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Managing Forests for Sustainable Economic Development: Optimal Use and Conservation of Forests

by

Clem Tisdell

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Managing Forests for Sustainable Economic Development: Optimal Use and Conservation of Forests

ABSTRACT

The conservation of natural forests contributes significantly to the goal of achieving sustainable economic development. There is, however, growing concern that natural forests (which provide tangible and intangible economic benefits to humankind) are being lost at a rate which (combined with other factors) seriously threatens sustainable economic development because of the environmental and social impacts of such loss. There is little doubt that in order to achieve sustainable development, multifunctional forest ecosystems (as well as other important ecosystems) need to be managed appropriately. However, determining the socially optimal level of conservation and use of forests is a challenging task. From a human point of view, it is clearly not optimal to conserve all natural forests. In other words, only some conservation of natural forest is socially optimal. The extent to which (traditional) neoclassical economics elucidates the matter is explored. It is found that due to market failures, a larger amount of forest conversion occurs than is socially optimal as determined by the application of traditional welfare economics. Nevertheless, neoclassical economics fails to address adequately the requirements for sustainable economic development. When the goal of economic sustainability is taken into account, even less forest conversion than recommended by neoclassical economics is socially optimal. Some economists (for example, Ramsey and Pigou) claim that the sustainability shortcoming of neoclassical economics can be overcome by applying a zero discount rate in making decisions about resource use. This, however, does not solve the problem because it does not give enough weight to the welfare of future generations and may result in too much forest conversion from an economic sustainability viewpoint. In general, variations in the discount rate are ineffective as a means for determining measures that ensure sustainable economic development. This finding seriously undermines established economic theory.

Keywords: Discount rates, ecosystem services, environmental conservation, forests, intergenerational equity, multifunctionality, resource economics, sustainable development.

JEL Classifications: Q20, Q23, Q56, Q57.

Managing Forests for Sustainable Economic Development: Optimal Use and Conservation of Forests

1. Introduction

Natural forests are complex multifunctional ecosystems the conservation of which contributes to sustainable economic development. Ecosystem services that enable forest to contribute to economic sustainability include:

(1) their role as carbon sinks and stores;
(2) their favourable impacts on local climates;
(3) their conservation of genetic diversity;
(4) their supply of hydrologic (water) services of value regionally; and
(5) their role in reducing rates of soil erosion. This, in turn, generates several positive externalities such as less silting of dams and forests and the avoidance of reduced fish populations.

Furthermore, natural forests are a renewable resource and can be used to a limited extent by humans for consumptive purposes without significantly eroding their provision of other valuable ecosystem services. Indeed, in some cases, limited use of forests by humans can add to the value of the other ecosystem services provided by forest, for example, the amount of biodiversity conserved in forests. Moreover, sometimes natural forests (and some human modified forests) provide valuable social safety nets for local communities (Lipton, 1985) and are especially important in helping satisfy the needs of the poor and in providing employment opportunities for females, as has been documented, for instance, in India (Tisdell et al., 2002).

Natural forests are not the only types of ecosystems contributing to economic sustainability. The conservation of other natural ecosystems as well as some human engineered ecosystems (such as agroecosystems) also plays a role in promoting sustainable economic development. Nevertheless, most concern appears to have been expressed about the rate at which deforestation is occurring globally and especially, about the loss of natural forests. Despite this, the conservation of all natural forests is unlikely to be socially optimal and the extent to which forests must be conserved to achieve economic sustainability is subject to debate.

Neoclassical economics emphasizes the opportunity costs involved in decisions about resource use, and can be applied to the allocation of land use. Its implications for the conversion of forested areas to alternative uses are explored. It is however, found that neoclassical economic theory pays insufficient attention to economic sustainability. When economic sustainability is taken into account greater conservation of forests and natural ecosystems is called for than indicated by neoclassical economics. Each of these matters are considered in turn and are followed by a general discussion of the issues raised.

2. Neoclassical Economics and the Optimal Conversion of Natural Forests to Alternative Uses

Historically, the general trend has been to convert land containing natural forests to alternative users. Neoclassical economic theory indicates that some such conversion (as well as conversion of many areas supporting other natural ecosystems) is likely to be socially optimal if Pareto's criterion is adopted. Pareto (1927) argued that if economic welfare is to be at a maximum it must be impossible by reallocating available resources to make anyone better off without making another worse off. Neoclassical economists argue that some conversion of natural areas is needed to enable human wants to be more fully satisfied given the limited availability of resources.

In its simplest form, the position of neoclassical economics concerning optimal land use can be illustrated by Figure 1. There the curve ACE represents the supply of commodities that can be obtained by reducing the area of a forest. The curve marked W_1W_1 is an indifference curve showing the relative value that the community places on forested land and the commodities that can be produced by its conversion to alternative uses. It should, however, be noted that the use of social indifference curves ought to be merely regarded as a convenient simplification. Although the concept of a social welfare function developed by Bergson (1938) is useful for expository purposes, as Arrow (1954) points out, it is often impossible to derive such a function from the preferences of individuals in a way that satisfies acceptable axioms. Given the representation shown in Figure 1 the socially optimal choice corresponds to point C. This implies that AG of the forested area should be converted to alternative uses and

that OG ought to remain as forest. The combination at point B would involve insufficient forest conversion to minimize economic scarcity (**given this theory)** and conversion corresponding to point D would include too much conversion to minimize economic scarcity.

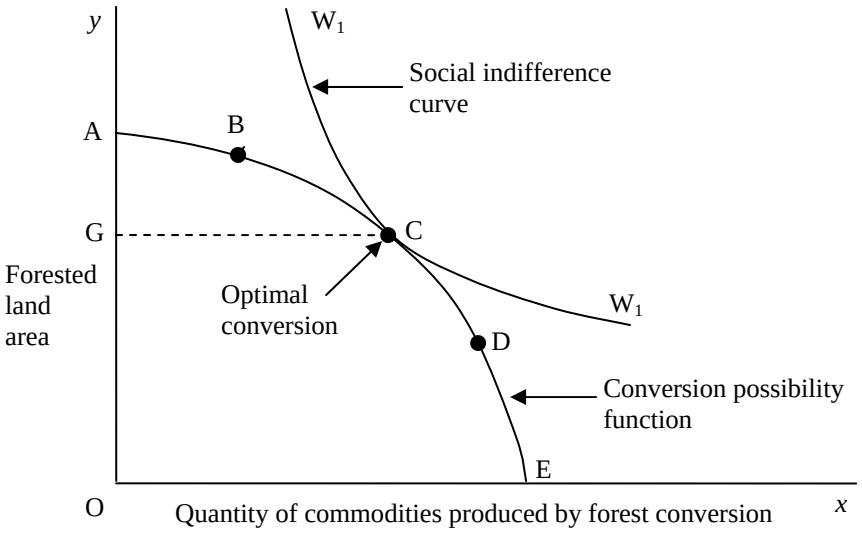

Figure 1: The socially optimal level of forest conversion as suggested by neoclassical economic theory corresponds to point C in this case.

As a result of market failures, neoclassical economist concede that too much forest conversion may occur, that is, conversion corresponding to a point like D may take place. While this is a useful observation, neoclassical economic theory suffers from several serious limitations when the dynamics of economic systems are taken into account. Its application (in practice) tends to be based on current preferences and transformation possibilities for natural resources and to a large extend ignores the needs of future generations, especially the importance of conserving sufficient natural capital to maintain the income levels of future generations. Let us therefore, consider economic sustainability issues that need to be taken into account when considering the optimality of forest conversion.

3. Sustainability Issues that should be Considered in Forest Conversion and Afforestation

Neo-Malthusian economists argue that achieving the goal of sustainable development requires the conservation of an adequate amount of natural capital, including natural forests. (Pearce et al., 1989; Tisdell, 2005, pp.248-251) and many have expressed concern that reduced levels of natural capital as a result of economic activity are, in practice, on the verge of causing a substantial collapse in future levels of per capita income. For example, greenhouse gas emissions are causing the atmosphere to change its properties and are expected to result in significant global warming and rises in sea levels in this century unless rapid and sufficient action is taken to reduce the level of these emissions (IPCC, 2007). As a result, levels of sustainable income are expected to fall globally in the absence of appropriate aversive action (Stern, 2007; Tisdell, 2009, Ch.11)

The neo-Malthusian point of view about the likelihood of unsuitable economic development can be illustrated by a couple of diagrams. With the passage of time the amount of natural capital globally has declined as a result of its conversion into man-made capital and its consumption. Assume that the sustainable level of per capita income or level of welfare can be related to the amount of natural capital that exists. One possibility is illustrated in Figure 2. Initially, there may be no conversion and the level of sustainable income might be close to the subsistence level, for example, might correspond to point A in Figure 2. As economic development proceeds, the actual and sustainable level of income might follow a path like that shown by curve ABCD in Figure 2. As a result of some reduction in natural capital (as a result of its conversion to other purposes, such as man-made capital), sustainable levels of per capita income rise at first. They reach a maximum in the case illustrated when a quantity of R_1 of natural assets is converted to other uses as a result of economic activity. Further conversion results in a reduction in the level of sustainable income. Many neo-Malthusians are concerned that globally the reduction in natural assets already exceeds R_1 (or is about to exceed it) and that per capita incomes can be expected to decline in the future. If further conversion of natural capital occurs, an even greater decline in the level of future income is expected.

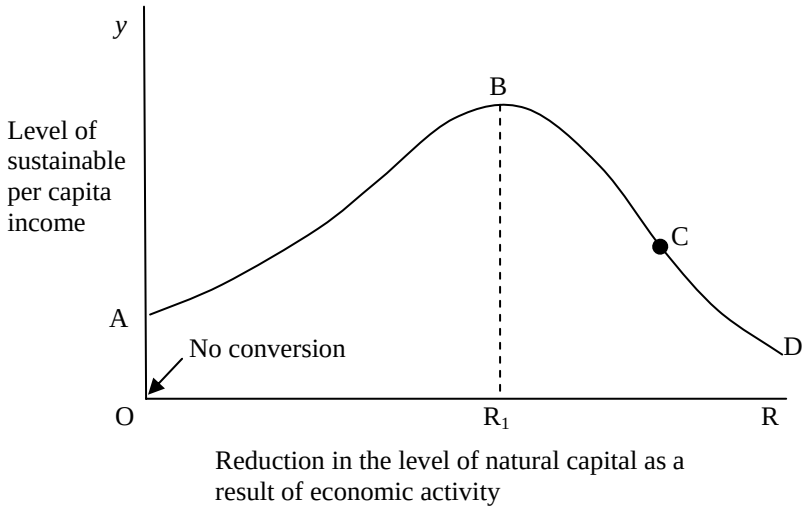

Figure 2: The availability of natural resources plays an important role in sustaining income levels. Some conversion of natural resources is necessary to increase the level of sustainable income but if there is a large reduction in natural capital, this can cause the level of sustainable income to fall.

To a considerable extent, the conversion of natural capital to provide economic commodities is irreversible. In the case illustrated in Figure 1, the decline in the level of per capita income is shown to be gradual once the reduction in the level of natural capital exceeds R_1. However, it is also possible that the decline could be abrupt once some threshold level of conversion of natural capital occurs. Consequently, there may be little or no advance warning of this impending irreversible collapse in income levels. An example of this type of situation is illustrated in Figure 3.

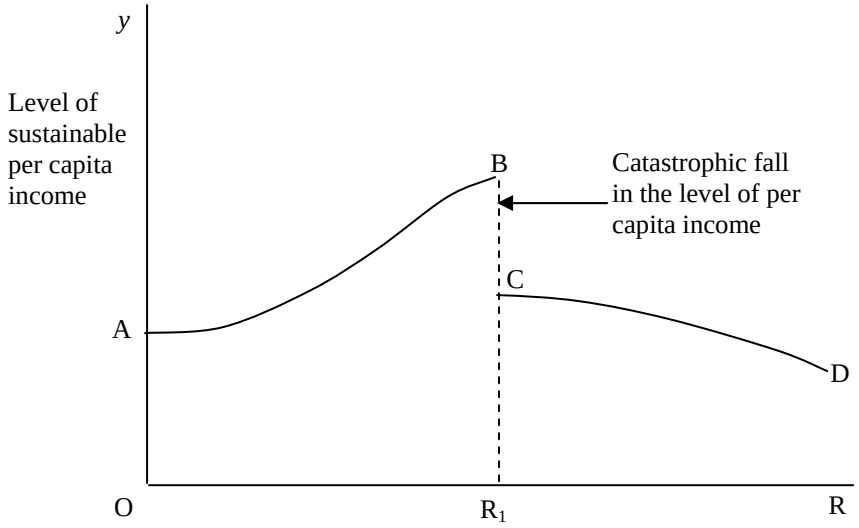

Figure 3: In the case illustrated, there is catastrophic irreversible fall in the level of sustainable per capita income when the level of reduction in natural capital exceeds R_1. Little or no prior indication of such a disaster may occur.

The above possibilities should not be dismissed as fanciful. The challenge empirically is to determine what levels of conservation of natural resources and what types of natural resources need to be conserved to avoid lack of economic sustainability.

Deciding on this is complicated because in many instances, the solutions are not fixed ones but are conditional. For example, additions to forested areas can help fight against global warming by sequestering carbon dioxide (Hunt, 2009). How effective reforestation and afforestation is likely to be in that regard depends on the level of greenhouse gas emissions, for instance, from the use of fossil fuels. For example, suppose that it is argued that in order to avoid adverse economic consequences from global warming that greenhouse gases in the atmosphere should not exceed Z parts per million in terms of CO_2 equivalent. Other things unaltered, suppose that greenhouse gas emissions from the use of fossil fuels will result in the threshold, Z, being exceeded. By adding to forest areas, it may be possible for a time to absorb the excess carbon dioxide that would otherwise be in the atmosphere. The scope for such absorption is nevertheless limited.

Additions to forests will need to rise with the level of CO_2 being emitted as a result of the use of fossil fuels if the forest additions are to absorb the excess CO_2 being

emitted. The rate at which newly established forests sequester CO_2 varies with their age. Their **rate** of sequestration increases at first with their age, then declines and at maturity of the forest is zero or close to zero. Consequently, additions to forested areas only reduce potential CO_2 accumulation in the atmosphere for a limited period of time. Afforestation and reforestation are stop-gap measures and not a long-term solution to excessive levels of CO_2 emissions from the concentration of fossil fuels which are the prime contributor to global warming. While forest additions can play a role in moderating the rate of accumulation of CO_2 in the short to medium term, they do not provide a permanent long-term solution to the global warming problem posed by excessive use of fossil fuels. At best, they buy time. On the other hand, loss of existing forests adds to CO_2 accumulation in the atmosphere and exacerbates the problem of global warming.

4. Intergenerational Equity and the Use of Forested Land (Forest Conversion)

Neoclassical economics does not adequately address the equitable distribution of resource availability between generations, nor as a matter of fact, does it provide much guidance on the just distribution of income between existing individuals. However, when considering economic sustainability, the equitable distribution of income between generations should not be ignored.

It has been claimed that a sustainable development policy should ensure that the income (welfare) of each future generation be not less than that of its predecessor. This requirement is usually based on Rawls' principle of justice (Rawls, 1971). Nevertheless, as pointed out elsewhere, this principle is deficient in some respects (Tisdell, 1999).

An alternative basis for this aim could be that it is usually **observed** that each generation of parents hopes that their children (and grandchildren) will be at least as well off as they are and usually hope they will be better off. If this is so for each succeeding generation of parents, then it implies the sustainability rule mentioned above. This is an empirically based rule unlike that attributed by Rawls which is a philosophically based one. This empirically based rule avoids some of the theoretical

flaws in Rawls' rule. Nevertheless, even this rule is not socially appropriate in all circumstances as will be illustrated shortly with reference to forestry policies.

In assessing the social desirability of alternative development strategies, we need to distinguish between different criteria or rules which may be applied for this purpose. A chosen development strategy might be expected to satisfy a **selection** of the following rules:

(1) ensure no deterioration in the per capita income (welfare) of each succeeding generation compared with its predecessor (a rule based on Rawls' principle of justice or on Tisdell's theory of the observed preferences of each generation of parents);

(2) maximizes the cumulative income (welfare) of all who will ever live in the future;

(3) maximizes the cumulative discounted income of all who will live in the future;

(4) meets condition (2) or (3) but ensures that the per capita incomes or welfare of no future generation falls below a critical value; and

(5) ensures that a Paretian dominant strategy is selected in preference to Paretian inferior ones. A Paretian dominant strategy enables all future generations to be better off compared to alternative strategies.

Assume that the population that will be born in each generation is a predetermined variable and that the human race only continues to exist for a limited period of time. Then given Rawls' theory that any individual could be born into any generation and lives only once, application of Rule (2) maximizes the expected income of each individual to be born, it being assumed that the probability of being born into any generation is equal to the population in that generation divided by the total population to be born. As I have argued elsewhere (Tisdell, 1999), if all to be born were to confer behind Rawls' veil of ignorance Rule (2) might be accepted, but **only** subject to the condition that the income level of no generation falls below a critical level, for instance, a subsistence level of income. Note that given this scenario there seems to be no ethical basis for discounting the income of future generations, an approach that

appears to be favoured by neoclassical economics. Furthermore, zero discounting, as recommended by Ramsey (1928) and by Pigou (1929) is inadequate because it fails to take account of the avoidance by each generation of a very low level of income.

Although Rule (1), stated above, is usually said to be based on Rawls' principle of justice, it actually relies on only part of that rule. Rawls stated that income of individuals should be equal **unless** inequality is to the advantage of all, that is that unless inequality results in Rule (5) above being satisfied. Let us now consider the implications of the above criteria for alternative scenarios for forestry development.

Case I is illustrated in Figure 4. In this model the human race is assumed to continue to exist until t_n. Two strategies for forestry are considered: (1) a low level of conversion to alternative uses and (2) a medium level of conversion to alternative uses. Income per capita follows the path ABC if option (1) is adopted and path ADE if option (2) is selected. Path ADE is Paretian dominant but does not satisfy the sustainability criterion that each generation be no worse off than its preceding generation (Rule 1 above). After point D, each generation is worse off than its predecessor if a policy of medium forest conversion is adopted. Nevertheless, if only an anthropocentric perspective in adopted, this is **the** socially optimal strategy.

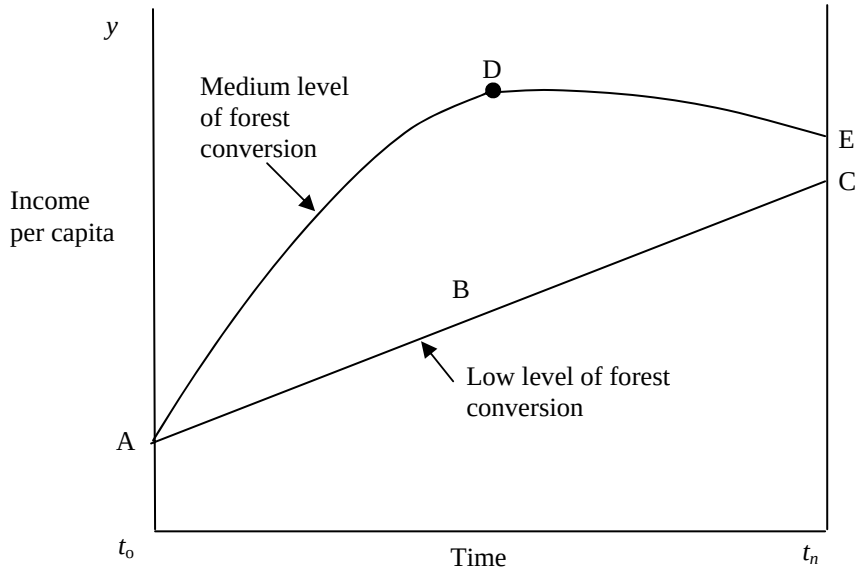

Figure 4: A case in which a medium level of forest conversion does not satisfy the intergeneration income sustainability rule (Rule 1) but is socially optimal based on Pareto's criterion.

Case II is more problematic because Paretian dominance is absent. In this case, a strategy for a high degree of conversion of forested lands to alternative uses provides greater income to earlier born generations but lower incomes to generations born later compared to a low forest conversion strategy. ABC represents the income path with a low forest conversion strategy and ADBE represents that with a high conversion strategy. Which option is socially preferable? If the high conversion path yields the highest level of expected income per capita then it is arguably socially preferable provided it does not result in the income per capita of any generation falling below an agreed critical level. However, if it does not maximize expected per capita income or if it does not meet the minimum per capita income restriction, then it would be rejected given that a combination of conditions (2) and (4) listed above is socially desirable. In that case, the sustainable development path ABC would be the most desirable.

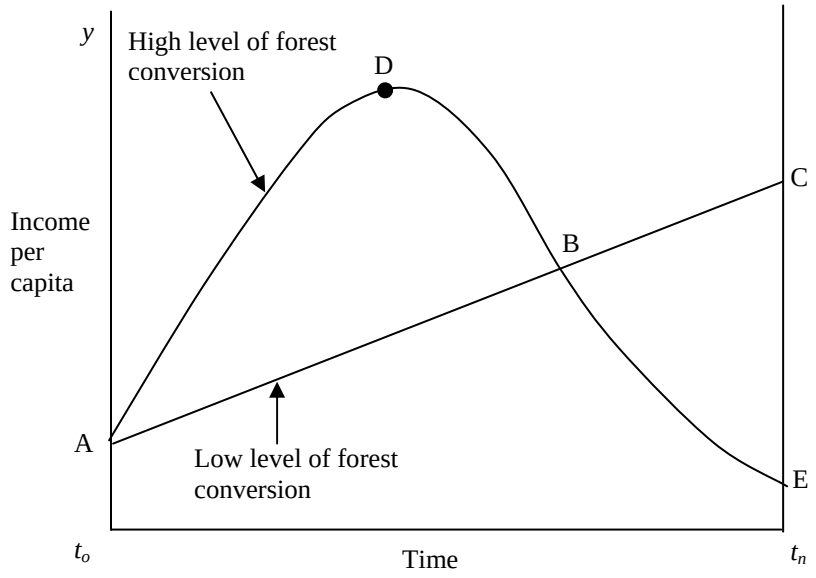

Figure 5: A case in which Paretian dominance is absent. In this case, the path satisfying the intergenerational income sustainability rule (Rule 1) may, but need not be, socially optimal, as explained in the text.

5. Discussion

From the above it can be seen that it is not always rational to apply the intergenerational sustainability of income rule, (Rule 1). This is most clearly so when it conflicts with Pareto's rule, as was illustrated by Figure 4. The application of this

sustainability rule is irrational in this case even though those who exist at time D and beyond will be disappointed that succeeding generations will be less well off than they are.

While the above is a significant (and general) result, it ought to be kept in mind that the intergenerational modeling used above has limitations. For example, the assumption is probably unrealistic that the total number of people who will live is given and their distribution between generations also is given. Levels of human population can be controlled to some extent and are subject to endogenous influences within socio-economic systems.

It is also relevant to note that exploration of theoretical possibilities involving sustainability has advanced well beyond empirical evidence for assessing these possibilities. As a result, the relative economic benefits from many alternative long-term development strategies are uncertain. Consequently, choices between alternative development paths have to be made under conditions of uncertainty. Hence, apart from possible uncertainty about the generation into which an individual might be born, this additional source of uncertainty needs to be taken into account. Therefore, decisions have to be made about the level of risk to which future generations should be exposed. For example, to what extent should a precautionary approach be adopted in selecting a development path? This matter is far from resolved in the academic literature and in current policy formulation, as for example outlined in Tisdell (forthcoming).

An additional aspect when considering forest conversion and conservation is how wide to cast the analysis of sustainability issues. Should the focus be on local, regional, national or global economic sustainability consequences? Analysis at these levels can proceed in two steps: (1) assessing the impacts of forestry policy on the sustainability of focal variables and (2) the desirability of these impacts. Many questions remain unanswered in this context. For example, to what extent should sustainability of local incomes, culture etc. be pursued if this means that national income is lower than otherwise?

Another important issue is to the extent to which it is socially desirable to replace natural forests by plantations. Usually, forest plantations are monocultures or include only a very limited number of tree varieties. Consequently, many of the (ecosystem) functions of natural forests are lost, in particular biodiversity within the forest is reduced. Nonetheless, forest plantations may be more productive in providing commercial timber and may sequester significant amounts of CO_2. On the other hand, some forest plantations are fertilized and this, together with silviculture operations, adds to CO_2 emissions.

While governments (for example the EU) have given considerable attention to policies to maintain multifunctional attributes of agriculture (Tisdell and Hartley, 2008, pp.76-80), much less attention has been given to the goal of maintaining the multifunctionality of forestry. Most forests in Europe now consist of plantations and worldwide, the area of land used for forest plantations is growing (Tisdell, 2005, Ch.8). Given this development, the economics and social desirability of sustaining the multifunctionality of forests would benefit from greater research.

6. Conclusion

This discussion of the management of forests for sustainable development has raised several issues about the extent to which natural forests should be conserved, altered or converted to serve non-forest purposes. Neoclassical economic theory indicates that some alteration in natural forests and the conversion of forested lands to alternative purposes is likely to minimize economic scarcity. However, the type of models typically employed to apply neoclassical economics do not give adequate attention to the needs of future generations. Neo-Malthusian economic theory also suggests that some conversion of land containing natural forests to alternative purposes can add to economic welfare and be compatible with economic sustainability. Empirically, however, the extent to which this conversion is compatible with economic sustainability remains unresolved. Nevertheless, as demonstrated, the critical point at which conversion of forests is incompatible with continuing sustainability of per capita income is not unique. It depends on the status of other natural resources.

Intergenerational equity involving the use of forested land (and other natural resources) was shown to be a complicated matter. While the sustainability rule that the income per capita (well being) of each succeeding generation should not be less than that of its predecessor has philosophical appeal and empirical support., it was shown that it is not always rational to adopt a development policy that satisfies this rule. Furthermore, there is no ethical reason for discounting future incomes and while zero discounting (as recommended by Ramsey and Pigou) is justifiable, the stream of income that maximizes undiscounted income may not maximize social welfare. This is because it could result in the income levels of some generations falling below acceptable levels. Apart from these matters, there are still several unresolved sustainability issues, as mentioned in the previous section.

The above discussion is not intended to belittle the importance of debating and assessing the sustainability attributes of alternative economic development strategies. However, it makes it clear that strategies which achieve sustainable economic development (defined as satisfying Rule 1 above) are not always socially desirable. Of course, some strategies that fail to achieve sustainable development may be even worse. In other words, the answer to whether a development strategy is desirable does not depend primarily on whether it achieves sustainable development. We need to take into account additional factors.

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