The valuation of non-market forest benefits in Ireland: a review

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Abstract
Forests are associated with the production of tangible market goods, most notably timber. However, trees and forests are also valued as providers of recreation and for the conservation and enhancement of biodiversity, among other environmental goods and services. Such benefits are undoubtedly important to the welfare of individuals but, as public goods, they are not traded and, as a result, not assigned a monetary price with which their value might be identified. Within the context of sustainable forest management, which calls for the balancing of forest outputs, the absence of a metric with which to compare benefits increases the uncertainty and complexity of forest management and decision making. A range of valuation techniques has been developed in recent decades, which offer the possibility of identifying the value of non-market forest benefits in monetary terms. This review describes the principle techniques and gives an overview of their use in an Irish context.

Keywords: *Non-market benefits, forest valuation, forest policy.*

Introduction

Forests vary considerably in their composition and, correspondingly, the benefits they can provide to society are diverse. This relationship is further complicated by the process of forest management that can both enhance or diminish the range and quality of the benefits supplied by forests (Mattsson and Li 1999). Planting a forest on agricultural land has the potential to either enhance or diminish existing biodiversity levels and may increase the recreational value of a given area (Buscardo et al. 2008, Bateman et al. 2003). Such impacts are not traditionally included in the calculation of the value of the afforestation enterprise, but may have a significant effect on societal welfare. The economically opaque nature of such benefits and costs can result in poor management decisions on the ground and a failure to account for them sufficiently in wider national and international policies. These failures can threaten the long-term sustainability of commercial activity and ultimately societal welfare (Costanza et al. 1997).

In an analysis of multi-use forest management, Hall (1963) lamented the fact that forest managers and policy makers were expected to be omnipotent in their decision-making, given the range of forest outputs they were expected to account for. Specifically in an Irish context, Convery (1970) recognised the difficulty of accounting for "unquantifiable" benefits such as conservation and recreation in economic planning of afforestation. Under the relatively new paradigm of sustainable forest management

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(SFM), individuals involved in forest management and policy formation are required to account for the diverse, and at times conflicting, demands that society places on the goods and services that forests provide. One of the specific challenges to this goal is the lack of a comparable currency with which the necessary trade-offs between forest outputs can be made. In particular, this complicates identifying how much timber production should be sacrificed in order to maintain or enhance other forest benefits.

One approach to accounting for non-market benefits is to identify a monetary value for them, thus making them comparable to those already identified and valued by existing markets. Where such values have been identified, specific policies can be analysed using cost-benefit analysis that accounts for wider, societal effects (Hanley and Spash 1993). How the monetary values of such benefits should be identified and quantified has become of significant concern to researchers in recent years, particularly in the context of SFM (Adamowicz 2003). Identifying a monetary value for the benefits of trees and forests can assist in forest management, particularly of state forests, and the allocation of state funds to ensure the production of particular outputs (Garrod and Willis 1992). Non-market valuation methods are now an important element of US environmental policy and have been incorporated into federal law (Portney 1996, Hanemann 2006). Policy makers in the UK also recognise these methods. This includes the UK Forestry Commission, which has employed biodiversity values in some of their forest management plans (Garrod and Willis 1997).

From the perspective of Irish forest policy, non-market valuation methods may be particularly beneficial as the majority of forests in Ireland are plantations, established with a variety of goals in mind during the previous century. In addition, Ireland's ambitious afforestation plan involves a large investment by the Irish state in a resource that has the potential to provide significant economic, social and environmental benefits to Irish society. However, the planning and management of these forests will dictate the type and magnitude of these benefits. Irish forest policy has been influenced by the diversity of forest outputs since its inception, both directly and indirectly, and a limited number of non-market valuation studies have been conducted, but the extent of their influence is difficult to gauge.

What are non-market forest benefits?

In simple terms, non-market forest benefits refer to the diverse range of goods and services produced by forests that are not traded in a market and thus, usually, have not been priced. Although the term benefits is most commonly used, both positive and negative forest outputs should be recognised in policy formation. In addition, negative values may be held by some proportion of society for what is, in general, viewed as an environmental improvement (Clinch 1999). It is generally recognised that the demand for such benefits has increased in recent decades (Bishop 1998). Given their diverse range and complexity, the recognition and quantification of all goods and services associated with forests is essentially impossible (Adamowicz and Veeman 1998). Therefore researchers most frequently concentrate on those that are considered the most important in terms of scale and/or value, such as those associated with biodiversity, recreation, carbon sequestration, water and landscape (Clinch 1999, Bateman et al. 2003, Willis et al. 2003). However, forests can also produce other,

sometimes more localised, outputs such as microclimate regulation, soil formation and stabilisation, the conservation (or destruction) of archaeology, the diversification of the rural economy and the absorption of pollution. Within these broad headings lie a variety of costs and benefits. For example, Pearce (1994) remarks that forests and forest management can impact on water directly by changing both its quantity and quality, in addition to being a potential controlling factor for pollution and sedimentation from other sources. The complexity of such benefits offers a significant valuation challenge as the available methodologies often treat complex multifaceted issues, most notably biodiversity, in a relatively simplistic manner (Nunes and van der Burgh 2001).

Many environmental goods possess the characteristics of being non-excludable and non-rivalrous, which have resulted in their exclusion from traditional markets that would normally dictate how a resource is exploited efficiently (Hanemann 2006). Rivalry, in economic terms, refers to the situation where the consumption of a good by one individual affects the ability of another to consume it. Many forest benefits are non-rivalrous; for example, individuals can derive value from the provision of habitat conservation or the sequestration of carbon by trees without affecting another's ability to experience the same benefit. Non-excludability refers to the situation where it is not possible to exclude an individual from consuming a good, for example it is impossible to prevent an individual from benefiting from carbon sequestration or from enjoying the external view created by a forest landscape. Weisbrod (1964) suggests that a clear distinction between private and public goods is not always possible and that a good may have elements of both depending on the perspective of the individual valuing it. It is important that these characteristics generally result in the absence of markets for many environmental benefits. In the absence of market derived price signals, environmental goods and services may be under- or oversupplied in relation to the demand of society.

The value of non-market benefits

Defining a concise concept of the nature of value has long troubled philosophers and economists. It is generally accepted, however, that something is considered valuable if a person is willing to trade something for it, either to gain or protect it, rather than solely measured by the price assigned by existing markets (Hanemann 2006). It is this idea that forms the basis of the methods adopted in valuing non-market benefits. In essence, studies that attempt to quantify the value of non-market benefits seek to identify the quantity of another good that an individual might trade to gain the benefit, while leaving them at the same level of welfare or utility (Pearce 2006). Although any tradable item could be employed for this measurement, using a monetary metric offers the advantage of being meaningful, recognisable and significant to most of society. Thus, most commonly, studies seek to identify the maximum amount of money that individuals might be willing to pay (WTP) to attain or protect the given benefit, either through directly surveying individuals or by attempting to reveal this value by analysing the behaviour of individuals in relation to the benefit. In this way the identified values are a reflection of the preferences of individuals for gaining or preserving an environmental good. It should be noted that an individual's willingness

to accept compensation for the loss of a benefit should also be a legitimate measure of value but this is a more difficult measure due to issues of ownership and the potential to encourage protest behaviour amongst individuals that are asked to state their valuation of the benefit (Arrow et al. 1994).

Such a definition of value is controversial as individuals may wish to secure the future of environmental resources for ethical and other non-economic reasons (Sagoff 1989). Although such beliefs may be reflected in WTP values, it is generally accepted that valuation may not meaningfully account for them (Bateman et al. 2003). Furthermore, even authors who champion such methods warn against using them as the sole decision-making instrument, particularly in a situation of irreversible biodiversity loss (Hanemann 1994). Thus, although it may be possible to identify the economic value of forest benefits and the preferences that the public holds for them, such values must be interpreted correctly and within the limits by which they are defined.

Extensive research has been conducted on both the definition and categorisation of the elements that make up value and the various tools that have been created or adapted with the purpose of measuring the value of environmental goods. Total economic value (TEV) can be used to categorise a set of values associated with an environmental good (Batemen et al. 2003). The concept of TEV offers a taxonomic deconstruction of the range of values associated with a given environmental asset. These values can be broadly divided into use and non-use values; i.e. values that an individual derives from the good through its consumption or use, directly or indirectly; and values that individuals derive through non-utilisation of the good. Possessing such a framework can assist in identifying the correct valuation approach for quantifying a given benefit and also assist in avoiding double counting of benefits (Pearce et al. 2006). Figure 1 displays the primary components of TEV and offers some forest related examples of each type of value.

Use values are, in general, more readily definable and encompass the value assigned through the direct consumption or experience of a resource, for example the value derived from recreating in a forest park and the indirect use of a forest for carbon sequestration. In a forestry context, many direct use values are associated with an established market and/or monetary exchange such as that for timber. Recreation

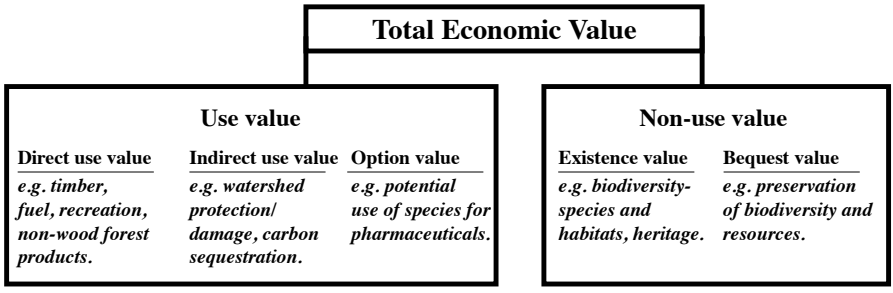

Figure 1: *The components of Total Economic Value with examples.*

can be associated with payments through entrance fees, but is often supplied freely to the consumer with the associated costs being covered by the forest owner and/or the state. Indirect use values are generally associated with the broad range of ecological services supplied by forests such as water catchment protection or damage, air pollution reduction, and the sequestering of carbon for the regulation of the global climate. Although these services are rarely marketed, they are often interlinked with marketed activities. Identifying the use values associated with forests, such as those associated with timber production or recreation, is now generally seen as a problem of data collection and appropriate analysis (Adamowicz and Veeman 1998).

In addition to direct and indirect use values, Weisbrod (1964) argued for the inclusion of option values in resource allocation decisions, citing national parks, hospitals and public transportation as examples of services where the option of future use is valued even if never fulfilled, i.e. individuals value having the ability to use these services in the future. Similarly future information or technology may create a new output from the use of a resource that did not previously exist; this is exemplified in the recently formed carbon credit markets.

Forests are valued beyond the consumption related goods that they provide. Focusing on their use values solely has the potential to severely underestimate their true contribution to societal welfare and could result in the gratuitous exploitation and loss of valuable resources. Non-use or passive-use values are more difficult to identify and more controversial, but are now accepted as a legitimate source of welfare (Arrow et al. 1993). Numerous additional names have been assigned to this set of values or its constituents but they possess the common characteristics of describing changes in welfare that are not associated with the use of a resource. Krutilla (1967) recognised existence value as the value that individuals possess for the continuing existence of a good, i.e. that the loss of a good will impact on the welfare of individuals who have no intention or possibility to exploit it in any way. Non-use values can be composed of a range of factors, such as intergenerational altruism (bequest value) based on the belief that there is an onus on present societies to provide for and protect future generations, and ideas of stewardship linked to our sense of duty to the environment and the interests of non-human elements. Such values may have much to do with the uncertainty with which future resources will be available (Krutilla 1967). Both Weisbrod (1964) and Krutilla (1967) noted the difficulty of capturing such values in existing markets, although the example of charitable donations is given, but suggest they should be accounted for in resource allocation.

In many situations maintaining biodiversity levels will be valued for their positive role in the production of traded goods. The importance of habitats, in particular tropical habitats, for the potential production of pharmaceuticals has been recognised and quantified previously (e.g. Mendelsohn and Balick 1995). Biodiversity also has a role in environmental services, such as soil conservation and water regulation. However, it is clear from international environmental policies that species and habitats are acknowledged to enhance human welfare by their very existence (Nunes and van der Burgh 2001). These values are starting to be recognised in the market directly through trading schemes and, of particular relevance to forestry, sustainable certification (Adamowicz and Veeman 1998). In general, however, such values are

excluded from existing markets and must be identified using non-market valuation techniques.

Non-market valuation methods

The failures of markets to account for the value of many essential resources has been recognised since the foundation of economics, but it was only in the last number of decades that researchers have developed methodologies to account for this shortcoming (Hanemann 2006). Both the nature of the benefits and the values that individuals hold for them depend on how the value of non-market benefits is identified. For example, a recreation visit to a forest has most frequently been valued, in the absence of an existing market, in relation to either the costs incurred by the individual in visiting the site or their stated willingness to pay for the visit in a hypothetical market. However, benefits associated with the existence of a species or habitat can be more complex and more controversial to value and rely on a more limited set of methods.

Methods for valuing non-market benefits are generally divided into three groups, the production function and other pricing methods, revealed preference methods and stated preference methods (Hanley and Spash 1993, Pearce 2006). The process of adapting previously derived values to new sites or services is increasingly employed as a cost-effective form of valuation, known as benefit transfer (Brouwer 2000). These methods differ fundamentally in how their result can be interpreted and the approach that they adopt in identifying monetary values.

Production function and pricing methods

Where forest benefits act as inputs to the production of a market good, the benefits can be valued in terms of their contribution to this production. Such an approach is often used to measure the services provided by ecosystems that impact on the welfare of society, as reflected in the production of goods that have an established market price. Such an approach is reliant on the effect of the environmental resource on the production-function of the market good being observable and quantifiable. Barbier (2000) describes the contribution of the area of mangrove forests to the production function of fisheries in Thailand and Mexico, i.e. how a change in the area of mangrove might influence the output of commercial fisheries. Where an existing market for the output does not exist, values can be derived using other valuation methods (Pearce 2006). For example, Clinch (1999) valued the effect of the Irish afforestation plan on water availability as the lowest cost associated with replacing the volume of water lost as a result of expanding forest cover, in this case as the cost of repairs to the water network. Researchers also use the cost of avoided damage as a measure of a benefit. An example might be the contribution of a wetland area or bog to the reduction of the scale of a flooding event and the cost of the damage to private property.

Bateman et al. (2003) argue that pricing methods do not capture value as such, since they do not identify public preferences or the demand for the given benefit, but rather identify a price for the benefit as reflected in a market good. Thus, the monetary value such methods derive may only be a partial reflection of the utility value of the benefit. Furthermore, such methods require that the relationship between

an environmental and market good can be identified and quantified in a meaningful way, which may be impossible for many benefits (Pearce et al. 2006).

Revealed preference methods

Revealed preference methods describe the set of non-market valuation methods that identify the value of a non-market resource by examining related market based activity (Bishop 1998). As a result, such methods are principally limited to the analysis of use values, by their nature, and are most commonly employed to identify recreational benefits. In addition they cannot, in themselves, be employed to value future resources, although values may be transferred from comparable studies. Nevertheless, although constrained in their applicability, revealed preference methods are often preferred by researchers as they are based on actual behaviour and may, therefore, be less susceptible to the potential hypothetical bias in stated preference data. The two common forms of revealed preference methods are the travel cost method and hedonic pricing.

Travel cost method

The travel cost method (TCM) is based on an assumption of weak complementarity between an environmental resource, such as a forest park, and the cost accrued in travelling to or accessing the resource (Bateman et al. 2003). This is reflected in the observation that individuals living further from a site are expected to visit it less often due, in part, to the higher cost involved. Information is gathered by surveying visitors to identify where and how they travelled to the site and, potentially other visit-related costs. The concept of using travel costs to capture the recreational value of natural resources dates back to the 1940s (Hanemann 2006). The history of TCM is closely linked with forest recreation and it has been used extensively to value the recreational benefits of forest parks (Zandersen and Tol 2009). Traditionally, TCM studies are divided between those that survey individuals on site or that survey individuals from populations surrounding a particular site, known as individual and zonal TCM, respectively. Both approaches attempt to create a demand curve for the site of interest. However, the zonal method may give a more accurate depiction of visitation across the population as it also gathers data on non-users. An increasingly popular approach is to interpret and model visitation as a choice amongst alternatives, including the option of not visiting, which is known as a random utility approach. Although TCM methods focus on existing sites, by ascertaining how individuals would change their behaviour (increased/decreased visitation) in response to a change in the quality of a site, these travel costs can be used to value future changes (e.g. Hynes and Cahill 2007).

Hedonic pricing

Hedonic pricing (HP) decomposes a private good into a selection of attributes that are identified as impacting on its price. These attributes can include those relating to the surrounding environment (Pearce et al. 2006). House prices are most commonly employed in environmental studies. A large amount of data about the characteristics

of houses, their location and the price they attained are gathered. Prices can then be modelled against these characteristics and the contribution of a public good, such as open space, forests or air quality, to the price of a house can be identified. The way in which these resources are included in the model differs and this affects the interpretation of the results. Both local forest cover and the distance between houses and forests have been included in models (Powe et al. 2007, Tyrvainen and Miettinen 2000). In general, forests are found to have a positive effect on house prices, but this may depend on forest composition. Garrod and Willis (1992) found that the area of broadleaf forests increased house prices whereas conifer forests had the opposite effect.

The HP method requires the collection of large amounts of data of sufficient quality and detail to avoid issues related to multi-collinearity, i.e. where two or more explanatory variables are correlated. In addition, the values attained from such studies can only be interpreted in the context of the private goods being modelled. The identified values are usually interpreted in relation to the effects of forests on landscape quality, but may also capture recreational benefits.

Stated preference methods

Some important forest benefits are not associated with existing behaviour or the production of other goods and so present a particular challenge to value through revealed preference or other methods. Valuation methods that survey individuals to ascertain directly their willingness to pay for a benefit, or willingness to accept compensation for its loss are described as stated preference valuation methods (Mitchell and Carson 1989). Such methods offer greater flexibility in the type of benefits and values they can quantify. In particular when examining non-use values associated with the existence or maintenance of biodiversity, stated preference methods may offer the only valuation alternative (Nunes and van der Burgh 2001). Ciriacy-Wantrup (1947) is credited as being one of the first to suggest using the willingness to pay of individuals as a measure of the value of a public good, in this case regarding soil conservation projects. Even at this early stage a number of potential weaknesses of the methodology were identified and survey design was highlighted as an important issue in combating strategic behaviour in reaction to suggested taxation changes.

Stated preference methods are generally composed of three sections (Portney 1994). Firstly, respondents are presented with a description of the good or policy in question; this should include the extent of the change of interest, how it will be managed and how respondents will fund it, as well as reminding them about the effect of this on their individual or household budget. Secondly, respondents are presented with the payment question, which can take a number of forms. Respondents may be asked to state the highest amount they would pay for the good, presented with the good and a monetary amount and asked whether they would pay or not; or presented with a range of different composite goods with differing costs and asked to choose their preferred one. In the final section, respondents are usually asked a number of socio-demographic and attitudinal questions to help to explain the choices of respondents.

Such methods are highly adaptable as they create hypothetical markets in which individuals can express their preferences, but for the same reason have been criticised

as being arbitrary measures of attitudes (Diamond and Hausman 1994). The quantity and quality of information given to respondents, the method of elicitation, and the range and order of choices presented to respondents are some examples of contextual issues which have been found to influence expressions of preference and value (Gregory et al. 1993). However, these methods are recognised as producing meaningful estimates of values, including non-use values, when conducted following accepted guidelines (Arrow et al. 1993). Given their flexibility and the scope of values that they can investigate, stated preference valuation methods have been employed extensively to value forest benefits (Barrio and Loureiro 2009, Meyerhoff et al. 2009). Traditionally, stated preference methods have been divided into those that ascertain values for single benefits, contingent valuation methods and those that present a selection of alternative composite benefits and derive values for the components of those alternatives, choice experiments.

Contingent valuation

Contingent valuation (CV) studies present a single change in a good or service to a relevant sample of the population and derive a value for it directly through surveying (Mitchell and Carson 1989). A variety of techniques for attaining this value have been employed, including open-ended questions which ask respondents to state their maximum valuation; referendum style questions which present a value to respondents and ask them if they agree or not to the payment; and payment card type questions which present a selection of monetary values to respondents and ask them to choose one. Each of these methods have their strengths and weaknesses but the referendum style of questions have been recommended on the grounds that they may reduce bias and strategic behaviour on the part of respondents (Arrow et al. 1993).

Early CV studies focused on recreational values, such as the value of hunting (e.g. Davis 1963, Bishop and Heberlein 1979). However, CV studies became more ambitious in the types of goods and values that they investigated and were recognised in US federal law in the 1980s leading to greater examination of the methodology (Portney 1994). This resulted in a report commissioned by the National Oceanic and Atmospheric Administration in the US on the legitimacy of the methodology and the values that it claimed to measure (Arrow et al. 1993). Such studies have now become common in the literature examining forest benefits at the forest, local and national levels (Lindhjem 2007, Barrio and Loureiro 2009).

Discrete choice experiments

In a discrete choice experiment (DCE) respondents are presented with a selection of alternative goods or policies and asked to choose their most preferred (Hensher et al. 2005). These alternatives are composed of a number of attributes that are combined through experimental design methods so that the relative effect of each attribute on preferences for alternatives can be identified in the modelling process (Carson and Louviere 2011). Through the inclusion of a cost related attribute the trade-off that respondents might make between attaining an attribute change and foregoing an amount of money can be identified (Hanley et al. 1998). Adamowicz et al. (1994) are credited with conducting one of the first environmental choice experiments in their

study of hunter preferences and this method has become increasingly popular in the literature examining non-use forest values (Meyerhoff et al. 2009).

DCEs have the significant advantage over CV in that they can produce a range of values for marginal changes in the composite attributes of the good (Hanley et al. 1998). In addition, DCEs may be more similar to respondents' day-to-day activities as they present a selection of alternative goods rather than an all-or-nothing choice, so they may reduce the risk of respondents rejecting the task in comparison to CV (Adamowicz et al. 1998). However, DCEs may place a greater cognitive burden on respondents than CV as they are required to make a series of relatively complex decisions. In addition, studies generally focus on the production of values for marginal changes to the attributes of goods or policies rather than their total value (Hanley et al. 1998).

Benefit transfer

Values derived from one site or for one benefit may be used to value a similar good through a process known as benefit transfer, where the value or the function derived to produce the value is transferred to a similar site (Brouwer 2000). Benefit transfer is reliant on the existence of suitable, comparable studies but may also be considered a methodology in itself. The primary advantage of this approach is the cost-effectiveness with which values can be produced (Brouwer 2000). A potential short-coming of the method is the generation of inaccurate values due to differences in the characteristics of the goods or the individuals valuing it (Ready et al. 2004).

Non-market benefits and Irish forest policy

Sustainable forest management (SFM) has been adopted as the central concept in Irish forest policy (DAFF 1996). This policy recognises the wide selection of forest outputs demanded by society, both market and non-market. Although SFM is considered a new development in Irish forest policy, non-market forest benefits did play a role in the past. State driven afforestation was often a political issue driven by concerns for domestic timber supply and rural development and employment (OCarroll 2004). Although such issues are related to economic activity, they are rarely accounted for in market derived prices and hence required state intervention to achieve them. As early as 1908, a Departmental Committee on Irish Forestry recommended that State forest development should take account of the "wider and less direct results of forestry, to its great influence upon the whole prosperity of rural districts and industries and to its social, economic, climatic and other national bearings" (Gray 1963).

A report prepared for the FAO in 1950 suggested Ireland should divide its policy in two parts, with one focusing on commercial forestry and the other on social forestry with an emphasis on rural development and employment in the west of Ireland (Cameron 1951). Although this suggestion was never officially adopted as policy, emphasis was placed on developing forestry in western counties in proceeding policies (OCarroll 2004). Gray (1963) suggested that the development of forest policy since the start of the 20th century may have been more concerned with wider forest benefits (self-sufficiency in timber supply, rural development and employment etc.) than considerations of financial return. Although such benefits were often mentioned,

early forest policy failed to formally identify the range of benefits that the forest estate might produce (Convery 1970).

A number of financial analyses of forestry have been conducted in Ireland but although many identify non-market benefits, few actually account for them (a previous review can be found in Clinch 1999). The first monetary value assigned to such benefits in official policy appears to be in the government's strategic plan with a suggestion that "external benefits" from existing forests produce an annual output of €26.6 million (£21 million) (DAFF 1996). However, little explanation of this figure is offered other than relating it to potential timber value. The benefits mentioned include landscape, amenity, wildlife habitat, tourism and recreation. Similarly, Bacon (2003) assigned a value of €7.97 million to "leisure amenity and non-atmospheric environmental benefits" from the planting of 20,000 ha of forestry per year, calculated as 10% of the timber benefits. Bacon (2004) noted the lack of available Irish data on forest non-market benefits and included a recommendation that more research be conducted on forest valuation, in particular in relation to different management approaches.

Most Irish valuation studies have focused on the recreational benefits supplied by existing forests. Murphy and Gardiner (1983) conducted what appears to be one of the first attempts at valuing non-market forest benefits in Ireland. This study employed a form of CV to quantify the annual recreational value of Portumna Forest Park, described as being "under multiple-use management for timber production, recreation and wildlife habitat conservation", with a value of €7,199.77 (£5,670.28). The same authors describe a separate study that compared six different valuation methods, including forms of travel cost and stated preference methods (Murphy and Gardiner 1984). Although these studies were limited to relatively small sample sizes, single sites and recreation values, they mark a growing awareness of non-market values in forest management in Ireland and a change in the approach to identifying them.

The CAMAR study was one of the first attempts to quantify non-market forest benefits in Ireland on a national level (Ní Dhubháin et al. 1994). The study was ambitious in its scope and included both CV and TCM approaches at 13 forest sites across the Republic of Ireland to measure the value of a recreation visit. Using the CV data from that study, Scarpa et al. (2000) incorporated forest attributes into the modelling of WTP. Their study identified higher WTP values for forests with nature reserves and larger areas of broadleaves and deciduous conifers. This demonstrates that preferences and values held by the Irish population for forest-based recreational experiences are related to the composition and management approaches adopted in individual forests. Bacon (2004) derived the value of forest recreation by combining a value of €3.34 per person per visit, based on a UK model, and an estimation of 11 million forest visits annually. The annual visitation figure is derived by assuming an annual increase of 3% on the figures identified by Clinch (1999). The report also arrives at €79 million as a maximum recreational value if all forests, were transformed to the hypothetical ideal recreation forests composed primarily of broadleaves with some diverse conifers. Fitzpatrick (2005) conducted a household postal and an onsite survey of forest trail use and included a CV question in both examining willingness to pay per visit. The postal survey derived a WTP of €3.64 per visit, including non-

users, from the sample of 441 who returned the questionnaire. An average value of €5.42 per forest visit was derived from the data collected on site at 12 forests. It is worth noting that mean WTP ranged from €3 to €8 depending on site. At the level of individual forests, Hynes et al. (2007) identified average travel cost as €7.36 and a consumer surplus of €12.33 for recreational visits to two urban fringe forests in Co. Galway using an individual travel cost method. The authors suggested that the location of the forest may explain the relatively large figure. Of particular relevance to the valuation of recreation are data on visitation rates. Table 1 summarises the available figures on national forest visitation rates per year from previous studies.

The government strategy to increase forest cover to 17% by 2030 (DAFF 1996) has also been the focus of a number of economic studies. Of perhaps most significance was the study by Clinch (1999), which included values for a range of non-market costs and benefits. A value was identified for the combined recreation, biodiversity and landscape benefits using a survey-based CV question. Individuals who were not supportive of the scheme were also given the opportunity to state whether they would be willing to pay to "avoid an increase in forestry". A reduction in water availability was valued as the equivalent replacement costs as a result of repairing water pipes and amounted to €2.54 million (£2 million) for the scheme. It was assumed that the eutrophication of water bodies would occur as a result of fertilisation, which was valued as a cost of €25.40 (£20) ha^{-1} based on a UK study. It was suggested that acidification would be avoided if appropriate planning and management procedures were followed and thus the cost was internalised. Carbon sequestration was valued at an assumed permit price of €19.05 (£15) t^{-1} C. Bacon (2004) derived biodiversity values from figures produced by Garrod and Willis (1997) for the conversion of remote conifer plantations in the UK, although reference was also made to the cost of biodiversity enhancement areas. The study also recognised landscape, water quality, health and heritage benefits and costs but did not quantify them.

Of particular importance to Irish forestry, given its high proportion of plantations, is the interaction of forest management and planning impacts and the values held by the public for the benefit provided for these forests. As part of the CAMAR study

Table 1: *Annual forest visit figures suggest a positive trend over time, although they are derived using different methods.*

Annual Forest Visits (millions)	Reference	Source
2.0	Ní Dhubháin et al. (1994)	Estimates from Forest Service and forest managers
8.5	Clinch (1999)	Household (7.7 m) and tourist (0.8 m) survey data
11.0	Bacon (2004)	Clinch (1999) data with assumed annual increase in demand of 3%
17.5	Fitzpatrick (2005)	Based on ESRI recreational trail walking data

(Ní Dhubháin et al. 1994), a household survey was conducted to investigate how the type of land on which forests would be established impacted on the values expressed by the public for forest expansion. They found that WTP was significantly higher for afforestation on marginal farmland rather than peatland, which was described as supporting higher levels of biodiversity. Clinch (1999) conducted an additional survey to identify the public's WTP for the afforestation programme to be conducted with broadleaves rather than conifers, which was valued on average at €13.26 (£10.44) for 10 years. Hynes and Cahill (2007) investigated how the inclusion of a wildlife viewing hide and a sculpture garden might increase the value of a small forest in Galway. Respondents were asked how their current visitation level would change as the result of the introduction of the hide and garden. They identified a value of €36.00 and €29.53 per person per year for the hide and garden, respectively. One of the few Irish studies to investigate the value of forest biodiversity examined recreationists WTP for different replanting strategies (mixed species, "natural" broadleaf, Scots pine (*Pinus sylvestris* L.) in comparison to Sitka spruce (*Picea sitchensis* (Bong.) Carr.) using CV (Mill et al. 2007). As part of the study respondents were asked to answer the question either from a personal or social perspective with the broadleaf and mixed options being most favoured by those taking a personal perspective.

It is important to note that many of the studies focus on a target forest cover of 17%, which was initially envisaged to be achieved by 2030. There has been a decline in planting rates in recent years that has been attributed to a number of factors, including competition from agricultural enterprises, land-use limitations imposed by agricultural and social schemes, uncertainty over future agricultural and forestry policy and cultural impediments to forestry adoption by farmers (Collier et al. 2002, McCarthy et al. 2003, Malone 2008). Lower planting rates obviously require a reinterpretation of derived values for benefits. At the same time, the composition of afforestation has changed significantly in recent years, with an increase in the use of species mixtures and broadleaf species. For example, 38% of the land planted in 2010 was composed of broadleaf species (Forest Service 2010). Such changes will affect public preferences and valuation of afforestation, which again would require a re-evaluation of the figures derived by previous studies. Increasing environmental restrictions will reduce potential costs associated with afforestation and the implementation of environmental enhancement measures are likely to be valued positively by the public. Thus the dynamic nature of forest policy poses a challenge to the interpretation of values that are often derived from one-dimensional studies.

In broader terms, moves to increase the production of non-market forest benefits (NMFB) may have unaccounted consequences. The imposition of stricter environmental controls has been suggested as a further disincentive to private landowners establishing forests (Collier et al. 2002) and public access to private property is recognised as a contentious issue in Ireland. From the perspective of enhancing the production of NMFB, this is clearly a dilemma in that measures that increase them in an individual forest may reduce the total amount of land converted to forest. If afforestation remains solely an activity of private landowners, and if the supply of NMFB is to be increased, this dilemma is likely to persist.

Ensuring that landowners, foresters and local communities understand the

diverse range of forest benefits may be one approach to maintaining and increasing their production. Primarily this is an issue of education and research. The potential contribution of forests to tourism may translate NMFB to a tangible direct income for local communities. Clinch (1999) found surprisingly high forest visitation rates amongst tourists and a general willingness to pay entrance fees. Additionally, private land owners could be paid directly for the public goods that originate in their property, thus incentivising their production or at least compensating for potential lost revenue from not maximising commercial activity. In an Irish context, it is worth noting that an additional barrier to farmers planting forestry is the perceived productionist mind-set of some, where land should be used for the production of food (McDonagh et al. 2010). The extent of this belief structure is difficult to gauge but the offer of financial compensation for limiting commercial activity may not in itself counteract this belief. In addition, the limitation of public access to private forests and land is unlikely to be motivated by a concern for financial loss alone. Nonetheless, the popularity of the rural and forest environmental protection schemes display the potential demand by farmers for such policies. From a forestry perspective, an examination of the success of the FEPS scheme in in encouraging afforestation and increasing NMFB would be worthwhile.

Conclusions and practical implications

Non-market benefits are increasingly recognised in national and international forest policy, but comparing them to those already traded in a market poses a significant challenge. A recognised approach is monetary valuation, particularly the use of stated and revealed preferences methods. Revealed preference methods have the advantage of being connected to actual behaviour, but lack the ability to value non-use benefits. Stated preference methods are more flexible but have been criticised as being potentially unreliable due to the hypothetical nature of the questions.

Irish valuation studies have been limited, but do include examples of both forms of valuation. Irish forest policy has changed significantly in recent years to take account of more diverse outputs, but relatively little information has been gathered as to how the general public value these changes. Further research into valuation methods is warranted given the general lack of existing Irish studies and the recognition of such values in forest standards. Studies that explore the connection between forest management and public valuation would be of particular benefit in assisting the incorporation of public preferences into management decision-making on the ground.

The main practical implications from the study are:

- Non-market forest benefits are being increasingly recognised in forest policy and management. The quantification of these benefits in monetary terms is likely to become more common as a method of comparing them to market benefits such as timber.
- The recognition of NMFB has resulted in the inclusion of environmental enhancement procedures in forest planning and management and in restrictions on practices and on afforestation in specific areas.
- It is important to note, however, that such benefits are important contributors to State and public support for afforestation and have the potential to offer

opportunities to forest owners to diversify forest outputs. However, questions exist as to how and to what extent NMFB should be encouraged in schemes that promote forest establishment for timber production by private landowners.

- The valuation of NMFB offers the capacity to quantify their value to society in a recognised way and may assist in the goal of sustainable forest management.

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References

Adamowicz, W., Louviere, J. and Williams, M. 1994. Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management* 26: 271-292.

Adamowicz, W., Louviere, J. and Swait, J. 1998. *Introduction to Attribute-based Stated Choice Methods*. Final Report to Resource Valuation Branch, Damage Assessment Center, NOAA, U.S. Department of Commerce, p. 44.

Adamowicz, W. and Veeman T. 1998. Forestry policy and the environment: changing paradigms. *Canadian Public Policy* 24: S51-S61

Adamowicz, W. 2003. Economic indicators of sustainable forest management: theory versus practice. *Journal of Forest Economics* 9: 27-40.

Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R. and Schuman, E.H. 1993. *Report of the NOAA Panel on Contingent Valuation*. Washington, DC: Resources for the Future.

Barbier, E.B. 2000. Valuing the environment as input: review of applications to mangrove-fishery linkages. *Ecological Economics* 35: 47-61.

Barrio, M. and Loureiro, M.L. 2010. A meta-analysis of contingent valuation forest studies. *Ecological Economics* 69: 1023-1030.

Bateman, I.J., Lovett, A.A. and Brainard, J.S. 2003. *Applied Environmental Economics: a GIS Approach to Cost-benefit Analysis*. Cambridge University Press, Cambridge, pp 335.

Bishop, R. and Heberlein, T. 1979. Measuring values of extramarket goods: are direct measures biased? *American Journal of Agricultural Economics* 61: 926-930.

Bishop, J. 1998. *The Economics of Non-timber Forest Benefits: An Overview*. International Institute of Environment and Development, London.

Brouwer, R. 2000. Environmental value transfer: state of the art and future prospects. *Ecological Economics* 32: 137-152.

Buscardo, E., Smith, G., Kelly, D., Freitas, H., Iremonger, S., Mitchell, F., O'Donoghue, S. and McKee, A.-M. 2008. The early effects of afforestation on biodiversity of grasslands in Ireland. *Biodiversity and Conservation* 17: 1057-1072.

Bacon, P. 2003. *Forestry: A Growth Industry in Ireland*. Available at http://www.coillte.ie/fileadmin/templates/pds/BaconReport.pdf. [Accessed August 2012].

Bacon, P. 2004. *A review and appraisal of Ireland's Forestry Development Strategy, Final Report*. Stationary Office, Dublin.

Cameron, D.R. 1951. Report on forestry mission to Ireland. *Irish Forestry* 8: 60-66.

Carson, R. and Louviere, J. 2011. A common nomenclature for stated preference elicitation approaches. *Environmental and Resource Economics* 49: 539-559.

Davis, R. 1963. Recreation planning as an economic problem. *Natural Resource Journal* 3: 239-249.

Ciriacy-Wantrup, S.V. 1947. Capital returns from soil conservation practices. *Journal of Farm Economics* 29: 1180-1190.

Clinch, J.P. 1999. *Economics of Irish Forestry: Evaluating the Returns to Economy and Society.* COFORD, Dublin.

Collier, P., Dorgan, J. and Bell, P. 2002. *Factors Influencing Farmer Participation in Forestry.* COFORD, Dublin.

Convery, F. 1970. Forestry and Irish economic and social development. *Irish Forestry* 27(2): 52-67.

Department of Agriculture, Food and Forestry. 1996. *Growing for the future: a strategic plan for the Development of the Forestry Sector in Ireland,* Dublin.

Diamond, P.A. and Hausman, J.A. 1994. Contingent valuation: is some number better than no number? *The Journal of Economic Perspectives* 8(4): 45-64.

Fitzpatrick, J. 2005. *The Economic Value of Trails and Forest Recreation in the Republic of Ireland*. Available at www.coillte.ie/fileadmin/templates/pdfs/Final%20Economic%20Study%20of%20Trails.pdf [Accessed August 2012].

Forest Service. 2010. *Afforestation Statistics 2010*. Government of Ireland. http://www.agriculture.gov.ie/forestservice/forestservicegeneralinformation/foreststatisticsandmapping/afforestationstatistics/ [Accessed August 2012].

Garrod, G.D. and Willis, K.G. 1992. The environmental economic impact of woodland: a two-stage hedonic price model of the amenity value of forestry in Britain. *Applied Economics* 24: 715-728.

Garrod, G.D. and Willis, K.G. 1997. The non-use benefits of enhancing forest biodiversity: a contingent ranking study. *Ecological Economics* 21: 45-61.

Gray, H.J. 1964. The economics of Irish forestry. *Journal of the Statistical and Social Inquiry Society of Ireland* 21: 18-44.

Gregory, R., Lichtenstein, S. and Slovic, P. 1993. Valuing environmental resources: a constructive approach. *Journal of Risk and Uncertainty* 7(2): 177-197

Hall, G.R. 1963. The myth and reality of multiple use forestry. *Natural Resource Journal* 3: 276-290.

Hanemann, W.M. 1994. Valuing the environment through contingent valuation. *Journal of Economic Perspectives* 8:19-43.

Hanemann, W.M. 2006. The economic conception of water. In *Water Crisis: Myth or Reality?* Eds. Rogers, P.P., Llamas, M.R. and Martinez-Cortina, L., Taylor and Francis, London.

Hanley, N. and Spash, C.L. 1993. *Cost-benefit Analysis and the Environment*. Edward Elgar Publishing Ltd, Cheltenham.

Hanley, N., Wright, R. and Adamowicz, V. 1998. Using choice experiments to value the environment. *Environmental and Resource Economic*s 11: 413-428.

Hensher, D.A., Rose, J.M. and Greene, W.H. 2005. *Applied Choice Analysis: A Primer.* Cambridge University Press, Cambridge , New York.

Hynes, S. and Cahill, B. 2007. Valuing the benefits to the local community of supplying recreational facilities in community owned forests: an application of the contingent behaviour method. *Small-scale Forestry* 6: 219–231.

Hynes, S., Cahill, B. and Dillon, E. 2007. Estimating the amenity value of Irish woodlands. *Irish Forestry* 64: 17-31.

Krutilla, J. 1967. Conservation reconsidered. *The American Economic Review* 57(4): 777-786.

Lindhjem, H. 2007. 20 years of stated preference valuation of non-timber benefits from Fennoscandian forests: A meta-analysis. *Journal of Forest Economics* 12: 251-277.

Malone, J. 2008. Factors Affecting Afforestation in Ireland in Recent Years. Available at www.agriculture.gov.ie/media/migration/forestry/malone.doc [Accessed: 20/09/10].

Mattsson, L. and Li, C.-Z. 1994. How do different forest management practices affect the non-timber value of forests?-an economic analysis. *Journal of Environmental Management* 41: 79-88.

McDonagh, J., Farrell, M., Mahon, M. and Ryan, M. 2010. New opportunities and cautionary steps? Farmers, forestry and rural development in Ireland. *European Countryside* 2: 236-251.

Mendelsohn, R. and Balick, M. 1995. The value of undiscovered pharmaceuticals in tropical forests. *Economic Botany* 49: 223-228.

Meyerhoff, J., Liebe, U. and Hartje, V. 2009. Benefits of biodiversity enhancement of nature-oriented silviculture: Evidence from two choice experiments in Germany. *Journal of Forest Economics* 15:37-58.

Mill, G.A., van Rensburg, T.M., Hynes, S. and Dooley, C. 2007. Preferences for multiple use forest management in Ireland: Citizen and consumer perspectives. *Ecological Economics* 60: 642-653.

Mitchell, R. and Carson, R. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Resources for the Future, Washington D.C.

Murphy, W. and Gardiner, J. 1983. Forest recreation economics. *Irish Forestry* 40: 12-19.

Murphy, W. and Gardiner, J. 1984. Measuring values in recreation: six different approaches. *Irish Forestry* 41: 36-44.

Ní Dhubháin, Á., Gardiner, J., Davies, J., Hutchinson, G., Chilton, S., Thomson, K., Psaltopoulos, D. and Anderson, C. 1994. *The Socio-economic Impact of Afforestation on Rural Development*, CAMAR, European Union.

Nunes, P. and van den Bergh, J. 2001. Economic valuation of biodiversity: sense or nonsense? *Ecological Economics* 39: 203-222.

OCarroll, N. 2004. *Forestry in Ireland - A Concise History*. COFORD, Dublin.

Pearce, D.W. 1994. Assessing the social rate of return from investment in temperate zone forestry. In *Cost-benefit Analysis*. Second edition. Eds. Layard, R. and Glaister, S., Cambridge University Press, Cambridge, pp. 464–490.

Pearce, D., Atkinson, G. and Mourato, S. 2006. *Cost-Benefit Analysis and the Environment: Recent Developments*. OECD, Paris.

Portney, P.R. 1994. The contingent valuation debate: why economists should care. *Journal of Economic Perspectives* 8 (4): 3-17.

Powe, N.A., Garraod, G.D., Brunsdon, C.F. and Willis, K.G. 1997. Using a geographic information system to estimate an hedonic price model of the benefits of woodland access. *Forestry* 70: 139-149.

Ready, R., Navrud, S., Day, B., Dubourg, R., Machado, F., Mourato, S., Spanninks, F., and Rodriquez, M. 2004. Benefit transfer in Europe: how reliable are transfers between countries? *Environmental and Resource Economics* 29: 67-82.

Sagoff, M. 1988. *The economy of the Earth*. CUP, Cambridge.

Scarpa, R., Hutchinson, W.G., Chilton, S.M. and Buongiorno, J. 2000. Importance of forest attributes in the willingness to pay for recreation: a contingent valuation study of Irish forests. *Forest Policy and Economics* 1: 315-329.

Tyrvainen, L. and Miettinen, A. 2000. Property prices and urban forest amenities. *Journal of Environmental Economics and Management* 39: 205-223.

Weisbrod, B.A. 1964. Collective consumption services of individual consumption goods. *Quarterly Journal of Economics* 77: 71-77.

Willis, K., Garrod, G., Scarpa, R., Powe, N., Lovett, A., Bateman, I., Hanley, N. and Macmillan, D., 2003. *The Social and Environmental Benefits of Forests in Great Britain*. Forestry Commission, Edinburgh.

Zandersen, M. and Tol, R.S.J. 2009. A meta-analysis of forest recreation values in Europe. *Journal of Forest Economics* 15: 109-130.