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Sustainable development

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ABSTRACT

Economic development is an essential element in the vicinity of the economics. The economic development is considered usually as an incremental production due to a positive change in production factors. Economic development therefore, depends on production factors. By virtue of nature the amount production factors particularly exhaustible resource are running out due to using of the factor. This paper is confined to the consequences of rapid extraction of exhaustible resource; hence, the economic development will come to an end when the deposits of exhaustible resources end. To make safety net to continue economic development we have to substitute alternative resource which minimizes usage of exhaustible resource. If we adapt this concept it will lead to sustainable development.

Key words: exhaustible resource, economic development, substitution, renewable resource safety net, capital,technology

Introduction:

Economic development leverages human pride as diluting the great threats of human dignity such as unemployment, poverty etc, in its path of process. The main target of every country in the world is either to achieve or to maintain the economic development. The economic development is not in the independent domain, the range or the pace of economic development depends on some independent variables mainly on the amount of utilization of natural resources (R), technology (T), capital (K). The functional relation between the independent and dependent variables can be confined to resources (R) in short run. it is shown

$$e = f(R) \ldots\ldots\ldots 1$$

The rate of economic development can be shown as

$$\frac{\delta e}{\delta R}$$

$$= \lim_{\Delta R \to 0} nR^{n-1} \quad \ldots\ldots 2$$

However, the technology and the capital lubricate the wheels of the engine of economic development. But, the technology is an innovation; a change in technology may take long period. The accumulation of capital in large scale is a big issue in developing countries. Even though international trade paves a good way for supply of natural resources the problem of balance of trade narrowing the accessibility for the poor countries. The poor countries, therefore, depend on the availability of natural resources for achieving economic development. The utilization of natural resources plays a core role in economic development in poor countries. The economic development is undoubtedly a long run process, in other way it can be expressed that economic development is a cumulative one. Mathematically it can be fitted that

$$e = \int f(R)dR \quad .....3$$

Above argument concludes that the economic development is relatively a positive change in production. Man cannot produce material but only utilities inherent in matter[1]. The economic development in Marshall's view is fitted in mathematics as

$$y = \varphi(u).....4$$

The amount of production (y) factors are confined to resources, then

$$u = \psi(R).....5$$

$$y' = \varphi'[\psi'(R)].....6$$

therefore,

$$e = \varphi'[\psi'(R)].....7$$

The inference through above discussion that the economic development the level of utilization of natural resources due to the equation is confined to natural resources. The natural resources can be categorized in to renewable and exhaustible resources. Hence, economic development can be expressed mathematically as

$$P = f(R_r, R_e).....8$$

$$e = \varphi'(Rr, Re).....9$$

Where P production, R_r, R_e renewable and exhaustible resources respectively.

Above discussion reveals that the economic development(e) is a positive change in production. It can be realized either of the equation.

$$e = \varphi'(R_r).....10$$

or

$$e = \psi'(R_e) \quad ....11$$

or

$$e = f'(R_r, R_e).....12$$

either of the equation asserts that if we want to achieve economic development we have to use more amount of input or inputs. The economic development or progressive movement may be considered as a measuring scale of the country's achievement. This is one side of a coin. There is another side which is the most important side that should be remember to get sustainable development in order to continue economic development or to maintain economic growth, is stock or deposits of exhaustible natural resources. The deposits of exhaustible natural resources though inelastic in nature as a whole, it becomes variable when it becomes the supply of a factor of product. We know that the demand for production factors is a derived demand hence, is expressed mathematically as

$$D_e = f(D_g) \ldots\ldots 13$$

Where $D_e$shows the demand for exhaustible resource andD_g indicates the demand goods. In equilibrium state demand and supply are equal. therefore

$$D_g = S_e \ldots\ldots 14$$

The following equation constructs the functional relationship between economic development ($e = \Delta y$) and the amount of deposits of exhaustible natural resources if the equation confined toequation11

$$\frac{\partial y}{\partial Re} \quad \ldots\ldots 15$$

Where, $y = (D_e - R_e)$

Assume the production factors are homogeneous in quality. The elasticity of exhaustible production factors is unitary as the ratio between production and production factor is constant. Hence,

$$\sigma_p = \frac{\partial y}{\partial Re} \cdot \frac{Re}{y} = 1 \quad \ldots\ldots 16$$

above discussion formulates a relation between economic development and the deposit of exhaustible resource is linear and diminishing. This is shown below

$$y = a - bR_e \ldots\ldots 17$$

In the figure 'OA = a' which represents total deposit of exhaustible resource, bR_eresents the marginal rate of consumption or extraction or supply of exhaustible resource. The figure illustrates that the supply of exhaustible resource increases the deposit of exhaustible resource diminishes as $P = f(R_e)$. The figure ascertains that the production at point B, the deposits of exhaustible resource becomes zero. Mathematically

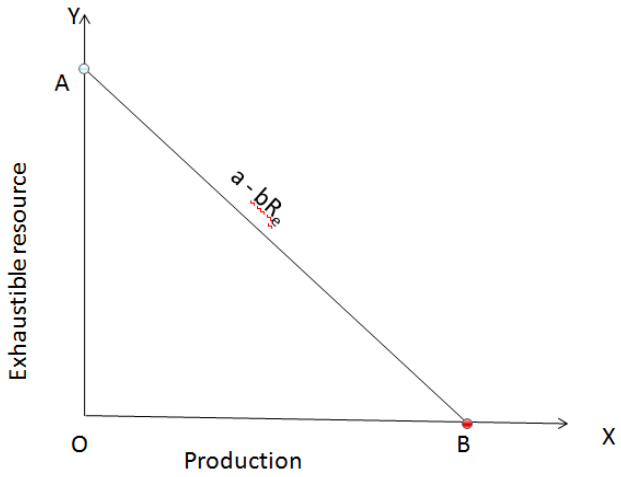
$$OA - OB = 0$$

$$OA = OB$$

$$a - a = 0$$

Figure No.01

Relation between production and deposits of exhaustible resources



The following equation indicates the consequence of above equation.

$$P = f(a)$$

If, $a = 0$

Therefore, $p = 0$

Hence, $\Delta y = \Delta p \ldots\ldots 18$

$$e = \Delta p \ldots.. 19$$

$$e - \Delta p = 0$$

if $p = 0$

$$\Delta p = 0$$

Finally $e = 0 \ldots.. 20$

Need of sustainability:

The inference from above discussion emphasis the economic development will be ended due to exhaust of exhaustible resource if the economic development is confined to available exhaustible natural resources. let us examine the scenario of extraction of non renewable resources.

Table No.01

The production some metallic and Nonmetallic Minerals in India

(In 000')

S.No.	MINERAL	YEAR				
		2017-18	2018-19	2019-20	2020-21	2021-22
1	Bauxite	22786.11	23689.62	21837.18	20379.59	13607.91
2	Chromate	3480.94	3970.69	929.26	2863.87	2487.6
3	Iron Ore	201424	206495	246081	204482	162633
4	Manganese Ore	2599.81	2832.31	2904.37	2688.04	1781.11
5	Limestone	340417	379775	359331	349170	268229
6	Magnetite	195.06	146.88	97.68	78.14	69.66

Source: Report 2021-22, Ministry of Mining,GoI

Above table has visualized the scenario of production of some metallic and nonmetallic minerals from 2017-18 to 2121-22. During this period in spite of fluctuations are there in the amount of production of mentioned minerals, one thing is confirmed from the table that minerals are being exploited undoubtedly. The exploited nonrenewable resources are perfectly inversely related to the stock. Therefore, at final the outcome will co inside with the equation No.20.

The existence of economic development or growth will be questionable this juncture. If all doors are closed nature will keep always a door on open, but that can be found by human effort. The thought of struggle for survival in the process of development will give the birth of sustainability.

Gro Harlem Brundtland defined the concept of sustainable development in his Report on Environment and Development as the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept undoubtedly emphasizes the need to adapt a proper management of nonrenewable resources to ensure economic development for future generations.

Economic development is an essential condition to meet the needs and inspirations of the people who are increasing in number comparatively previous but, it should not be at the cost of future generations who have same rights like us.

The term proper management does not confine to allocation of resources alone. It includes the meaning of curtailing wastage. If we dis-link this term, it rises many challenges for human beings like ecological imbalance due to environmental pollution such as water, soil, air etc,. as such hazardous impacts make threat to the human development which depends on economic development. Therefore, mere economic development should not be enough for maintaining to attain predetermined goal, it should be sustainable development.

Substitutability:

The equation 1 concerned with production. Production function is the relationship between the amount of input required and the amount of output that can be obtained (Paul Samuelson and William D Nardhans, 1998). It summarizes a technological relationship and there is a calculation that determines optimal output which depends on the input. William J Baumol expressed that there are technological relationship summarized in the production function. The knowledge of such a functional relationship presupposes that a set of optimality calculation has already been carried at, explicitly or implicitly, by the firm engineers or production managers. Therefore economic development is the first degree of derivative of production function. In mathematical equation

$$P = f(v_x, v_y \ldots\ldots v_n), \ldots\ldots 21$$

Vi, indicates production factors. But the paper is confined to natural resources; therefore, the equation is rearranged as

$$P = f(R_r, R_e) \ldots\ldots 22$$

Now take total differential to indicate economic development as it is a positive change in the magnitude of production.

$$e = f'.dR_r + f'dR_e \ldots\ldots 23$$

f' is a derivative of production function $\left(\frac{dp}{dRr}, \frac{dp}{dRe}\right)$

The equation 20 clearly visualizes the consequences of continuous consumption of exhaustible resources. in this speedy extraction of exhaustible resource how to break the equation 20 is the question at now. To continue or maintain economic development we require sustainable development is the answer for the question. For effective sustainable development we need the consideration of substitution of production factors. It reduces the consumption of the factor which has been in threatened. The concept of sustainability makes to inflow another concept into the mind which ignites the engine of economic development vehicle such that substitutability. The substitutability in the process of production is the answer for the question.

Lagrange introduced substitution method for construction new functions for attaining maximization or minimization with constrain. The substitution of production factors in view of obtaining same amount of output is very close to J R Hichsian concept of indifference curves such that

$$U = f(x,y) \ldots..24$$

$$U_x = f(x), \ldots 25$$

$$U_y = f(y) \ldots 26$$

The slope of the indifference curve indicates marginal rate of substitution of one good for another, in other wards at what rate one good is sacrificed for gain of another good, this is called marginal rate of

substitution (MRS). A small movement towards down along with indifference curve indicates the marginal rate of substitution is diminishing and vice versa. The slope of an indifference curve in mathematical expression is $\frac{\Delta y}{\Delta x}$ which means a loss of y utility is equal to gain of x utility, by definition of indifference curve therefore

$$\Delta y \text{ x } mu_y = \Delta x \text{ x } mu_x \quad \ldots.27$$

That is loss of y times marginal utility of y is equal to x times of marginal utility of x. The difference in total utility is zero or the total utility is same, therefore

$$\Delta y \text{ x } mu_y - \Delta x \text{ x } mu_x = 0 \ldots 28$$

Or

$$\Delta y \text{ x } mu_y \div \Delta x \text{ x } mu_x = 1 \quad \ldots\ldots 29$$

That is the total utility at any point on same indifference curve is constant. Similarly at any point on same isoquants is constant. Ragnar Frisch defined isoquant such that the product equality remains constant along this curve. Therefore

$$P = f(KL)$$

$$Isoquants(IQ) = KL = \alpha \quad \ldots 30$$

That is α is a constant (production). The slope of the curve is similar to that of indifference curve that is MRS. But, in the case of isoquants the substitution of one factor for another is called marginal rate of technical substitution (MRTS). The equation 8 is modified in order to attain sustainable development. Therefore

$$P = f(R_e, R_a) \ldots\ldots 31$$

R_a represents an alternative resource.

The gain in output from little more of R_a being equal to the loss from little less R_e. the gain output is the extra product of Ra i.e, marginal physical product of the additional units of alternative resources ($MPPR_a$ x ΔR_a), the loss of output is the foregone marginal physical product of the subtracted units of exhaustible resources ($MPPR_e$ x ΔR_e)

$$\text{Slope} = \text{MRTS} = \Delta R_e \div \Delta R_a \ldots 32$$

$$\text{Los of output} = \text{gain in output}$$

$$\text{MRTS} = \Delta R_e \text{ x } MPPR_e \div \Delta R_a x \text{ x } MPPR_a \quad \ldots\ldots 33$$

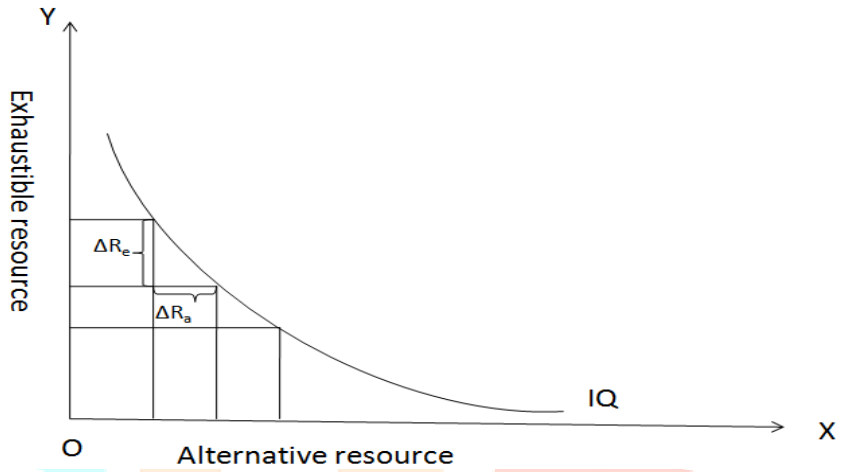
Rearrange the equation,

$$\text{MRTS} = (MPPR_a \div MPPR_e) \times (\Delta R_e \div \Delta R_a) \quad \ldots..34$$

The substitutability of alternative resource in the place of exhaustible resource for obtaining sustainable development is explained with isoquants technique. Below figure has explained MRTS.

Figure No.02

Isoquant curve



An isoquant is a hyperbolic and monotonic curve, it moves down and convex to the origin. The shape of the curve depends on substitutability. If they are perfect substitutes the isoquants would be straight lines. If they are good substitutes, the isoquants are sright and convex to origin and the substitutability is infinite. If they are poor substitutes the isoquants would be highly convex to the origin. If the factors are complementary the shape would be right angle, it means there is substitution between the factors.

Elasticity:

The elasticity technique is a better one rather than marginal rate of substitution as there is a pit fall in the technique of Marginal rate of substitution. The elasticity is measured by number where as the marginal rate of substitution is measured by units.

Factor Elasticity of production:

The factor elasticity of product is a responsiveness of production to change in a varying factor. The definition, therefore, in mathematical form, that is

$$\frac{\Delta p}{x} \div \frac{\Delta x}{p}$$

$$\frac{\Delta p}{\Delta x} X \frac{x}{p} \quad \ldots..35$$

In Cob Douglas production function that is

$$P = bL^k C^{k-1} \quad \ldots.36$$

Here, k and k-1 indicate marginal products of labour and capital in other the exponents represent elasticity of labour and capital respectively. The sum of exponents is equal to one (k + K-1 = 1). The production function of Arrow et.al represents constant elasticity substitution but it is not necessarily equal to one.

$$Q = \gamma[\partial x^{-p} + (I - \partial) L^{-p}]^{-1/p} \quad .....37$$

Marginal Elasticity:

The marginal elasticity of a factor is equal to the partial elasticity of the product function with respect to the quantity of the factor concern (Ragnar Frisch 1965), that is to say if production function is

$$P = f(v_1 \ldots\ldots v_n) \quad .....38$$

$$\sum_{1}^{n} xi,$$

$$(x_i = v_1 \ldots\ldots v_n)$$

By Ragnar's definition the partial elasticity of production with respect to the quantity of a factor v_i, that is

$$\left(d\,(v_1 \ldots\ldots v_n) \div vi\right) \div \left(d(vi) \div (v_1 \ldots\ldots v_n)\right)$$

$$= \left(d\,(v_1 \ldots\ldots v_n) \div d\,(vi) \times (v_i \div (v_1 \ldots\ldots v_n)\right) .....39$$

Elasticity of substitution:

The elasticity of substitution is a measure of the case with which the varying factor can be substituted for others (Hicks, 1932). By definition, in mathematical equation that is

ξ = percentage change in $(R_e \div R_a)$ ÷ percentage change in MRTS

or

$$\xi = d(R_e / R_a) / R_e / R_a \div d(\text{MRTS/MRTS}) \quad ....40$$

Or

Factor elasticity ÷ elasticity of MRTS = Elasticity of substitution (ξ)

Sustainable Development Index: the ratio that is factor elasticity divided by elasticity of MRTS indicates which is an average of extraction or consumption of exhaustible resources by substituting alternative resource. It shall be negative as the level of alternative resource increases. It does mean the utilization of exhaustible resource diminishes at increasing rate, it leads to increase in sustainable development, then square rooting the ration in order to minimizing the values.

Sustainable Development Index = $\sqrt{}$Factor elasticity ÷ elasticity of MRTS

Conclusion:

The sustainable development has fallen in jeopardize due to the deposits of exhaustible resource are proportionately diminishing to growth of economic development as the economic development is an incremental change in production economy as a whole. The simple logic behind the presumption that economic development comes to end as economic development and the availability of exhaustible resources which is inelastic in nature, move hand in hand.

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