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Ecological-Environmental Economics: A Tool For Environmental Management Of Resources

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ABSTRACT

Within the discipline of Economics, two sub-disciplines have formed over recent decades that seek to address environmental issues. These two fields are Environmental Economics and Ecological Economics. While the former has addressed environmental problems with a focused analytical rigor, the latter has utilized a wider multi-disciplinary approach. However, both seek to understand the complicated relationship between the Environment and the Economy to redress the market failures that have led to worldwide resource degradation. Few resource better exemplify this complexity than forests due to their unique position as an ecosystem, a renewable resource, and a tool to mitigate climate change. This paper is focused on the differences between these two models of Economics and their treatment of forest resource with special attention towards which model is best able to achieve sustainability.

Introduction

Historically the treatment of resources within economics has evolved. The shift of economic frameworks from classical to neo-classical, and more recently from environmental to ecological economics has each provided a distinct view on natural resources. their scarcity, and their value. While this paper has a focus on the environmental and ecological economic models and their treatment of resources, it is important has provide a brief map of how these differing views came into being through the evolution of economic theory. The early classical theory provided a mechanistic and structured view of the economic functions in society that was well reflected in the surrounding industrial increases that provided a context for its creation. The theory provided for divisions between fixed capital, such as buildings and machines, non-fixed capital such as food, materials, and tools. and land which was regarded by many of the time as a productive tool because "it provided a surplus of output above the material input advanced at the beginning of production" (Christensen, 1989). As such, resources were treated as exchangeable with other forms of non-fixed capital. As this theory evolved, the analysis of the economy shifted from one of production as the central catalyst to maximization of utility, which led to the marginal utility approach to price (Christensen, 1989). The inclusion and trust of the market's ability for substitution, technological advance, and self-regulation that solved the Malthusian dilemma of upper resource limits led to a relativistic view of scarcity in resources (Sahu, 1994). The 1960's and 1970's saw a shift in the economic theory, valuations, and treatment of environmental resources. The increasing scarcity of resources that were not reflected within the market, such as clean air, water, and soil were now viewed as the result of a market failure (Sahu, 1994). This was the context in which Neo-Classical Environmental Economics developed, which utilized the theories and methods of the previous century to revisit the view on scarcity, values, and substitution. However. with continued environmental degradation, a philosophical gap developed within the economic community that influenced the formulation of an Ecological Economic model. This economic model sought to develop and utilize methods outside the traditional neo-classical framework. Included in their analyses is the use of thermodynamic limits to growth, a holistic approach to economic-social-ecological factors, and human welfare viewed as a function of the natural environment. Nirmal Sahu traces the divide between Environmental Economics and Ecological Economics to the Club of Rome meetings in 1972. It is after this analysis of the world's growth problems that the Environmental Economists sought to utilize the current tools of Neo-Classical Economics to counter the relevant issues, while the Ecological Economists sought inclusion of new tools that could translate real world economies into the theories more effectively. Partly the Ecological economists hoped to affect this change by looking

to the natural sciences, specifically biology and ecology which both deal with complex interactions analogous to economies (Sahu, 1994). It is in the context of this evolving view towards the environmental and economic connections that the two economic models began to develop theoretical and philosophical splits. The Environmental Economists followed in the tradition of Neo-Classical Economics and maintained the positive and value-free principles (Sahu, 1994). Which is to say that economics is meant to describe facts without personal value or subjectiveness allowed to influence the facts (Tacconi, 1998). This was reflective of their belief in the neo-classical framework's ability to solve the environmental problems presented to economists and its objectiveness in the issues. However, the Ecological Economists took a differing view towards economic theory and proposed a more subjective viewpoint (Sahu, 1994). This concept includes a dimension of value and ideologies, as well as recognizes the fallibility and bias of the economists themselves. This theoretical base also is inclusive of other methodologies to economic research, as Tacconi states "The recognition that there are multiple realities appears to lead to the acceptance of the fact that multiple paradigms exist. The existence of multiple paradigms is important to the development of science." (Tacconi, 1998).

In specific consideration of resources, the two economic models have different views as to both the value and scarcity. With the advent of globalization in the past 60 years, the access of markets has increased dramatically and resources particular to one region has been made available to the rest of the world. Through this globalized network of resources, environmental economics was able to utilize a model of relative scarcity (in which one resource that is considered scarce has a price that reflects this scarcity) to solve environmental problems. However, a corollary of globalization is the awareness of global concerns and environmental issues that affect a greater area than the local or regional. In this context Ecological Economists utilized the concept of absolute scarcity, with limits on the thermodynamics of resources (Sahu, 1994). Both of these treatments of resources claim to aid sustainability, and provide for intergenerational equity. As Ger Klaassen states "Neo-classical economics concludes that, due to substitution and technical progress, consumption can be sustained even if production depends on a natural resource that is being depleted. If production depends on an essential renewable resource, there is a level of consumption that can he sustained forever." (Klaassen, 1991). And as Environmental Economics has an alignment in framework with neo-classical, this same treatment of resource sustainability is utilized, This is contrasted against Ecological Economics, which restricts substitution possibilities, considers the full recycling of resource waste as impossible according to physical limits,and the initial input of energy into the system is limited further by the solar radiation of the sun. As such, sustainability can only be achieved if these restrictions are recognized (Roma, 2009). The following paper will discuss the differences between these two economic models in various aspects, such as scarcity, valuation, and methods. These aspects will be compared and contrasted with examples of forest resources and the application of the economic theory in sustainability of forest resources.

Theoretical Differences

A central figure in the divide between Environmental Economics and Ecological Economics is the frameworks of the two models. The framework is based on the definition of terms, underlying philosophy, and the methods utilized. Environmental Economics is defined by Nirmal Sahu as "the study of economy-environment relationship with particular emphasis on regulation and control under allocation grounds to ensure sustainable development" (Sahu, 1994). Similarly, Ecological Economics is defined as "the study of symbiotic relationship between ecosystem and economy with particular emphasis on stewardship to ensure sustainable development within biophysical constraints" (Sahu, 1994). However, this definitional divide extend to other concepts within economics. Sustainability in Environmental Economics can be defined as a function of resource growth potential, discount rate, and technical progress, while Ecological Economics' definition demands an inclusion of inter-species relations, conservation, and ecosystem security (Klaassen, 1991). Further more. defination that differ between the two include economic concepts such as welfare, scarcity, and even the concept of science (Illge, 2009). The inherent view towards resources by these two schools of thought can be traced back to the philosophical differences inherent in their respective economic models. Economics, typically, is a positivist science and has been presented as such for centuries. This is also the philosophical base for Environmental Economics and assumes that there is a reality, which is controlled by absolute laws of nature (Tacconi, 1998). However, Tacconi states that the decline of acceptance of the positivist philosophy in the 1970's has led to a greater acceptance that the researcher or observer has an effect on the observation itself (Tacconi, 1998). This acceptance has led to the development of a post-normal philosophy, which was directed from 'normal science' which is defined as the science normally performed with values unspoken and an agreed upon paradigm for the research (Tacconi, 1998). The philosophy of post-normal science is particularly regarded for environmental studies in which "problems addressed can no longer be chosen on the basis of abstract scientific curiosity or industrial imperatives. Instead, scientists now tackle problems introduced through policy issues, where, typically, facts are uncertain, values in dispute, stakes high and decisions urgent."(Tacconi, 1998) In essence, a problem with a significant amount of both uncertainty and risk in the

decision may require a post-normal outlook. Another economic philosophy, which has been seen increasing use in recent decades, is constructivism. This philosophy is based in the subjective nature of mental constructions of reality, and the dependence of these constructs on the person who holds them (Tacconi, 1998). This philosophy is More. readily acceptable among the Ecological Economists as it is utilized in interpretation of issues such as sustainability, where individuals may have differing views or interpretations of limits. This lack of objective limits is opposed to the positivist philosophy and can potentially be opposed to the quantitative methods that economists utilize to solve environmental problems. In relation to methods. the two economic models also differ. These different methods are due to both the varying philosophies used as well as the different goals of the research. Some of the most utilized economic measures for environmental services is the willingness to pay (WTP), willingness to accept (WTA) cost surveys, Cost-Benefit Analysis (CBA), and Total Economic Value (TEV). These methods are used often in neo-classical and environmental economics as way to quantify environmental services (Sahu, 1994). These methods are contrasted against the evaluative methods utilized in Ecological Economics, which include environmental impact assessment, contributory value analysis. system analysis. and other more qualitative methods that are rarely used in other forms of economics. The use of qualitative methods in Ecological Economics is a result of the constructivist position in which qualitative methods supersede quantitative methods because they are better able to deal with multiple realities, varying values. and different viewpoints. However, the use of quantitative methods still forms the mathematical base of Ecological Economics. While this methodological approach is well suited for the Ecological Economists' research goals, it is contrary to the views of many neo-classical and Environmental Economists, which is presented as a positivist and quantitative science (Tacconi. 1998). This difference in method can affect the structure in which resources are valued and managed from an economic point of view, potentially enough to change policy or decision making judgments. This includes one of the most fundamental economic tools. marginal utility analysis, which is the economic analysis of value derived from an extra unit or service (Ruth, 2006). While in neo-classical economics. marginal utility is the base of pricing models and utility maximization. from an Ecological Economic stand point the value of this method is minimal. As Ruth states "[Marginal utility] makes sense when the goods or services are far from their limits, but not if the integrity of ecosystems is at issue. Thus. calculating the value of losing another hectare of forest or wetland from averaged or interpolated data makes little sense if we are left with little of these systems and if we do not know were ecological thresholds are." (Ruth, 2006).

Resources

A resource, such as forests, can potentially be treated differently according to which economic model is used.Environmental Economics will help determine the price of the timber stand through an opportunity cost of extraction and market demand for the supply. When the extraction reaches an upper limit, the cost of extraction and thus the price of the timber on the open market will be too high and demand will cease (FAO, 2010). The way in which Environmental Economics differs from Neo-classical Economics in this treatment of resources is the internalization of environmental degradation from production and consumption. This could be exampled in carbon credit offsets required for logging concessions. However, as Ecological Economics focuses more on the biophysical approach to resources, forests are deemed to have value irrespective of the utility they provide (Venkatachalam, 2007). This can be exampled in a forest with coarse woody debris for floor cover, which may be counterproductive to amenity and aesthetic values but will hold a higher value for the ecosystem. This treatment of resources has the implication of resource equity regardless of scarcity, which is counterintuitive to the marginal utility theories of neo-classical economics. While it is counterintuitive to Ecological Economists that the Environmental Economist consider resource allocation to protect resources that hold no economic welfare is socially wasteful (Venkatachalam,2007). As mentioned before, scarcity is viewed differently between the two economic models and this applies to both renewable and non-renewable resources. While scarcity has been an issue of major concern within economics for over two centuries, the refutation of Malthusian scarcity in the 20th century conceptualized scarcity in economic models as a method of pricing rather than an immutable law. Environmental Economics has continued this perception of relative scarcity and adapted it to solve problems related to environmental resources. It is the belief of the Environmental Economists that the combination of market mechanisms, substitution, and technological advances will allow resources to be managed sustainably within economic growth (Sahu, 1994). The Ecological Economic theory suggests a more diverse view of scarcity. Since the limits on natural resources is in effect constrained by the first and second laws of thermo-dynamics, no amount of substitution or technological advance will be able to create more resources to function in the economy. As such, there is an upper limit to economic growth and a further restriction to sustainability that is not included in most valuations (Sollner,1997). The recognition of these thermodynamic laws and limits represents one of the largest divergences between the two models and their view of resources. Traditionally thermodynamics had a minimal role in economics, as substitution assumed a non-special role for any individual input into the production process, including energy. However, as Roma discusses, the ignorance of thermodynamics in the production process leads to a misinterpretation of both the

effectiveness of substitutability between resources and the idea of unlimited technological advances, which represent two pillars of economic growth (Roma, 2009). The potential result of this perceived flaw is that appropriate policy and resource extraction decisions are not taken as a result of the respective theories not imposing the necessary constraints (Amir, 1994). The Ecological Economic approach, however, recognizes the laws of thermodynamics both as a catalyst for resource degradation and a long-term constraint on economies.

Valuations

The aforementioned differences in views of resources and theories associated with the respective economic models leads to distinctive valuations of environmental resources. As Environmental economics value resources according to the anthropocentric welfare maximization and associated trade-off between individual choice, the value of the resource reflects an 'instrumental value' (Venkatachalam, 2007). While this represents the most common and intuitive method of valuation, the opposing viewpoint to this values natural resources as if they should be protected regardless of the level of welfare provided for humanity (Venkatachalam, 2007). This represents an 'intrinsic value' viewpoint of the resources, which is often applied to forests in the context of National Parks and unique landscape areas. but is not often applied to commercial forests or timber plantations. However, the intrinsic valuation of a forest can potentially lead to conflicting values for a resource, while ecological economists deny the instrumental value's effectiveness in determining the true value of the resource since it does not take into account the entirety of the value to society (Venkatachalam, 2007). The instrumental approach to resource valuation includes the use of a marginal analysis to determine the cost-benefit of the resource. As Ruth states "The marginal cost of resource extraction together with the opportunity cost of a unit of the resource in the ground, helps set the price for the resource and, for a given demand, determines extraction rates. As extraction proceeds, the opportunity cost of a unit of the resource rises." (Ruth. 2006). However, in recent decades the inclusion of `externalities' into this valuation system has been a focal point of environmental economics. An assessment of degradation costs (both intended and unintended) from resource extraction has been included to a greater extent into the valuation models and thus has increased the cost of resource extraction. Examples of these externalities can include pollutants such as sulfur or carbon dioxide, and the inclusion of these in the pricing model potentially involves tax policy, trading mechanisms, or other market mechanisms (Ruth, 2006). However, the valuation through ecological economic paths do not utilize this marginalist method in the same manner, as it is in contradiction to a holistic worldview. As mentioned before, Environmental Economics and Ecological Economics differ in their methods and the valuation of resources is no exception. Methods utilized from Environmental Economics focus on quantitative assessments even in situations in which quantitative numbers are difficult to assume. Uses of hedonic pricing models, travel-cost method, contingent valuation or conjoint analysis are common in determining the willingness to pay for a resource (Batabyal et al. 2003), and thus the value it has to the market. However, some natural resources do not have an open market to determine their value, and thus rely solely on these approximations to establish a value (Ruth, 2006). While these methods would be utilized in the Ecological Economic model as well, they would not be wholly responsible for the valuation of the resource. The qualitative methods would be included to obtain value representative of the multitude of services, social values, and ecosystem values associated with the resource. A forest resource, for example, may be valued to include "species, ecological zones, succession stage or other indicators of ecological processes." (Panagopoulos, 2009).

Forest Resources

Forests as a resource are difficult to define as the dividing lines between a collection of trees and a forest are not clear, as well as the population requirement of trees within a certain area to determine a forest is not a set number. However, they typically represent a renewable resource with a medium to long-term regeneration rate, complex habitat for many species, and provide a myriad of ecosystem services both within the boundaries of the forest and beyond. As such, management of forests and economic valuations can potentially be complex. While the main product of forests is typically timber on commercial forestland, there is potentially a variety of separate or complimentary services and products which can be economically viable. The addition of amenity values, existence values, intrinsic values, and ecological values can further complicate the assessment and valuation of a forest resource in economic terms (FAO,2010).

With the unique profile of forest recourses, the concept of intergenerational equity is particularly important matter of discussion. This is because, as well as providing the only livable ecosystem for hundreds of species, it also represents the form of economic subsidence for many poorer communities. This combination of potentially conflicting values is complicated in terms of intergenerational equity and its consideration of sustainability. While the treatment of an infinite number of generations equally is difficult, it is theoretically possible with a renewable resource such as forests (Asheim et AI. 2001). However, as Asheim states "a rational evaluation of infinite utility streams will unavoidably lead to discriminating against future generations."(Asheim et al. 2001). As the present deterioration of the resource being extracted is unavoidable, it is the Enviroimiental Economics approach that this resource is substituted for capital, which will achieve equity in the future. This exchange of the resource for capital of those who subside on

the forest, however, is not viewed as best practice to Ecological Economists. The cause of generational inequity, to Ecological Economists, is a matter of distribution and non-commitment to transfer of resources to future generations. As Venkatachalam discusses, this uncommitted resource preservation for future generations is a result of property right endowments, income, and intergenerational preference. The two economic models both have a respect for the need of sustainability and intergenerational equity. These two concepts represent one of the greatest challenges of economics within the 21st century. However the methods in which to achieve sustainability, and to what level of sustainability within forestry will be determined by policy rather than economics. The two different views on sustainability are either "strong sustainability" or "weak sustainability" (Brand, 2009). The concept of strong sustainability states that natural capital is complimentary to man-made capital and it is the obligation of the user to maintain the stock of both types of capital and this is often the sustainability measurement used by Ecological Economists. This is contrasted against the concept of weak sustainability, which determines sustainability is a function of utility maintained over multiple generations, with man made and natural capital as substitutable in essence and this is often presented as the path towards sustainability by Environmental Economists. This represents the origin of the critical natural capital discussion, as the infeasibility of maintaining all capital and substituting clean water for money as a matter of equity (Brand, 2009). Particular to forest resources is the concept of natural capital. A natural capital that performs "important and irreplaceable environmental functions" (Brand, 2009) is deemed to be critical natural capital. This concept has important regard within ecological economics, as the loss of a critical natural capital can severely harm an ecosystem's ability to function or can cause severe monetary costs.

Discussion

Forests were chosen to provide an example of economic valuation in environmental economics and ecological economics because of its unique stance as a resource and an ecosystem. This combination of factors makes the discussion of forest economics a well-placed divide between the two economic models, in which many factors of the forest can be provided as examples of the contrasting view of the two economic models. As well, forests represent a key factor in achieving global sustainability as they not only provide an economic resource but also a key service in biodiversity protection and mitigation of climate change through carbon sequestration. Since this plethora of values can be attributed to forests, the accurate assessment and determination of value is essential in decision-making and forest management policies (FAO, 2010). Various examples of how these two economic models may differ in terms of their treatment of forest resources have been provided, however it is still often a neo-classical approach that is used in forest management decision-making where the timber value is contrasted against the cost of extraction. For centuries this was the approved practice, however in recent decades this has proved to be a detrimental method (FAO, 2010). This leads to the question of which other model of economics would be best for forest management? Throughout this paper the two models of economics have been discussed in terms of their differences and how these may be relevant to the economic assessments of forest resources. However the overall relevance of the two individual models have only been briefly discussed. The necessity of the Environmental Economic model is apparent in its divergence from the Neo-Classical framework's inability to address important environmental issues of the 20th century. Continued resource degradation required a reevaluation of the role of resources and how economic theory should address the `market failure' that allowed it to happen. Both of the economic models previously discussed have a particular relevance in the 21st century and can be utilized to better reflect reality within economic theory. This, however, does not disregard the evolving structure and increasing niche diversification of the two different frameworks. While this has led to diverging philosophies and methods in recent decades, it is possible that the two frameworks will find themselves as a policy tool or a strategic planning tool respectively. They both have their niches within economics, and in particular with regards to natural resources and problems relevant to their management (Sahu, 1994). This niche diversification however does not apply equally to the concept of sustainability, which has gained prevalence in recent decade since the Brundtland Commission's publication of Our Common Future. The previous discussion of theoretical differences, treatment of resources, valuation differences, and intergenerational equity of forest resources are all relevant to the issue of sustainability. If one is to assume sustainability as a function of future generations having equal access to resources as present generations, the continued degradation and thermodynamic irreversibility of this degradation need special merit that is only provided through an Ecological Economic approach. The application of this theoretical difference in Ecological Economics will lead to a dramatically different valuation of resources, one that is required if future generations are to be considered. Extending beyond the valuation methods used for resources, it is also necessary that social institutions and their interactions within the economy and environment be considered in order to achieve sustainability. While Environmental Economics develops a strong relation between the environment and economy, it does not often consider the social component that influences resource use and allocation. This can lead to misinterpretation of sustainability indicators as well as a misunderstanding of preference, values, or perception of resources (Illge, 2009 & Ruth, 2006).

Conclusion

Despite the aforementioned utilization on sustainability, there is no clear benefit of one model over the other. Each has its own niche in economics and each has its own drawbacks. Particular problems may find themselves better solved through an Ecological approach to valuation, while other problems may find an Environmental approach more suited to the desired outcomes. However, it is clear that the two models have many differenees both constructed and inherent. These differences allow the two models to provide different, potentially complimentary, approaches in which to solve problems. This is in reference to scale of applications, which is a matter of high importance in the present decade, as problems have become more complex. The Environmental Economists typically pursue a reductionist view of the world, where segments can be observed independently in a mechanical fashion, the simpler and often more common environmental issues can be accurately reflecting with this method. However, the larger, more complex, and temporally significant environmental issues are best handled by the Ecological Economists, as their multi-disciplinary and value recognition approach is best suited to reflect the reality of the issue (Venkatachalam, 2007). The awareness of global environmental problems as well as local and regional environmental problems creates the need for this dichotomy. In the situation of local scale, small stakes, and clear problem definition Environmental Economics seems most applicable in its elegant functionality. However, the large scale, high stake, and institutionally complex problems an Ecological Economic approach will prove to be most applicable. The usefulness of one model in a particular situation does not preclude the existence of the differing models, but merely demands a discerned approach to application (Venkatachalam, 2007). However, recent decades have shown a widening gap in the two models. These differences have been highlighted and intensified through applications and attempts at sustainability economics. The philosophical differences, sustainability indicators, and perceptions of resource scarcity have been increasingly debated between the two schools of thoughts. As well, Venkatachalam recognizes the strong ideological positions from Ecological Economists create a difficulty in inter-disciplinary research. This combined with unresolved issues in other disciplines that ecological economics utilize in qualitative assessments, and the pluralistic approach that makes policy decisions difficult conflicts with the environmental economic approach of analytical rigor that has a sway with policy decisions (Venkatachalam, 2007). This combination of difficulties for ecological economics and relative effectiveness of environmental economics has widened the ideological gap further. Venkatachalam discusses potential avenues for the two economic models to converge into one effective and holistic model; this however is unlikely to occur in coming decades unless there is a dramatic shift in the outlook from the two schools of thought (Venkatachalam, 2007). The future for economics will see the increased importance of the two models discussed here. As the complexity and risk associated with environmental problems at all scales has increased through climate change, population growth, and other global issues the need for permanent resolution will become increasingly demanded. There is a likelihood of the continued recognition of interconnections between the economy and environment, which may increase the demand for economic models such as Ecological Economics that incorporate the social, environment, and economic relations into the assessments. However, it is unlikely that any large shift away from the neo-classical model will be achieved within the next few decades. This may have particular bearing on forest management in the next century. As the protection of biodiversity, old growth forests, ecosystem complexities, and forests has generally increased, policy makers will increasingly look for economic justification to account for the increasing political pressure. Since the Ecological Economic model will typically value forests higher than a standard neo-classical valuation or an environmental economic assessment there is little incentive for forest managers to utilize such an approach in resource valuation. Thus, it is unlikely that without stringent forest policy implementation the ecological methods of valuation and assessments will not be applied in forest management (FAO, 2010).

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