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A Note on the Difference Between Optimal Growth and Sustainable Development

Bishwa Nath Tiwari*

INTRODUCTION

Defining optimal growth and sustainable development requires a thorough Knowledge of two adjectives *optimality* and *sustainability*. While former has its root in neoclassical economics, latter is virtually of recent origin. There is nothing wrong in the sequential order in which they appear in the human civilization. But, the one thing what has gone wrong is the late perception of the sustainability problem by the human being.

The sustainability question has something to do with optimality because both are the outcome of constraint. And the constraint is there because the globe is finite. On this finite globe human being strive for their livelihood. This is how the human civilization is going on. The one thing which is of crucial importance is how far we will be able to continue the human civilization. This question has striked the genius mind that ultimately gives rise to the concept of sustainable development.

However, the optimality then is not a vice as it refers maximization of utility from a given constraint or minimization of sacrifice for a given level of utility to be obtained. If this is what optimality means then certainly it has some relation with sustainability. But the relationship between them appears inharmonious once one departs from static analysis to dynamic analysis and then introduces neo-classical notion of optimization.

Optimality in neoclassical economics refers the equality condition between marginal benefit and marginal sacrifice. Such an equality has to ensure all the three conditions of Pareto optimality. Its geometrical counterpart is the Marshallian-cross where the interest of both buyers and sellers are perfectly matched. This is how optimality is interpreted in static analysis. But in comparative static or dynamic analysis such equality is to be held in each time period, t or say in each generation.

Thus, the problem of dynamic efficiency involves:

- allocation of resources in one generation; and
- allocation of resources between generations.

The first case does not seem problematic as one can identify the Marshallian-cross for each commodity and therefore can decide what bundle of goods is to be

* *Dr. Tiwari is Lecturer at the Central Department of Economics, Tribhuvan University, Kirtipur, Kathmandu, Nepal.*

produced to keep the society at its highest level of satisfaction. But the second one is not easy because one does not know what the preference of future generation is. Therefore the straight application of the maximization of utility principle over generations is not a happy exercise.

The classic in optimal growth field is a paper by Ramsey (1928). Assuming that population and also the state of art are constant, it is held that output (Y) depends only on capital (K).

$$Y_t = f(K_t) \quad \ldots\ldots\ldots\ldots \qquad (1)$$

In a closed economy, Y has to take two forms of use: saving and dissaving, i.e.

$$f(K_t) = C_t + \frac{dk_t}{dt} \quad \ldots\ldots\ldots\ldots \qquad (2)$$

Equation (2) is an allocation constraint in the sense that aggregate output is to be divided into present and future consumption. Hence, the problem of dynamic efficiency lies in the comparison between rate of interest and marginal productivity of capital. To evaluate efficiency therefore, requires discounting future consumption or utility.

$$\text{Max. } u = \int_0^{\infty} e^{-\delta t} u(c_t)\, dt \quad \ldots\ldots\ldots\ldots \qquad (3)$$

Of particular interest is the discount factor whose weight diminishes with the time, t. Equation (3) is a formulation of optimal growth which explains how resources are to be allocated over generations.

Neoclassical production function considers only two factors: labour and capital, and sometimes only capital. such a practice continued even during sixties. But with the publication of *Limit to Growth* in 1972 many scholars started to think over neoclassical production function and the process of the economic growth in terms of finite natural resources. Thus, the role of natural resources as production inputs was being recognized then. The second event that surfaced is the failure of growth to improve unemployment, poverty and inequality conditions in developing countries. Hence, with the failure of *trickle down* effect of the growth concept *growth* has been discarded as the measure of development or welfare. With this a distinction is made between growth and development. This distinction made development as a subjective concept and growth as an objective and measurable concept. However, the major component of development is still growth.

Development can be defined as a vector D whose elements are:

- growth of real output
- improvement in unemployment
- reduction in poverty
- reduction in inequality in the distribution of income.

- improvement in health and nutritional status
- educational achievement
- access to resources
- freedom, self-respect, etc. (see Pearce et al.: 1989, 1990)

THE PROBLEM

Optimality refers maximization of utility, whereas sustainability refers a non-declining utility over time ($\frac{du}{dt} \geq o$).. In this sense, *optimality* is one step ahead of *sustainability*. The utility function concerned with optimality of growth has output or consumption as the only argument, but the utility function for sustainable development has some other arguments related to the environmental quality and other qualitative variables, besides price.

The above is the basic difference between the *optimal growth* and *sustainable development*. While one difference is the outcome of the differences in the two adjectives, the other one is the result of the difference in two nouns, growth and development. So, if one considers only one adjective *sustainability* for both growth and development, there appears greater similarity. It is because both concepts, viz; *sustainable growth* and *sustainable development* imply a nondeclining utility. Yet, utility function of former is different from that of latter. In particular, sustainable growth means a non-declining consumption or output (Pezzey, 1989:13). Interpreted in another way, the difference in utility functions of the both concepts is not large since the basic element of the both functions is common.

Hence, it seems that there are some similarities between the *optimal growth and sustainable development*. This is true because:

- both imply an increase in consumption or utility over a limited horizon of time and
- the major element of the development vector is the growth.

However, sustainability is certainly different from optimality, and therefore, similarity is more between *sustainable development* and *sustainable growth* than between *sustainable development* and *optimal growth*.

There exist two variants of sustainable development which derive from differences in the opinion about the slope of the monotonic utility function over time. This is also evident from the notation ($\frac{du}{dt} \geq o$) used for defining sustainable development. Thus, strict positivity of the utility function over time ($\frac{du}{dt} \geq o$) requires that per capita utility should increase in each successive time period. On the other hand, the weak inequality i.e. ($\frac{du}{dt} \geq o$) emphasizes only on the positive trend of utility over time.

While optimality refers maximizing something, sustainability does not. It merely states a situation of non-declining utility over time. How sustainability could be achieved is more important than what sustainability is. Again, difference in opinion occurs in that there is one group of scholars *(Weak Sustainability School)* who held a smooth substitution between natural capital (Kn) and manmade capital (Km), and therefore, urges for a constant capital (K) as the condition for sustainability. This school therefore holds neoclassical views and is represented by Solow, Hartwick and quite a few others. On the other hand, the other school, Known as *Strong Sustainability School* is represented by Pearce and some other from London School, and many ecologists. This school imposes an additional condition of constancy of natural capital, besides the constant overall capital.

The above distinction shows that weak sustainability is close to optimal growth in terms of its underlying assumption of a smooth and continuous isoquant. None the less, weak sustainable development does not mean maximizing the present value of utility,

DISCOUNTING AND INTER-GENERATIONAL EQUITY

The optimal growth model emphasized on the idea of present value maximization. On the other hand, there are some ecologists who do not prefer discounting future value at all.

The idea of discounting is supported on two grounds:

- Positive rate of time preference,
- Positive marginal productivity of capital.

Thus, so long as these two conditions prevail in the society, discounting has a solid ground. It is because of this fact many economists consisting *Strong Sustainability School* think the validity of the discounting (Pearce et al 1990). But, the issue at stake is about the rate of the discount. Even economists from *Strong Sustainability School,* with a view to preserving the natural assets, favour for a low discount rate. Thus, on the matter of discounting the difference is only of magnitude rather the discounting issue as such. But, what is more important is that: does discounting permits intergenerational equity ? It all depends upon our coefficient of concern about future generation.

The issue which is of grave concern is the issue of optimality associated with optimal growth or *Pareto Sustainability School.* Thus, if resources (natural) are exploited according to the rule of efficiency, it is held that they will be depleted fast and therefore, future generation could not consume an equal amount or may not find to consume at all.

Concern that nonrenewable resources may limit economic growth has generated interest in the conditions for which it is feasible and optimal for the economy to sustain a non-decreasing level of production and consumption (Koopmans, 1973; Dasgupta and Heal, 1974; Solow, 1974; Stiglitz, 1974). The growth literature has identified that there

are three factors which strengthen an economy to overcome the scarcity of its non-renewable resources.

- easy substitution between man-made capital (Km) and natural capital (Kn);
- technological progress; and
- decreasing cost to scale.

Dasgupta and Heal (1974), using CES production function, and assuming constant population, explained that sustained growth is feasible if the elasticity of substitution is greater than unity. Using such production function model with constant population, Solow (1974) and Stiglitz (1974) came out with the view that sustained growth is feasible if elasticity of substitution is equal to unity and elasticity of output with respect to capital is greater than elasticity of output with respect to the natural resource.

In this respect the belief that natural resources should be preserved, held by Pearce and many other economists of London School and by some ecologists, seems to be in the correct place. Again, in the face of uncertainty and irreversibility their view is further reasonable.

Following optimal growth path if future generation suffers from lack of natural resources, then the only solution is to deviate from this path and follow the path of *Strong Sustainability School*. But how far this is valid for a developing country is a major question. Maler (1989) held the view that the application of Rawl's criterion will lock a poverty striken society in poverty forever. Thus, he favours the optimal growth model.

However, if a developing country has sufficient natural resources then following the optimal growth path for a few years does not seem much problematical. But, there is a growing evidence that they don't have sufficient natural resources.

However, since the eightees grows a popular belief that there is not always an inverse relationship between growth and amount of natural resources. But, one can't think of always a positive relation either. Thus, the view held by Pearce et. al. (1990) seems in the right order. Again this complementarity obtains only when there is an economic liberalization in the country. It is what the world Bank opts for to promote economic growth without degrading the resource base.

One may argue that a rapid technological progress could solve the issue. Yes, it is true, so long as the technological progress exceeds the population growth. But, technical progress is generally capital intensive. This suggests that it can substitute for natural resources and therefore, economic growth is feasible. But how long this could happen and to what extent man-made capital finds its way in substituting natural capital.

The above observation remarks that economic growth is possible for the near future. But following optimal growth path could not go with the interest of sustainable

development. Thus, it is in this respect the sustainable development (strong version) largely differs from the optimal growth model.

Again, estimating the optimal stream of net benefits of the future is how far correct. The one thing the optimality necessarily implies is a perfect match of interest of both producers and consumers. But, how far it is feasible to know about the demand of future generation, is certainly an important issue to think over. If one cannot estimate truly the demand curve for future generation then the optimal path based on such curve is meaningless. Thus, it can be inferred that deviating the neoclassical optimal path is not at all wrong so long as one is unable to know about future preferences. However, the present generation does know that future generation prefers a bundle of goods which consists of more of goods units than that of the present generation. Then, based on this corrca rational behaviour of human being why not to follow a path which ensures atleast inter-generational equity.

SUBSTITUTION BETWEEN NATURAL CAPITAL (Kn) AND MANMADE CAPITAL (Km) AND INTERGENERATIONAL EQUITY

Intergenerational equity is the social objective of sustainable development. To obtain it, while the *Weak Sustainability School* holds a smooth substitution between natural capital and man-made capital, the *Strong Sustainability School* doubts about such a smooth and continuous substitution between them.

Thus it seems that weak sustainability school is related to the optimal growth model, in that both assume a continuous and differentiable function. The idea of limited substitution, of course, emphasizes the role of natural resources (Kn) in production process. Because of this fact strong sustainability school prefers a constant Kn or some component of Kn. As this restriction is not valid in respect of non-renewable resources, constancy of Kn implies a constancy of renewable resources. In this sense, the production function assumed by *Strong Sustainability School* consists of renewable resources as the additional argument whereas, that of weak sustainability school includes non-renewable resources.

While economists comprising *Strong Sustainability School* show their interest in limited substitution, the ecologists of this school flatly reject the idea of substitution between Km and Kn. On the other hand, *Weak Sustainability School* comes closer to *Optimal Growth Model* in case of an economy totally reliant on natural resources:

"In an economy that is totally reliant on natural resources for economic output, and where the resource itself has environmental value, *Environmental Protection* (reducing the rate of natural resource depletion) is essential for *Sustained Economic Growth*, i.e. positive growth of consumption and utility into the indefinite future" (Pezzey, 1989: 35).

The above statement does not run against the basic philosophy of *Weak Sustainability School* that the productive capacity of economy should be maintained intact. This is because the direct dependence of an economy on environment implies that the economy is not fully developed. Thus, in this sense the substitution between

Kn and Km is not an abstract idea. Rather, what seem abstract is the smooth substitution between (Kn) and (Km) and this is, of course, a product of mathematics used in neoclassical economics.

In developed countries the aesthetic value of natural resources has been increasing. The idea of existence value groomed by deep ecology suggests that the production and utility functions of either *Weak or Strong Sustainability School* should incorporate the critical limit of some natural resources which have highest amenity values. In doing so, the preferences of people obtain due respect. But, how far this is relevant in case of developing countries is difficult to say. To the extent that these countries lack productive capacity, a recognition of conservation of natural resources may produce a slow progress in these countries. However, the incentives in the form of subsidies for resource extraction is not desirable even in such countries.

Thus, the notion of substitution between Kn and Km is governed by the stage of development of a country. In this sense, the underlying assumption of substitution between Kn and Km of optimal growth model is not absolutely wrong even in attaining sustainable development. Also, substitution possibility depends upon what types of natural resources is taken into account. In this respect, the view of *Strong Sustainability School* is in the right order.

Maler (1989), points out two reasons why substitution of Km for Kn can be feasible. The first has to do with the aggregate nature of production function and the other with the substitution of one resource for another through capital investment.

OPTIMAL GROWTH AND INTERGENERATIONAL EQUITY

The other way how *Optimal Growth* differs from *Sustainable Development* is due to the difference between *Growth* and *Development*. Growth takes care of only total value of production, and so is optimal growth. Again, optimal growth emphasizes on the economic efficiency rather than distributive justice. On the other hand, development vector consists of improvement in the distribution of income.

The current belief that there is not always a negative relationship between development and environmental quality makes a point for sustainable development where the resources could be conserved on the one hand, and economic growth could be achieved on the other. But this underlying belief of sustainable development could not be maintained if one follows the path of optimal growth which emphasizes on the present value of output without giving due consideration to the environmental quality.

CONCLUSION

That *Optimal Growth* and *Sustainable Development* both work under the constraint of finite resources. But optimal growth while identifies only one path, sustainable development generates different paths, and among them one may be the most efficient. Thus optimal growth is one step ahead of sustainable development.

If finiteness of resources (natural) and their existence and aesthetic values are given due consideration, by valuing properly preferences of the people, in the production and utility functions of society, the optimality concept could be applied even in respect of sustainable development. But this application could not result into sustainable development as conceived by *Strong Sustainability School.*

Furthermore, the duality of economic efficiency implies minimization of cost for a given output. This seems more appropriate to apply in respect of sustainable development where countries of the world are allowed to achieve a moderate growth rate putting limited strain on the natural resources. Keeping in view the different development stages of the countries, different growth rates may be specified for the countries. Following such an optimal growth rule may produce a global sustainable development.

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BOOK REVIEW

Dahal, M. K., and Dahal, D. R. (eds.), (1993) Environment and Sustainable Development: Issues in Nepalese Perspective, Nepal Foundation for Advanced Studies, Kathmandu, PP. 201+XIV, Price not mentioned.

Sustainable development can be described as a pattern of social and structural economic transformation which optimizes the economic and other social benefits available in the present without jeopardizing the likely potential for similar benefits in the future. Thus the concept of sustainable development as a goal presumes two things:

- goals and paths which can not endure in the long run, because they are threaten sooner or later to destroy the country's ecological bases,
- development by no means abandoned as a goal.

This means that a different development from the pursued upto now i.e. an ecologically and socially sustainable development is conceivable and practical.

Nepal characterized as the one of the poorest countries in the world with percapita income of about 180 US dollar, has social indicators well below the average of South Asia. A country with a population of 18 million and growth rate of 2.6 percent per year between 1971-88, has its half of GDP from agriculture which employs over 90 percent of labour force. About 93 percent of the population lives in rural economy and population density with respect to areable land is one of the highest in the world i.e. 590 persons per sq. km forcing the farmers to cultivate increasingly marginal land and forest. In addition, forest has been denuded to meet the growing household demand for fuel wood. Soil erosion accelerated by deforestation is matter of serious concern as a cause of river silting and consequent flooding. Rugged topography has restricted to areable area and created various microclimates in the form of impediment to wide spread application of standard cultivation technology. In addition, population pressure had contributed to rapid deforestation, inter-ecological region migration and emergence of land less class with 5.8 percent urban growth rate between 1981-91 which pose long term threats to its development. Crop production accounting for about 60 percent of agriculture out put, live stock for 30 percent and forestry for 10 percent, tourism provides 20 percent of the country's export earnings and carpet and readymade garment account for over half of merchandise trade.

Under these scenario Nepal has to attempt to course its development along with '3Es'.

- maintaining Environment integrity,
- pursuing Economic efficiency and,
- pursuing Equity.

This *other development* philosophy, blended with *earth Policy* is probably theme of the book under review which is the outcome of the National Seminar on the theme of book's title, and contains scholarly papers by eminent authors arranged in six chapters dealing with, Biodiversity Profile and Conservation Strategy for Nepal;

Population, Agriculture Productivity and Environment; Economic and Environmental Management of Forests in Nepal; Trade, Transport, Tourism and Environment in Nepal; Urbanization, Industrial Pollution and Environment in Nepal and Environment and Sustainable Development: Issues in Nepalese Perspective.

Growth of Nepal during the 1970s barely kept up with: population growth and during the Sixth Five Year Plan (1981-85), growing frustration with past economic performances manifested itself in surging public expenditure to accelerate the pace of development having insufficient focus on the issues that compatiate sustainable development, i.e. addressing poverty. If poverty is the cause and effect of environmental degradation in Nepal, it is the consequence of inappropriate policies. This is what, the authors Tirth Bahadur Shrestha and Vimal N.P. Gupta admit that Nepal's strategy for biodiversity conservation has yet to be elaborated and clarified. The strategy should be able to influence policies directly dealing with land use, forestry and resource management, which is not at present.

Men are acting on nature from early history of their emancipation for their survival. But men, multiplying their member, have resulted deforestation, exploitation of marginal land, reduced industrial raw materials and fall in agricultural yield. These are recorded opinion of the author Harihar Acharya. But other part of the coin is, hills population growth rate is not very high and in the mountains, in fact, there is decline in the actual population. If that is the case, then environmental problems, in our context, had have been because, besides natural, of political factor, in conjunction with modern values of rapid and abrupt changes that deteriorated environmental conditions, disrupted stability of the harmonious relationship between human beings and nature. That is why, the author opines in favour of population and agricultural management strategy that are friendly to the physical and social environment. Similar is the opinion of the author Keshar Man Bajracharya on forest management, however, emphasizing on strong political and administrative commitment at all levels, peoples participation have been advocated beautifully.

Trade Transport and Tourism, however, are much of importance for country's economic development, have caused much environment degradation, is the view that the author Ramesh Araya has. Trade policy of the country misses environment content, transport policy misses emission control and fuel quality control content and tourism policy misses garbage disposing policy content in Nepalese context. Dealing with these issues author suggests ropeway and electric trolley buses, to study the cost benefit analysis of tourism business and advice to seek judicious balance between environmental concern and overall development of the country but left no alternative for developmental course resting on exploitation of non- renewable sources and unplanned location of industries that cause much environmental degradation.

Modern urbanization can be traced directly to the industrial revolution and urban growth accelerated as a result of the introduction of noval production possibilities and technological breakthroughs. Environmental impact of rapid industrialization was felt when life support system began to be threatened. The rising menace of land, air and water pollution gradually brought environmental concerns to the centre stage of the development and *Our common Future* exemplified nexus between urbanization,

industrialization and environment and pointed towards lessons to be learnt. The author, Pitambar Sharma have dealt at length on these issues and puts a very comprehensive analysis of the features and trends of Nepalese urbanization, industrialization, industrial pollution and environment. He opines for a sustainable urbanization and industrialization and suggests for a defined urban industrial location policy in the context of national spatio-economic development strategy and pleads for *polluter pays principle*. These seem to be very correct diagnosis of the problems, because environmental problems in Nepal are associated with unplanned and unscientific urbanization and are on the increase due to lack of environmental safety regulation and determination of minimum infrastructure levels.

The authors, Madan K. Dahal and Kishore K. Gurugharana have the conception that economic growth has caused intractable environmental damage, yet they regard it is crucial for combating poverty. Poverty may be cause of environmental degradation but, it is not the only factor. Material growth, in the sense of *catch up*, is indispensable for the poor majority of country's population. So, instead of putting bar on to achieve at least minimum material standard, the *floor standard* valid for all the poor in the country, ceiling on the maximum amount of wealth to be owned by the better off class of the population is, probably, the right strategy to be adopted in our context. This should be followed by not only by the type and extent of capital and technical stock but also significantly, by ecologically relevant determinants such as:

- the reserves and changing reserves of non-renewable resources;
- the reserves and changing reserves of renewable resources;
- by stopping infinite consumption of non-renewable resources by changing to other forms of consumption or to substitutes.

In this context, in spite of accepting vicious phenomenon of poverty as the root cause of environmental degradation and environmental degradation as the cause of poverty, the authors, very skillfully, have not addressed to which specific part or aspect of poverty leads to environmental degradation, while they have dealt with other major issues very lucidly.

Lastly, the contents of the book present a laudable accounts of environmental and sustainable developmental issues in Nepalese prospective and offer many significance observation which may be very useful for policy makers. On the whole, the book has raised many pertinent issues but, on the other hand, has not shed any light on to manage ecosystem requirements to the market place and build economy that stimulates sustainable form of investment and resource use because, non-linear linkage occurs between the environment and the economy and environmental problem emerges from investment decision made in the past.

Central Department of Economics
Tribhuvan University Kirtipur, Kathmandu

Vishnu Prasad Sharma