalities are present.

Private goods	Goods are non-rival and/or non-excludable in nature i.e. we are dealing with public goods.
Well-defined property rights	Property rights do not exist or are not enforceable.

For the analysis of market failures in the context of environmental goods and services, we will focus on: (i) the existence of externalities and public goods and (ii) absence of well-defined property rights i.e. covering the assumptions 6 to 8 above. While the violation of the assumptions of perfect competition, perfect information and rationality are also sources of market failure, it is the presence of externalities and public goods which are critical for environmental goods resulting in welfare loss. Hence, in this unit, we will assume that the other assumptions (1 to 5) will hold and focus only on the violation of 6 to 8.

3.3 PUBLIC GOODS

Recall the discussion in Unit 1 where we described the different services the environment provides to economic agents. Several of these services, especially the amenity services, have certain characteristics that cannot be handled well by the neoclassical market system. Specifically, environmental goods and services possess the features of **public goods** (which are different from private goods traded in the market) and therefore assumption seven listed above is violated, resulting in inefficiency.

3.3.1 Non-rivalry and Non-excludability

To understand whether a good is private or public, we need to apply the two concepts of *rivalry* and *excludability*. A good exhibits *rivalry*, for a fixed amount of the good, if increased consumption by one agent reduces the consumption of the good for another agent. In other words, one agent's consumption occurs at the expense of another. In contrast, a good exhibits non-rivalry if the consumption by one agent does not reduce the amount of the good available for consumption by another agent. In economic terms, the marginal cost of providing a non-rival good to anyone is zero. On the other hand, a good exhibits *excludability* if an agent can be prevented from accessing or consuming the good (say by imposing a fees or price on it). Similarly, the good can be called non-excludable (i.e. possess the non-excludability feature) if no one can be excluded from the consumption of the good. Thus, prices cannot be used as a rationing device for non-excludable goods. Often, whether a good is excludable or not depends on legal institutions and technological innovations.

Pure public goods are non-rival and non-excludable (e.g. the ultimate energy source, sunlight). The 'consumption' of sunlight by one person does not reduce the 'amount' of sunlight available to anyone else. Hence, the good is non-rival. The good is non-excludable as well since it is not possible to deny anyone the light of the sun as long as it is there. Pure private goods, on the other hand, display both rivalry and excludability. For instance, consider the case of a bar of chocolate. Assuming that there are ten bars of chocolate in

the economy with two agents, the consumption of x chocolates by one agent necessarily means that only $10 - x$ chocolates are available for the other agent. Since the same bar of chocolate (or its part) cannot be consumed by another agent, the consumption for this good is rival. Further, if the good is being traded in the market, those who cannot pay the price can be excluded from consuming the product. Hence, the good is excludable.

In addition to the two categorisations of pure public and pure private goods, there are two additional classifications. Some goods, like open-access resources are rival but non-excludable i.e. no one can be denied consumption of the good but the consumption by one agent affects (i.e. reduces) the consumption by another agent. An example of such open-access resource (or common-pool resource) is ocean fishery lying outside the territorial waters of a country. Anyone with a boat can access the fishery, but more fish caught by one agent necessarily reduces the catch that another agent can obtain. Thus, the good is rival but non-excludable. The opposite of such a good is a resource that is excludable but non-rival (at least to a degree) called a club-good or congestible resource (e.g. a tolled road). Levying the toll excludes certain users, but the use of the road by one agent does not decrease the availability of the resource for another as long as there are not too many cars on the road (i.e. until congestion sets in). The four types of goods can be summarised as in Table 3.2.

Table 3.2: Classification of Goods

Type of Goods	Excludable	Non-excludable
Rival	Chocolate, ice cream (any private good)	Common grazing land, common fishery (open-access resource)
Non-rival	A tolled highway or bridge (Congestible resource)	National defence, lighthouse, atmosphere, sunlight (pure public good)

While private goods are typically allocated through a market mechanism, the features of congestible goods, open-access resources and public goods make it infeasible for the market to allocate them efficiently. To reiterate, the marginal cost of a non-rivalrous good is zero which means its price should also be zero in a competitive market (Since P = MC is the standard condition for efficiency.). However, no seller with a profit-maximising objective would be interested in providing the good at a zero price and hence a market would not exist for such goods. Further, no one can be forced to pay for the use of a non-excludable good i.e. the good cannot be denied to those who do not pay. Again, profit-maximising sellers would run the risk of incurring losses if the good is provided and no one pays for it. Hence, resource allocation through the market mechanism will be infeasible in those cases. As a result, the government, being an entity that can obtain the revenue required to cover the costs of production [through some other source (such as taxation) rather than through the 'sale' of these goods and services], needs to intervene in the provision of such goods. This is the reason that public goods and services

(such as national defence, civic amenities, public cleanliness, parks, etc.) are provided by the government. However, even here we can have a efficiency condition for providing these services based on 'willingness to pay'.

3.3.2 Efficient Provision of Public Goods

We are concerned here with the decision on the condition under which a public good (not in the pure sense of sunlight but defined differently as a good desired for public consumption due to its societal good) should be provided by the government. For instance, consider the case of providing a park to the residents of a locality. For simplicity let us consider the case of two agents or individuals and then generalise it to more individuals. We assume that once the park is opened, no agent can be denied admission (i.e. non-excludability) and the consumption of the park by one agent does not reduce the amount available to anyone else for its consumption (i.e. non-rivalry in consumption). Let w_1 and w_2 denote the initial wealth of two agents, g_1 and g_2 their contribution to the park and x_1 and x_2 their consumption of the good. The budget constraints can then be written as:

$$x_1 + g_1 = w_1 \quad (3.1)$$

$$x_2 + g_2 = w_2 \quad (3.2)$$

Let the cost of the establishment of the park be c rupees, which means that to provide the park, the sum of the contributions by each agent should be at least equal to c. Thus:

$$g_1 + g_2 \geq c \quad (3.3)$$

The utility of each agent i ($i \in \{1,2\}$) depends on her/his private consumption (x_i) and the public good G (which does not have the subscript i, as it is a public good) takes the value 1 if the park is provided and zero otherwise. The utility function can be written as:

$$u_i(x_i, G), i \in \{1,2\} \quad (3.4)$$

We assume that the utility functions are well-behaved i.e. they increase in x_i for each agent i. We further assume a reservation price r_1 as the maximum price agent 1 is willing to contribute to have the public park provided. In other words, r_1 makes agent 1 indifferent between paying r_1 and having the public park (i.e. G = 1) or not having the public park at all (i.e. G = 0). We can write this as:

$$u_1(w_1 - r_1, 1) = u_1(w_1, 0) \quad (3.5)$$

On the left-hand side of Equation (3.5) is the utility of agent 1 after deducting r_1 from his wealth. Hence, G equals 1 and his private consumption equals $w_1 - r_1$. Solving the Equation (3.5), we obtain r_1, the reservation price of agent 1. Similarly, we can write:

$$u_2(w_2 - r_2, 1) = u_2(w_2, 0) \quad (3.6)$$

by solving which we obtain r_2, the reservation price for agent 2.

Now to decide whether the public park *should* be provided, we compare the welfare from the two allocations i.e. one where the public park is provided and another where it is not provided. If the welfare from providing the park is higher, then it should be provided, otherwise not. Simply put, the park should be provided if both agents would be better off with the park, than without it. We can write this as:

$$u_1(w_1, 0) < u_1(x_1, 1) \quad (3.7)$$

$$u_2(w_2, 0) < u_2(x_2, 1) \quad (3.8)$$

Using the definitions of reservation prices and the budget equations introduced above [i.e. by using Equations (3.1), (3.2), (3.5) and (3.6)] , we can rewrite the Equations (3.7) and (3.8) as:

$$u_1(w_1 - r_1, 1) = u_1(w_1, 0) < u_1(x_1, 1) = u_1(w_1 - g_1, 1) \quad (3.9)$$

$$u_2(w_2 - r_2, 1) = u_2(w_2, 0) < u_2(x_2, 1) = u_2(w_2 - g_2, 1) \quad (3.10)$$

Since u_i is increasing in x_i for each agent, it follows that:

$$w_1 - r_1 < w_1 - g_1 \quad (3.11)$$

$$w_2 - r_2 < w_2 - g_2 \quad (3.12)$$

The above implies that: $r_1 > g_1 \; and \; r_2 > g_2$. In other words, the inequalities (3.11) and (3.12) convey that the public good should be provided if the reservation price of each agent is greater than his/her contribution i.e. his/her willingness to pay (WTP) is greater than his/her share in the total cost of providing the good. By summing up the inequalities, we see that this means that the *sum o*f each agent's willingness to pay must be greater than the cost of the public park or equivalently any commonly used service. That is:

$$r_1 + r_2 > g_1 + g_2 = c \quad (3.13)$$

The summary of the insight from the above is that it is efficient or socially desirable for a good to be provided as a public good so long as the inequality (3.13) is satisfied. Generalised to a finite segment of residents who would commonly enjoy the benefits of a public place like a park in their neighbourhood, the condition implies that the cost of establishing the facility should be less than the 'combined willingness to pay' or the sum of all the reservation price of the residents or households in the locality or the community. However, in this context it is important to consider the problem of 'free riding'.

3.3.3 Free Riding

The concept of 'free riding' refers to the usage of a freely available good without regard to its efficient usage. The first step in determining whether a public good is to be provided or not requires the taking into account of the willingness to pay (WTP) of every consumer. If the aggregate WTP adds up to the budget required for establishing the public facility (i.e. the amount collected is equal to the amount necessary for provisioning) then we have an ideal situation (called the Lindahl equilibrium) in which there is no intruding

factor to cause inefficiency. However, in the absence of the knowledge on what each one would pay or how much each one is willing to pay, a consumer is likely to understate his own WTP. This introduces a distortion into the articulated demand. This is what is known as 'free riding' where, even when one is having a larger WTP, there is a tendency in one to free ride on the public good once the same is provisioned. Evidently, in situations where the number of potential users are very large, such free riding will not come in the way of a decision to establish the facility itself. Another example of an environmental good where free riding could come in the way is when consumers are to make contributions to reduce pollution. Some people might claim a lower contribution to pollution in order to minimise on their contribution. In its application of game theory, a free riding situation would not result in Nash equilibrium as each agent will chose to 'not contribute' as it is his/her dominant strategy to do so. Thus, when more people decide not to contribute, or contribute less than their marginal WTP, the government may not find it desirable or feasible to provision the good. In other words, it is a paradox where while it is in each individual agent's interest to have the public facility by showing their marginal WTP, their individual actions would not yield the welfare-maximising outcome. This behaviour, known as the prisoners' dilemma, translates to the free-rider problem in the context of public goods where each agent tries to 'free-ride' on the other agent by not contributing himself but expecting the other agent to contribute so as to get the benefit of the public utility without paying for it.

Check Your Progress 1 [answer within the space given in about 50-100 words]

1) Define the term 'market failure'.

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2) When does 'market failure' arise in environmental goods?

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3) What is a 'common pool resource'? What is its opposite known as? Give an example for each.

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