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WOODLAND WEALTH APPRAISAL FOR THE EAST OF ENGLAND: UPDATE 2010

REPORT TO THE FORESTRY COMMISSION (EAST OF ENGLAND)

Researched by :
The Countryside and Community Research Institute
Dunholme Villa
The Park
Cheltenham
GL50 2RH
www.ccri.ac.uk
Edited by the Forest Commission.

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EXECUTIVE SUMMARY

The Woodland Wealth Appraisal is an attempt to put a monetary value on the 'natural benefits' which the existing woodland in the East of England provides. These natural benefits provided by environmental assets are often difficult to quantify, but they underpin the welfare of society in its widest sense, that is -human welfare and its supporting economy. This Woodland Wealth Appraisal, carried out by the Countryside and Community Research Institute (part of the University of Gloucestershire) in 2010, updates and builds on a similar study published in 2003.

Woodland has a role in providing valuable opportunities to benefit human health and well being, our economic sustainability, maintaining environmental assets and addressing the imperatives driven by climate change. The estimated value of woodland in the East of England is put at of ***£1.3 billion****, this is a midpoint value estimate and represents the annual level of wealth generated by forest and woodland each year.*

CLIMATE CHANGE

Adaptation and mitigation

Trees have a very important role to play in climate change. Trees take carbon from the atmosphere and store it. There it will remain until the tree is felled for fuel or for timber. If for timber it may well get locked away in a building or product for years. Its role in adaptation is also important urban trees have a cooling effect, remove pollutant particles from the air and trees can also slow down flooding and provide shade along river banks, which, as weather may be warmer will be important for fish. Wood is important as an energy source and is vital for displacing the use of carbon intensive materials such as iron, steel and concrete in construction.

One estimate suggests the maximum rate of carbon accumulation in woodland in the UK is 10 tonnes of carbon per hectare per year (tC/ha/yr), and the average over a full commercial rotation is closer to 3tC/ha/yr .Forest and woodlands account for around 80% of the vegetation carbon stock in the UK. Forest soils also sequester an average of around 110Kg of carbon/hectare/year and plant matter is the single most important source of carbon in the soil. Soil carbon can be increased by planting native hardwood species.

Carbon uptake associated with existing woodland in the East of England, (assuming a uniform age distribution) is estimated to be 484 thousand tonnes of Carbon Dioxide per hectare per year (kt/CO2/ha/yr) for conifer woodland, and 527 kt/CO2/ha/yr for broadleaf woodland (or, a total of 1.1 million tonnes CO2/yr), excluding soil carbon sequestration. In 2010 the value for the annual increment in carbon sequestration is just under ***£60 million per year****, rising in value to* ***£342 million*** *per year by 2070. The estimated stock of carbon locked up in the woodlands and trees is estimated to have a total present value of* ***£3.534 billion*** *based on the current stocking level with values rising over time in line with the predicted increases in the value of the traded price of carbon.*

Renewable energy

Wood is a clean renewable carbon lean energy source. It is estimated that currently 8.1% of the East of England's consumed electricity comes from renewables both on and off-shore with on-shore contributing 7.3%. Woodfuel is a valuable source of energy in particular as heat. Woodfuel was identified in 2003 as a major opportunity, especially for private woodland owners based on the estimates of undermanaged woodland in the East of England and poor quality roundwood production. Evidence suggests the market for woodfuel has expanded since 2003 and will continue to grow into the future based on grants for wood heating and concerns over fossil fuel price rises. The 2003 study indicated the major market was firewood, but more recent developments suggest the market for wood pellets and woodchips is growing. Woodfuel East - a project to stimulate the woodfuels industry in order to encourage woodland management has a target of 110,000 green tonnes timber harvested per year (log value of approximately £11 million/annum gross) and a target of stimulating120 full time equivalents (FTE) jobs. It is estimated that woodfuel currently adds around ***£ 5.2 million*** *to the regional economy.*

HEALTH AND WELLBEING

The quality of the environment is a vital factor in health, well-being and quality of life. The quality of the urban environment and the wider landscape and countryside in which it sits has an effect even though we may not realise it. The cleanliness of our water, the air and the character of our neighbourhoods are important to our health and trees play an important part in maintaining these qualities which we rely on.

Health

A considerable body of evidence has gathered over the past few years about the importance of green infrastructure (of which woodland is a part) and its benefit to health. Woods and forests provide opportunities for improvements in physical activity and the promotion of psychological health and mental wellbeing. Trees directly reduce pollution through acting as filters, capturing particulates on leaves and needles.

Cardio Vascular Disease cost the UK economy £29.1 billion in 2004, with coronary heart disease (CHD) and cerebrovascular disease accounting for 29% (£8.5 billion) and 27% (£8.0 billion) of the total respectively. Only the cost of mental illness surpassed the cost of Cardio Vascular Disease.

Less than half of men and less than 40% of women undertake adequate levels of physical activity but by increasing the level of activity, avoided health care costs in the East of England could lie in the range £6 - 14 million/yr, and if the non-health care costs are included the total avoided costs are in the range ***£12 - £27 (mid point £19.5million/yr).*** *This is a conservative estimate as it only takes into account one disease (CVD) and does not account for the potential of physical activity in woodlands to cause reduction in costs associated with a wide range of other illnesses such as mental illnesses The cost of mental ill health in England is now £105.2 billion a year, according to the latest update (Oct 2010). And the cost to business of working days lost through ill health in the region is estimated to be between £1.17 to £1.43 billion/yr.*

Recreation

Recreation is an important aspect of our quality of life particularly locally accessible woods. However, only 38% of woodland in the East of England is accessible for free public access, but overall the percentage of people with access has increased over the last five years. There were some 17.5 million leisure visits to Woods and Forests in the East of England and of these 1.5million visits were to Thetford Forest Park part of the Public Forest Estate managed by the Forestry Commission. The average spend on these visits was £25.88. Whilst a large number of these visits would be the regular dog walkers, holiday visitors were not included in this, the average spend indicates considerable income generation which estimated to be ***£550 million per year*** *(includes the figure for Tourism visits).*

Education

Forest Schools which began in Scandinavia have become well established in the East of England. These use the forest as classrooms for regular trips for over 150 schools in the East of England. The benefits of these open air classrooms have been well researched but are difficult to put in monetary terms. Forest School allows participants to learn and explore in a constructive way and encourages them to be active. Forest Schools gives confidence in the outdoors and the tools to develop healthy lifestyles while providing a unique and unforgettable learning experience.

Forest School sessions happen all year, in all weathers. Groups are suitably warned that the Scandinavians believe that there is no such thing as bad weather, only bad clothing. There is a regularity of visits. Most Early Years groups are looking at half a day, once a week, for a year. Older groups do 6 - 10 week stints of full days. Anything less is classed as a taster, not a life-changing experience. A conservative figure of ***£0.82 - £1.64 million per year*** *has been estimated for East of England for educational benefits. However the real value of Forest schools is difficult to estimate in monetary terms as the aim is to develop the individual and how the individual child gains in a wide number of skills that will benefit both them and society going forward.*

ENVIRONMENTAL ASSETS

Biodiversity:

Woodland is an important element of landscape and vital for in its role as habitat for a number of species both flora and fauna. Woodland forms an essential part of many Sites of Special Scientific Interest (SSSIs). The intrinsic value of biodiversity is not considered in this report but rather the willingness to pay for it. Studies showed that at the local level, even very small improvements in woodland biodiversity are regarded as significant, and highly valued to local residents. It proved very difficult to put a clear value per hectare so a range of around ***£36 million to £107million (mid point £71 million)*** *per year based on a £15 and £45 per household per year was estimated from the various studies. If the cost to the public of agricultural High Level Schemes was also considered it is likely that the value would be considerably higher.*

Air quality and water management*.*

A 2008 study found that tree lined streets have been associated with a lower prevalence of asthma in children, even after adjusting for other factors. In the same year the Sustainable Development Commission reported that admissions to hospital linked to air pollution cost the NHS between 17million and 60million a year. Examples of water management and other tree related effects include: attenuation of downstream peak water flows, reduction in water temperature (and protection of fish populations) through shading by riparian woodland, reductions in soil erosion (which could become greater through drier summers and wetter winters), shade and reductions of 'heat island' effects in built up areas, and removal of pollutants. It is estimated that costs avoided due to the affect of trees amounts to ***around £22 - 45 (mid point £33.5) million annually*** *(2009 values)*

Landscape

Trees and woodland help to define the landscape and provide the backdrop for our villages and towns in the East of England. The value of landscape in the East of England is estimated to worth ***£124million per year****; this is based on the value that people are prepared to pay for a view of woodland.*

ECONOMIC BENEFITS – TIMBER, TOURISM, GAME AND INDUSTRY.

Timber and wood products

There is a significant body of evidence that Woodland can have a positive impact on investment and job creation, playing a significant part in making an area attractive to investors, business and householders. However the main purpose of trees and woodland is as a raw material for the timber industry. Being in predominantly rural areas managed forests contribute to the diversity of the rural economy. The industry encompasses suppliers of seedlings, machinery and processing facilities such as mills and factories for turning out wood based products. There is also a burgeoning wood fuel industry driven by the move to alternative energy sources.

The UK is the second largest net importer of timber in the world, by value, at US$ 11 billion per annum. The 144,000 hectares of woodland in the East of England, represent 7.6% of the land area. Approximately 26,000 hectares (18%) of this is managed by the Forestry Commission with the majority (82%) owned by other public bodies, charities or private companies and individuals a large proportion of which is currently undermanaged. Overall timber related industry supports 2,789 full time equivalent jobs, arising from direct or indirect effects of timber production. £115m is added to the economy from timber processing £49 million from arboriculture,£33.5million from wood products including wood fuel (believed to be an under estimate): all together a total economic input to the East of England of ***£345.5 million.***

Recreation and Tourism

Recreation and tourism is a major industry for the East of England. There are an estimated 17.5 million leisure visits to woods and forests in the East of England (5.4 million of these are categorised as tourism visits). The average spend on these visits was £25.88. to woods and forests generated an average spend per trip of £35.69, this provides an estimated overall spend of some ***£193 million*** *however this forms just a small part of the overall recreation spend generated by woods and forest of* ***£550million annually.****. Holiday destinations which use forests as a backdrop such as Centre Parcs at Elveden generate considerable indirect value to the economy of the East of England - adding some £15 million from wages and £2.5million from contracts locally and within the East of England.*

Housing and industry.

The contribution of green infrastructure, which includes trees and woodland, to land and property values, local economic regeneration and inward investment has been demonstrated by a number of studies. The creation of the National Forest for example increased the number of local jobs by 4.1% and local regeneration using green infrastructure attracted £96 million of investment. For every 1% added to the tax base by well designed and located tree cover, an additional £15.9m of annual revenue could be created. In the East of England as many as 125,000 properties are at risk from flooding, woodland has the potential to ameliorate flooding by slowing down run off. If the woodland in the East of England were to reduce this risk by 1%, this would have an annual worth of £880,000. Although there is no reliable basis to calculate the industry and residential benefits of woodland for the East of England, by combining the 'percentage points' for the local tax base (£15.9m) and flood mitigation (£0.88m), and the £14m 'avoidance cost' of not having to remediate damaged land. A figure of ***£30.6million/yr*** *seems conservative, but at least provides some indication of the value of these roles*

Field sports and game

Field sports are a significant user of woodland and are a therefore a principal management consideration for many private woodland owners. Sporting/shooting usage of woodlands is one of the activities most likely to generate significant income, and may thus strongly influence woodland management and contribute to local rural economies. The total gross value added from shooting which can be attributed to woodland in the East of England is estimated to be around ***£81million*** *This includes spending by both providers and shooters of game.*

Summary table.	(£ in Millions)
Market benefits	
Field sports and game	81.0
Timber and wood products	345.5
Recreation and tourism	550
Housing and industry	30.6
Other benefits	
Air quality and water management	33.5
Biodiversity	71
Carbon sequestration (annual figure)	41
Health costs avoided	(19.5)
Education costs avoided	(1.23)
Landscape	124
TOTAL WEALTH	£1,297.3 or £1.3 billion
Carbon asset stocks	3,306

THE EAST OF ENGLAND WOODLAND WEALTH APPRAISAL 2010

1. OVERVIEW

1.1. There are approximately 144,000 hectares of woodland in the East of England, representing 7.6% of the land area. Approximately 26,000 hectares (18%) of this is managed by the Forestry Commission at an estimated cost (2007/8) of approximately £57/ha net operating cost. However, the majority (82%) is owned by other public bodies, charities or private companies and individuals. East of England woodland is very fragmented and of small block size with a total of 7,767 woods over 2 hectares with a mean wood area of 14.6 hectares. The region has a diverse woodland resource with broadleaved woodland the dominant forest type representing 61% of all woodland. Conifer woodland represents 22%, mixed woodland 11% and open space within woodlands and felled areas 6%. Corsican pine is the main conifer species and oak the main broadleaf species.

1.2. The UK is the second largest net importer of timber in the world, by value, at US$ 11 billion per annum and by per capita the largest. Woodland is recognised as a key resource which not only supports an employment sector in its own right, but also contributes more widely to the quality of life, natural environment and economy of the East of England. Woodland is recognised as a key resource which not only supports an employment sector in its own right but contributes more widely to the quality of life, natural environment and economy of the East of England.

1.3. This report presents the results of an exercise to update the Woodland Wealth 2003 study carried out to estimate the values of woodland and forests in the East of England. The report has explored the literature from 2002-2010 and updated the woodland values from 2003 based on new information, and in some cases alternative approaches to measuring benefits. The report addresses two major aspects. First, it describes and evaluates the importance of woodland wealth to the East of England in broad terms, emphasising the significance of public benefits which are often not reflected in market terms. Second, it assesses the economy of woodlands and forests, addressing both the timber production and processing industry, and the more local but very significant role played by woodlands in the economy.

1.4. An attempt has also been made within this report to highlight the Ecosystem services or 'natural value' delivered by woodland using the broad categories utilized in the United Nations Millennium eco-system assessment. Ecosystems services being defined as 'the benefits people obtain from ecosystems' (Millennium eco-systems assessment 2005). The four categories of services are – supporting, cultural, provisioning and regulating. Alongside this the report indicates how the various elements relate to the pillars underpinning sustainable development, such as the economy, environment social and resource use.

1.5. In some cases alternative approaches may not be completely comparable though we have tried to include discourse about this. The present study has been a desk-based exercise it does not purport to provide a definitive value but to give an estimate based on the best information available at the time, the midpoint figures are often a point between a very wide range. Neither is this report an in depth ecosystems services evaluation, at the present time no methodology exists to fully value interactions of ecosystems. It is a valuation of those elements which we can to a certain extent put a monetary value on. It needs to be realised that the interrelationship between various ecosystems are an essential element of benefit provision e.g. habitat provision for pollinating insects which in turn are essential for provisioning services. These linked benefits are at present difficult to capture and value and is not attempted in this report. This report does not look at the value of urban trees.

1.6. This first section will discuss the findings and the main differences between the 2010 and 2003 valuations. Later sections will provide the background evidence and describe how benefit estimates were derived. Table 1.1, below summarises the main findings of the exercise. In 2003 the value of trees and woodland was calculated as £680 million, if the 2003 figures are updated to account for inflation the figure would be approximately £801 million. In this case current 'wealth' estimates for 2010 range from **£1,022.5 million to £1,531.3** million with a mid point range of £**1,276.6 million.** These are annualized values and thus represent the annual level of wealth generated by forest and woodland each year. Some of this increase from 2003 is due to inflation but more often it is caused by a change in the value (or the value estimates) of different sources of woodland wealth.

Recreation and tourism.

1.7. Estimates of wealth generated from recreation and tourism activities have increased significantly from the 2003 estimate of £128 million/year to a mid-point estimate of **£550 million/yr**. Much of the increase has come from more realistic assessments of expenditure by active and passive visitors to forest and woodland using the Leisure Visits Survey from 2005 (Natural England et al), and estimates based on actual expenditure from visits of different durations. Survey data from various sources has provided a more accurate picture of visitor numbers, duration of visits, activities undertaken, and expenditure per trip raising confidence in the benefit estimates. The major unknown aspect to this area of activity continues to be the level of activity occurring in private woodlands.

Field sports

1.8. Field sports, in particular shooting game, was not included in the 2003 study as no benefit estimates existed at the time. Since then British Association for Shooting and Conservation has commissioned a major study of the benefits of field sports which enables some calculations to be made on the extent to which woodland contributes to this area of activity. The wealth generated by woodland from field sports is estimated to be in the range **£54 - £108 million/year**. This is a conservative estimate as it does not include potential multiplier impacts from those employed directly or indirectly in supporting the activity.

Biodiversity.

1.9. Biodiversity remains a difficult area to value. Few studies have been completed in the period 2003-10 and most estimates are based on some form of 'willingness-to-pay' (WTP) derived through contingent valuation approaches. Current estimates range from **£36 – £107 million/year,** with the mid-point of the range not much greater than the 2003 estimate (when inflation has been taken into account). Key problems with the valuation of biodiversity relate to ensuring respondents in WTP surveys understand the concept of 'biodiversity', and isolating the concept from other aspects of woodland, and the wider countryside, with which it is integrated (e.g. local versus national or global significance, habitat, ecosystem service functions). A more comprehensive and innovative approach to valuing biodiversity combining studies at the local, regional and national levels would create greater confidence in any future measures of woodland

biodiversity 'wealth'. The recent Cydcoed work in Wales noted that even small improvements in woodland could be highly valued at the local level.

Landscape.

1.10. The 2010 value estimates are double those reported in 2003 (from £60 million/yr in 2003 **to £124 million/yr in 2010**). This is due to a change in the way the values were calculated providing more reliable figures. The 2010 estimates have been calculated using estimates from a study (Garrod, 2002) conducted across Britain which generated household, travel related, and national aggregate estimates of value for woodland landscapes; and on assumptions about the proportion of households in the East of England with woodland landscape views. The 2003 estimates were calculated on the basis of willingness-to-pay for 'valued landscapes' using survey data largely generated in the 1990s in Scotland, rather than for woodland landscape. We have more confidence in the 2010 estimates in relation to woodland landscapes, but aggregated data are subject to influence by the proportion of households that benefit, which remains uncertain.

Health

1.11. Potential benefits to both physical and mental health from woods and forest are widely recognized; stemming from the beneficial effects of exercise and physical activity, and the calming influence of being in woodland which can lead to reduced stress levels. The approach taken in measuring benefits has been one of costs avoided, in particular the health care costs (hospital, drugs) and the non-health care costs (informal home care, production losses for illness and premature mortality). Table 1.1 presents data for health care costs avoided (in brackets as these values are also contained within the value estimates on the line below) and for the combined health care and non-health care costs avoided. However, due to a lack of evidence of the costs of other illnesses, only cardiovascular diseases (CVD) are considered in this measure. Therefore the health benefits presented represent a significant under-estimate of value.

1.12. The 2003 and 2010 estimates are similar in magnitude (£18 million/yr in 2003 and **£19.5 million/yr** in 2010), but we have a much higher level of confidence in our 2010 estimates. The current estimates build on recent work conducted in the UK to specifically estimate the costs of CVD in terms of both heath care and non-health care impacts. Whereas the 2003 study utilized planned estimates of National Health

expenditure to overcome levels of physical inactivity, the current report was able to use actual measures of the costs of CVD to estimate the level of costs avoid at the regional level. The cost to business of working days lost through ill health in the East of England is estimated to be between £1.17 to £1.43 billion/yr.

Housing and industry

1.13. There has been little change in the evidence base for the contribution of woodland and trees to the value of housing and industry. The impact of trees on residential property values is recognized, and there is some evidence to suggest that woodland settings for industrial parks help attract and retain businesses. The estimates for 2010 presented in the report are based on inflation adjusted estimates from 2003.

Education

1.14. Education estimates show a decline between the 2003 study and the present. This is largely due to changes in methodology. The 2003 study relied to a large extent on data reported in a study of teacher WTP for access to woodland for teaching conducted in the South-west region, and adapted the figures to estimates of the school aged population in the East of England. Since then a number of 'Forest Schools' have been established in the East of England and it is estimated that Forest Schools help deliver benefits costed at some £1.23 million.

1.15. The 2010 study uses a measure of costs avoided through having access to woodland and forests as 'open-air classrooms' or laboratories for teaching. The estimated value is based on the assumption that local access to woodland for teaching will eliminate the need to spend money on transport and payments to an external provider at a field studies centre (or some similar location). The values are sensitive to assumptions about the proportion of school children benefitting from this form of teaching in any one year, and the actual costs avoided through using local woodlands. The reader should note that 'educational' benefits per se are not measured and thus the approach probably represents an under-estimate of the educational value of woodland.

Carbon sequestration

1.16. Carbon sequestration is the most complex of the non-market values to estimate. The values provided in Table 1.1 dominate all other market and non-market values. The vast majority of this 'wealth' is attributed to the estimated net present value for the

carbon locked up in forest soils and the standing stock of trees, amounting to around **£3.3 billion** in 2010, however this wealth cannot be realised in terms of money but contributes to the UK's carbon reduction targets. . Looking at the value of annual increments indicates a range of values from **£22.38 million/yr to £59.2 million/yr** (based on two different approaches to calculating and valuing) for carbon sequestration in the East of England's woodland. The 2003 study did include a small estimate of the value of carbon sequestration under the heading 'water and air quality' but this was based on an elementary model to establish the level of carbon fixed in the East of England's woodlands.

1.17. Values are derived from measures of the 'social costs of carbon' (see DECC 2009 Guidance) which are damage estimates from greenhouse gases released into the atmosphere. There is currently general acceptance of damage estimates, but the actual estimates themselves are based on predicted levels of atmospheric carbon dioxide (and other greenhouse gases), about which there is some uncertainty, and on the local impacts of those levels, which are also uncertain.

1.18. In a sense what is reflected in these values for carbon is the potential benefit arising from taking precautionary action. Precautionary action in terms of locking carbon up into woody material does not mean the impacts of climate change will be avoided (especially if one's neighbours continue to increase their greenhouse gas emissions), but if that carbon were to be released it could have significant negative impacts. The stock of carbon in the East of England's woodland is like a capital investment, where the interesting aspects are the marginal changes to the stock (i.e. is the level of stock increasing or decreasing through felling and restocking, and new planting) and the value of the annual increment in terms of the trading values of carbon dioxide absorbed. In terms of using 'woodland wealth' in policy decisions it might be more useful to concentrate on the value of the annual increment to the stock, rather than the 'sunk costs' represented by the existing stock of carbon in soils and trees. Removing the net present value of the stock of carbon from the calculations, but keeping in the value of the annual increments of carbon provides a 2010 woodland wealth conservative estimate in the range **£0.964 - £1.415 billion**, and a mid-point value of £**1.221 billion**.

Water and air quality

1.19. Measures are updated from the 2003 estimates. The reason for the major apparent decline in value from 2003 to 2010 is removal of the estimate for carbon sequestration, and for estimates of flood mitigation and soil conservation. It was felt that the evidence for the magnitude and location of soil conservation, flood mitigation, and water quality was not robust enough to enable monetary values to be assigned. In 2010 the only monetized value is that for improvement of air quality.

Market values

1.20. Market value estimates are complicated by fluctuations in timber value, lack of information on private woodland activities, and limited data on a wide range of wood related businesses in the East of England. The values in Table 1.1 for timber production and processing are largely updated estimates from 2003 using the same multipliers applied to estimates of woodland employment and associated activities. The values for arboricultural activity, retail wood products and fuel wood are based on applying an inflation calculator to the 2003 estimates, we were not able to estimate the current level of activity which was based on empirical survey data in 2003. Market values thus suffer from recent measures of regional activity with which to make calculations. Despite this we have some confidence that values have taken into account changes in employment within the forestry and wood processing sector.

Strengths of the current study

1.21. The estimates for recreation, biodiversity, landscape and health impacts are more secure than in 2003. More recent studies in recreation have identified a range of values for different activities raising confidence in the value estimates for recreation in forest and woodland areas. Values for field sports, although largely based on one study, are reasonable robust. Values for carbon sequestration are included. This is an important and significant role for forest and woodland, in terms of the carbon locked up in the soils and standing stock, and in the capacity for new planting to absorb carbon from the atmosphere and so reduce potentially damaging effects of greenhouse gas emissions.

1.22. Market values build on the estimates made using empirical data from the surveys carried out for the 2003 Woodland Wealth report.

Weaknesses of the current study

1.23. Heath benefits measured as costs avoided are sensitive to assumptions about the number of households potentially affected by CVD, and the level of access to woodland which might influence using woodland for beneficial physical activities.

1.24. Education benefits are based on simplistic calculations of costs avoided, rather than some measure of the educational value of woodland in society. The values are sensitive to assumptions about the numbers of children benefitting and the level of costs avoided.

1.25. Measures of water and air quality are incomplete with many potential benefits (e.g. soil conservation, groundwater quality) missing, or inadequately estimated (e.g. flood mitigation). It was decided not to attempt monetization of these potential benefits due to the impossibility of assigning values to the role of woodland and forests without some empirical data on location of woodland in relation to impacts on soils and water.

1.26. Unlike the 2003 Woodland Wealth study no new empirical data has been collected. In some ways this has inhibited the estimate of current values, particularly in respect to market values for woodland where there is limited national and regional data, and the information being used to generate market values is based data that is in some cases 10-12 years old. Some of the market value data in 2003 was estimated from surveys carried out at the time. It has not been possible to repeat these surveys, and no other evidence is available as a substitute. The market values to a large extent are based on application of multipliers generated by Public and Corporate Economic Consultants (PACEC) in a study carried out in 2000 using data from the 1998/99 national inventory of trees and woodland. There have clearly been changes in the East of England since 2003 to employment, production of roundwood and wood products, fuel wood, and associated business development, but no empirical evidence exists to enable more detailed analysis. Thus, in some ways the market value estimates are weaker in this report than in 2003.

Table 1.1 Comparison of woodland values 2003 and 2010

Activity	2003 Values £million/yr	Range of values 2010 (£million/yr)		
Non-market values		Low	High	Mid-point
Recreation and tourism	128	400	700	550
Field sports	N/A	54	108	81
Biodiversity	55	36	107	71
Landscape quality	60	112	136	124
Health costs avoided: health care costs only	N/A	(6)	(14)	(10)
Health costs avoided: Health care + non-health care costs Health benefits	18	(12)	(27)	(19.5)
Education costs avoided	5	(0.82)	(1.64)	(1.23)
Carbon sequestration: Annual increment	N/A	22.38	59.2	41
Water and air quality (includes estimate of carbon sequestration value)	102	22	45	33.5
Market Values				
Timber production and processing Indirect and induced effect Arboriculture (including indirect and induced effect)	87 133 42			115 148 49
Woodfuel (Figures are also included in figure above for wood products)	(4.2)			(6.1)
Retail wood products and crafts	24			33.5
Housing and industry	26			30.6
Current annual 'wealth' estimate including net present value of carbon stock 'Wealth' without carbon sequestration 'Wealth' including value of annual increments from carbon sequestration		4,039 1,000.1 1,022.5	5,020 1,472.1 1,531.3	4,560 1,235.6 1,276.6
Total costs avoided (health + non-health care, and education		12.82	28.64	20.73

Total woodland benefits	680	1,035.3	1,559.9	1,297.3

Carbon sequestration: Net present Value of carbon stock	N/A	3,078	3,534	3,306

Notes on Table 1.1:

Where figures only appear for the mid-point – use this value for all calculations (i.e. include this figure when adding low and high range totals). Mid point is estimated between the lowest estimate which may be derived from one methodology and the highest which may have been derived from an alternative method, the real figure may be somewhere in between the two poles

Health figures in brackets are for costs avoided and not any 'additional value'. There are two sets of numbers for health care costs avoided, the first is health care costs alone, the second figure incorporates both health and non-health care costs. Only one of these figures should be used, not both of them.

Education figures in brackets are for costs avoided.

2. BACKGROUND TO THE EAST OF ENGLAND

2.1 The East of England comprises the County Council geographical areas of Cambridgeshire, Norfolk, Suffolk, Essex , Hertfordshire and the Unitary Authority areas of Bedford, Central Bedfordshire, Luton, Peterborough, Southend-on-Sea and Thurrock (Map 1). The general picture is one of considerable prosperity, possessing an £1.1 trillion economy, which is 10% of the UK GDP despite having only 9% of the UK population. The East of England's economy is also highly diverse. It has a significant manufacturing base as well as established service, high-tech, research and development, and rural industries, with particular importance attached to specific clusters of industrial enterprise.

2.2 The environment is diverse and generally of high quality, contributing to a high quality of life and a tourism industry which sustains around 50,000 jobs. Broadly speaking, the East of England has a relatively 'rural' character, with approximately 45% of its population residing in rural areas, and an appearance which has been fashioned by centuries of agriculture. It contains some renowned landscape features, including the Norfolk Broads (national park equivalent status), and Areas of Outstanding Natural Beauty, such as parts of the Norfolk and Suffolk coast, Dedham Vale and the Chiltern Hills. Not surprisingly, the East of England Development Agency (EEDA) states that people who live and work in the East of England rate the natural and built environment as a key aspect of the East of England's image and identity, seeing the East of England as a good business location with an open and unpolluted environment, which is close to countryside and the coast.

East of England Historical counties of the East of England

3. THE PUBLIC BENEFITS OF WOODLAND

3.1 Introduction

3.1.1. Public benefits of woodlands have come to be recognized as significant over the past two decades. This section of the report is organised according to what we consider to be the key public benefits of woodland, namely:

- the value of woodlands for recreation and tourism
- the biodiversity values of woodland
- the contribution of woodlands to landscape quality
- the contribution of woodland landscapes to physical and mental health
- woodland as a framework for housing and industry
- the educational role of woodland
- the physical environmental benefits of woodland, namely, its role in maintaining air, soil and water quality (i.e. provision of what are currently termed 'regulatory ecosystem services').

These values are likely to add substantially to the already considerable market benefits of timber production and processing.

3.1.2 This section of the report uses the term 'public benefit' to represent those woodland-related sectors for which markets rarely exist and thus derive their value from the presence of woods *per se* rather than timber extracted from them. In reality, the degree to which a market is absent varies: for example, some direct charges may be made for woodland recreation, (e.g. car parking, charges to use special features such as a mountain bike trail), indirect economic benefits arise from expenditure by woodland visitors in the local economy, and while emerging markets exist for trading 'credits' for the atmospheric carbon sequestered by trees, no market exists for the role of lowland woodlands in moderating floods, or the contribution of trees to landscape.

3.2 Estimating Non-market Values

3.2.1 This report has considered the available sources of information on non-market woodland benefits, particularly those produced over the past seven years, in an effort to update the original Woodland Wealth study which was completed in 2003. This study reiterates the caveats in the original report that it is rarely possible to take a single reliable figure and apply it directly to the woodland resource of the East of England. In practice, economic studies of environmental resources tend to be specific to the original research context, and are highly sensitive to the type of question being asked. In addition, perceived values may variously be attributed to individuals or households, allocated on a per visit or annual basis, or applied on a whole woodland or per hectare basis giving rise to a wide range of values measured at different times and in different ways. Consequently, the study has avoided precise estimates, in order to avoid a false sense of accuracy. A range of measures have been utilized where available, and estimates have been checked against those in other recent studies, where possible. In some instances, it has not been possible to establish a plausible basis for the magnitude of benefits, even where it appears highly probable that some benefit exists. In these cases, the potential scale of benefit has been indicated by supposing that woodland cover makes 'a percentage point' contribution: that is, the scale of benefit has been stated as if woodland were to contribute one per cent of the total worth of a particular feature. This is probably a highly conservative assumption, but it is at least a starting point.

3.2.2 Precise figures or confidence limits have not been used to avoid conveying a false sense of accuracy. Rather, rounded figures to yield broadly credible estimates in the light of available evidence have been utilised. Where figures arrived at by different methods are roughly the same (convergent) it suggests that the credibility of the evidence is stronger. Consequently, estimates of non-market 'wealth' are offered as convergent approximations.

3.3 Recreation and Tourism

3.3.1 This can be categorised as an eco-systems cultural service and relates to both economic and social pillars of sustainable development. One of the most widely studied non-market benefits is that of woodland recreation. The various categories of benefit of woodland recreation comprise: leisure benefits derived by visitors to woodlands to carry out specific formal and informal leisure activities; health benefits associated with gentle but sustained physical exercise and psychological wellbeing; and lifestyle benefits for visitors who seek particular kinds of emotional and spiritual refreshment, and which are particularly associated with woods possessing ecological and cultural values. The most recent England Leisure Visits Survey (ELVS 2005) indicated a total of 699 million visits to the countryside with a value of £9.4 billion. Of these 170 million visits were to woodlands/forests (a slight reduction compared to 2002/03 data) estimated to be worth £2billion (table 2.8 ELVS 2005). The main activities undertaken by those visiting woods/forests were identified as walking, rambling (62%), cycling/mountain biking (9%), taking part in sports or active outdoor pursuits (5%), to eat or drink out (6%). The data suggest that 48% of rural visits were from higher income groups ('wealthy achievers' and 'Comfortably off' categories), and 75% owned a car. Data for the East of England suggests 17.5 million leisure visits to woodland/forest.

3.3.2. Most woodland recreation is of frequent but short-duration activity undertaken close to home in a woodland often perceived to be owned by a local authority. The Woodland Trust –Space for People (2010) indicated that 36% of the East of England's woodlands are publicly accessible. The ELVS 2005 indicated that leisure visits (identified as round trips made from home and completed within one day) to the countryside (including woods and forests) tended to be short lasted just under three hours with average time spent at the destination of 2.1 hours. Over one third of countryside trips were found to be under 1 hour duration with 36% of trips for walking (including dog walking), and 69% of trips of less than 3 hours duration. Only 8% of visitors spent more than 4 hours at their destination and 60% of visitors travelled under 10 miles on their visit. Leisure visits tend to be spread fairly evenly across the year with slightly higher numbers in autumn and winter than in spring and summer. Average expenditure per trip (for leisure visits) is estimated at £11.74 for all items (2005 prices), which provides an overall estimate of £1,997 million spent on trips to woodland and forest in 2005.

3.3.3 Many trips are low-key in nature, benefiting from the presence of formal or informal general access or rights-of-way. This is very significant with regard to subsequent arguments about exercise, social inclusion and reductions in car use. Virtually no expenditure is involved by the users, and any economic values can only be imputed indirectly. A significant minority of activity may be more formal (perhaps as high as 20% according to the ELVS 2005, 9% of which is cycling/mountain biking), generally involving expenditure in travelling to a far larger site, and may involve purchasing or hiring equipment to pursue particular leisure activities. Here, there are actual economic benefits, often to a local rural area. The ELVS 2005 suggests that the main activity for 28% of all rural visits is for walking/hillwalking/ rambling, while 3% of visits are for cycling/mountain biking, and 5% of visits are for some active pursuit. One interesting feature of the ELVS is the estimated expenditure of £14.50 per leisure visit (defined as a round trip from home undertaken during one day) to rural areas and a total of £25.88 per trip for visits to woods and forests in the East of England

3.3.4. The ELVS 2005 explored 'tourism' visits (defined as round trips from home lasting more than three hours but completed within one day) as a subset of leisure visits. These trips tend to be longer and less regular than leisure visits. Activities undertaken on tourism visits to woods/forests are mainly walking/rambling (31%), visiting a leisure attraction/special event (17%), and undertaking a hobby (13%). More active outdoor pursuits are undertaken by only 5% of visitors). Expenditure for rural tourism visits is higher than for leisure visits. Average expenditure in the East of England for rural tourism visits is estimated at £35.69 per trip and for visits to woods and forests at £38.55 per trip.

3.3.5 Trips taken from a holiday base reveal a slightly different pattern. These are additional visits undertaken by those on holiday at a place other than their home. Only 6% of all trips from a holiday base are to woods/forest areas. The main activities undertaken on all trips from a holiday base are eating/drinking out (21%), walking/rambling 15%), and shopping (15%). Only 5% or less people on holiday visits engage in active outdoor pursuits.

3.3.6 A number of woodlands in the East of England have significant provision for recreation. The 'flagship' woodland recreation resource is the Thetford Forest Park, attracting over 1.5m visitors a year, of which an estimated 90% are day visitors and 21% are cyclists (Christie, et al. 2006). A local visitor survey of Thetford Forests in 2008 (Diggins and Jamieson, 2009) support the general findings from the ELVS regarding characteristics of forest visitors. Over half of visitors were on a short day trip (less than one hour from home) and only 10% on a longer day trip (over 3 hours) and 6% on holiday. Average length of stay was 2 hours 44 minutes and nearly two thirds (65%) of visitors had been previously. Walking was popular with 37% engaged in walking and a further 6% walking with a dog.

3.3.7. The range of recreational facilities available in Thetford Forest are not widely replicated elsewhere and the majority of woodland in the East of England is in private ownership. Private sector woodland generally makes less access and recreation provision than does public woodland. In England open access to woodland beyond rights of way was estimated (in 1998) to exist for 281,000ha, of which 128,000ha were non FC-owned. This does not always mean that access is generally available: factors limiting the willingness of private owners to extend access include occupiers' liabilities, insurance costs, perceived risks to commercial interests and desires to protect field sports and property values. (PSPS, 1997) Urquhart, Courtney and Slee (2009) have noted that many private woodland owners are concerned about involvement in grant-schemes that require provision of public access for recreation (partly due to a desire for exclusive personal use, and partly due to potential conflict with nature conservation objectives).

3.3.8. The Public Opinion of Forestry survey indicates, for 2001, that 73% of adults in England had visited woodland in the last few years, while in the 2009 survey the figure was 77% (and the figure for the East of England was 85%). Of those visiting woodlands, 60% indicated they visited at least monthly during the summer. Most visits are by regular visitors, to woods near their homes, and for 2 hours or less. In the East of England respondents to the Public Opinion Survey indicated that the majority visited woodland owned by the Forestry Commission (46%) and the National Trust (36%), while only 15% of visitors claimed not to know the ownership of the woodland they were visiting. Visitors to larger woodlands tend to fall into two groups: those undertaking active pursuits, such as walking, cycling and sports; and those seeking

leisurely activities, such as picnics, bird-watching and visiting attractions. Walking is the most popular activity and is undertaken on 62% of visits (ELVS, 2005). Most popular activities in 2009 were reported to be 'exercise, e.g. walking, running, mountain biking' (74%) and 'watching nature' (55%). For the East of England the figures are 82% and 50% respectively. It has been estimated that woodland day visits have an overall expenditure of around £1,090m /yr including travel costs.

3.3.9. The pattern of recreational woodland usage also raises issues of social inclusion. Scott (1999) observed that the proportion of respondents to FC surveys who had visited woods in GB was larger for social classes ABC1 than for C2DE (60% and 40% respectively). FC Forest Visitor Surveys (FC, 2001b), indicate that 'wealthy achievers', 'affluent greys', 'comfortable middle agers', 'affluent executives' and 'well-off workers' from rural and suburban locations are significantly over-represented relative to urban and blue-collar members of the population. The ELVS (2005) reinforces the view that it is mostly the more affluent households that have access to woodland and forests as nearly half of all visits are made by those in the 'wealthy achievers' and 'comfortably off' categories.

3.3.10. The 2003 Woodland Wealth study examined the availability of accessible woodlands in the East of England. The analysis indicated two major issues. First, the East of England contains many woodlands with public access, though these are largely beyond easy walking distance of the bulk of the population. According to the calculations, there were 87 woodlands with access within 0.5km of urban edges and a further 359 with access within 0.5-5km of urban edges. It was concluded that the pattern of recreational woodland provision is likely to encourage car borne visitors. Second, there were clear variations in the availability of accessible woodlands across the East of England: for example, Luton, Colchester and the new towns (e.g. Stevenage, Welwyn, Harlow) appear to be favourably endowed with walkable woods with public access, whereas these are virtually absent from whole counties elsewhere.

3.15. Space for People recently published by the Woodland Trust (2010) points out that although access to woodland in the East of England has improved slightly over the last six years, accessible woodland within walking distance is still only available to a minority. Only 11.6% of the population live within 500m of a small accessible woodland; 51.5% live within 4km of a larger wood.

3.3.11. With regard to the economic benefit of woodland visits, various estimates have been derived for the value of day trips (CJC Consulting with MLURI, 2000; Willis et al, 2000). There are several methodologies available, and these yield varied results. Some earlier studies suggest a variation of £1.15-£7 per trip, depending on site characteristics (Scarpa, 1999, reported in Willis et al, 2000). A more detailed study, based on 'benefit transfer' methodology, could assess the characteristics of the East of England's woods and allocate appropriate trip expenditures on the basis of studies elsewhere (Lovett et al, 1997).

3.3.12. Bateman et al (1996) conducted a contingent valuation survey to identify WTP for a proposed 100 acre community woodland near Wantage (where no current woodland exists). Mean WTP was estimated at £9.94/household/year which, aggregated over all households in Wantage, amounts to £44,450 or £1,100 per hectare. This can be taken as a measure of recreational and amenity benefits to households in Wantage (there is no estimate of benefits to potential users from outside the village) but might overestimate the marginal value of woodland for areas where some woodland access already exists.

3.3.13. A benefit transfer study (Scarpa, 2003) estimated woodland recreation values in the UK. Using a mix of 1992 and 2002 survey data benefit estimates in the form of compensating variation of foregoing a visit to woodland were estimated to be between £1.66 per visit and £2.78 per visit. When figures were aggregated to level using number of visits (54.5 million), the willingness-to-pay (WTP) for the East of England was estimated at £90.44 million per year.

3.3.14. To this must be added actual expenditure by visitors (in addition to imputed non-market benefit). The South-West England study (2003) proposed a pro rata figure (based on national estimates) of £4.53 for day visitors and £9.60 per head by staying visitors per 24 hours (based on the figure of the 23.14% of total expenditure that is leisure-related). In 2003, taking an approximate figure of £5/day average expenditure to reflect the likely preponderance of day trip visitors total annual leisure expenditure by visitors to woodlands in the East of England was estimated at £217m.

3.3.15. More recent work has provided a broader range of measures of the benefits from woodland recreation, some of which monetise benefits to specific categories of user (e.g. cyclists or walkers). A large two-phase study was conducted during 2005-06 (Christie, et al., 2006) which valued forest recreation in six case study sites, one of which was Thetford Forest in the East of England. The average spending per visitor was estimated at £37.08 per day. Spending was also investigated in terms of type of recreational activity (see Table 2.1 below). The spending is expressed in total amount spent per day (including travel and accommodation).

Table 2.1. Local expenditure by visitors to forests in Great Britain (figures are mean spending (£) per visitor)

Activity	Thetford	Proportion Spent locally	All forests	Proportion Spent locally
Cycling	8.08	77.8%	23.35	57.5%
Horse riding	10	100%	136.28	86.6%
Nature watching	4.61	54.5%	28.07	71.9%
General visitors	10.18	73.4%	32.05	78.8%
All visitors	9.17	72.9%	37.08	70.7%

3.3.16. Horse riding figures are high but skewed largely by high spending levels reported by horse riders in the New Forest (where around one quarter of the sample reported spending of £500 per day in high quality accommodation and horse rental). The Christie et al. study also disaggregated data further into day visitors and holiday visitors (defined as those staying overnight in the area). Mean spending per holiday visitor tended to be higher than for day visitors as this category of visitor was also spending money on accommodation and eating out. Across all forests mean spending per day visitor was estimated at £13.29 and mean spending per holiday visitor estimated at £60.52. This figure masks significant variation between the six case studies (which for Thetford revealed a slightly lower expenditure figure for holiday visitors than for day visitors).

3.3.17. The study also explored the proportion of expenditure spent locally (defined in the case of Thetford as the Forestry Commission East Anglian District) and estimated the number of visitors per year to each forest. In Thetford overall almost three-quarters (72.9%) of expenditure was deemed to be local, with an estimated 1.5 million visitors per year (the vast majority of whom are day visitors). Other survey data was incorporated (e.g. indicating 21.3% of visitors are cyclists, 0.4% horse riders, 4.2% nature watchers and the other 74.1% were general visitors to provide an estimated £10.37 million annual expenditure for Thetford Forest, the majority of which (91%) came from day visitors The largest amount of spending came from general visitors (£8.08 million/year).

3.3.18. Multiplier studies were also conducted to estimate indirect spending in the local economy suggesting that recreation in Thetford Forest created an additional income generation of £17.1 million per year. The study used a coefficient (£34,000 additional spend in the local economy generates one additional full-time equivalent (FTE) job) from an earlier piece of research to estimate employment generation at around 305 FTE jobs. This latter figure appears somewhat high given the seasonal nature of spending, and does not account for under-employment within the existing workforce, nor the likelihood that many jobs might be part-time and seasonal in nature.

3.3.19. However, these figures relate to the Public Forest Estate and do not take into account enterprises which require forests as a base; for example - a report by Hallam Environmental Consultants and Sheffield Hallam looked at the value to the Bedford economy of a proposed new Centre Parc in their study - *The local economic impact of Center Parcs holiday villages with particular reference to the potential local impact of a proposed village at Warren Wood Bedfordshire (2005*). They examined a number of Center Parcs including Elveden Forest centre (set within Thetford Forest) to derive their figures. From their analysis they reported that Center Parcs' Cyclical Refurbishment Programme aims to spend a minimum of approximately £2.5 million per year per Village (at 2004/5 prices). If multipliers are included the resulting expenditure impact is £1.7 million locally and £2.3 million regionally. It is estimated that the Programme creates or safeguards approximately 24 jobs locally.

3.3.20. The report indicates that the direct economic effect of a Center Parcs Forest Holiday Village is creation of approximately 900 to over 1000 FTE jobs. The multiplier effect means that the villages each support a total of 990 to 1100 jobs locally, and 1350 to 1500 jobs regionally. In addition to those directly employed by Center Parcs, therefore, a village supports an additional 90 to 100 local jobs indirectly. The average wage bill is £10.5 million, This is a substantial economic impact. Applying the Local and East of England al Multipliers to a net wage payment of £10 million, gives sums of £11 million and £15 million of net wages payment effect injected into the local and regional economies respectively, each year.

3.3.21. A contingent behaviour analysis was conducted to explore variation in the estimated number of trips visitors might make as a result of changes in facilities at the destination. Results showed that in general improvements in facilities resulted in less than 10% change in number of trips predicted. The largest value was attributed to improvements in family play area, which was estimated to increase value to visitors by £8.75 per year. Choice experiments also explored changes in value to different categories of user from improvements in facilities (e.g. to horse riders, cyclists, nature watchers). The results of the travel cost study were problematic; results of the contingent behaviour and choice experiment studies were of lower reliability than the expenditure studies, and relate more to valuing marginal changes in quality of the facilities than in valuing the existing resource base.

3.3.22. Hill et al. (2003) undertook a meta-analysis of 44 forest ‘sites’ in six forests across the UK. They estimated mean expenditures at £6.39 per person per visit for day visitors in England, and £8.44 per person per visit for people taking holidays in the area. Estimates were slightly higher at £9.6 and £23.16 respectively for visits where forests were combined with a visit to some other destination. The figures come with a warning that they are only ‘best guesses as they are subject to high levels of uncertainty. More recently Christie, Hanley and Hynes (2007) suggest that over 30 studies have been undertaken in the UK to measure the value of forest recreation, resulting in an estimated annual national aggregate consumers’ surplus of £40 – 50 million (at 2003 prices).

3.3.23. A recent (Zandersen and Tol, 2009) meta-analysis examined 26 forest recreation studies in Europe (eight of which were in the UK) using the travel cost approach during the period 1977-2001. Results indicated wide variability in consumer surplus estimates from €0.66 to €112 per trip with a median value of €4.52 per trip. The study suggested that values are influenced by the measurement of value (i.e. the value per trip, per day or per season), the definition of costs (i.e. whether opportunity costs of time were included) and other methodological issues.

3.3.24. Eftec (2010) took a slightly different approach in their estimate of recreational value for the public forests estate (PFE) in England. Using expenditure estimates from the England Leisure Visits Survey (2005) and earlier studies (e.g. Scarpa, 2003) they divided the PFE into 'high facilities' woods (trip value of £12.50) and 'low facilities' woods (trip value of £2.50). Making assumptions about number of visitors to various categories of woodland, the level of access, and different types of woods they arrived at the following estimates illustrated in Table 2.2 below. Total estimates of recreational value in the PFE amounted to £160 million/year (£740/ha/yr)

Table 2.2 Estimates of recreational value of the public forest estate in different geographic locations

Type of woodland	Total Value (£millions/yr)	Value (£/ha/yr)
Urban	30	2,850
Peri-urban (low)	30	400
Peri-urban (high)	50	4,000
Rural (low)	20	180
Rural (high)	30	2,400

3.3.25. One must be careful in extrapolating data based on recreation valuation measures in public forests to private woodland. In many cases private woodland is not accessible, or only accessible by limited rights of way. Recent work (Church and Ravenscroft, 2008) suggest that although finance is the most important incentive in persuading private woodland owners to provide public access, uptake of incentives schemes is linked to personal goals for their woodland. In other words it is the pre-disposition of the woodland owner, and their identified woodland management objectives, that determine the number (and location) of woodland owners that provide access.

3.3.26. Specialist recreation – such as off road cycling, motor sports, orienteering, paintball – can be lucrative at the individual enterprise level. However, recent studies including that by Christie, et al (2006), which looked in detail at Thetford and five other sites in Britain, suggest that cyclists might actually spend less per visit than general forest visitors (although they may be more willing to pay local fees for access to trails). Table 2.3 below indicates the range of recreational values that can be derived using recent estimates from UK and European studies. Comparisons are complicated by the fact that most studies measure expenditure per person, while the leisure visits survey estimates expenditure per trip (with an estimated average of 3.4 person per leisure visit). Expenditure includes travel, accommodation and food and drink, not all of which will have been spent in the local area (in fact it is feasible that in some cases all expenditure will take place outside the local forest area, or even outside the East of England).

3.3.27. Aggregated expenditure estimates for the East of England vary from a low of £83.4 million to £2.31 billion depending on the approach taken. The high end of the range is based on estimated expenditure from six forests in Great Britain and skewed by inclusion of holiday visitors in the sample with much higher average spending (estimated at £60.52 per person per day compared to £13.29 for a day visitor). Expenditure data from the ELV Survey on the other hand, does not include holiday visitor expenditure so potentially underestimates the total expenditure on recreation in the East of England's forests. We suggest that recreational benefits (in terms of expenditure based on a travel cost approach) for woodland and forest lies in the range **£400 – 700 million per annum**.

Table 2.3. Estimated recreation values for public woodland and forests

Source	Visits (million visits)	Expenditure per trip (£)	Total expenditure (million £)
England Leisure Visits Survey 2005 data for the East of England	15.8 (leisure)	14.50	229.1
	5.4 (tourism)	35.69	192.7
	21.2 (Total)		421.8
Christie, et al. 2006 estimated mean spending per day	21.2 leisure visits[a]	31.17[b]	661
		45.18[c]	957.9
		108.97[d]	2,310.1
Zandersen and Toll 200 estimates of expenditure (travel cost approach)	21.2	3.93	83.4
Hill, et al. 2003 estimated mean expenditure per person	21.2	£21.72[e]	460.6

Notes

Estimates do not include holiday visitors (i.e. those on holiday that might visit woodlands) except for the Christie estimates which are a mix of day visitors and those on holiday.

To make estimated values comparable the per person expenditure figures reported in some studies have been multiplied by 3.4 – the average number of person per party found in the England Leisure Visits survey 2005.

[a] All estimates use the 2005 ELV Survey 2005 for visitor numbers

[b] Value for 'All visitors' to Thetford Forest £9.17/person x 3.4 ave. size of party)

[c] Disaggregated value for general visitors to all forests – mean spend per person/day visitors only - £13.29/person x 3.4 average size of party

[d] Value for general visitors all forests (in sample) £32.05 x 3.4 ave. size of party

[e] Hill, et al. Estimates were £6.39 per person per trip multiplied by the ELVS estimate of 3.4 persons in an average leisure visit party.

3.4. Field Sports

3.4.1. This falls into the ecosystems cultural and provisioning categories and relates to economic, social and environmental pillars of sustainable development. A significant recreation/ tourism benefit is associated with field sports, and it was clear from the landowner survey (carried out in 2003) that this is a principal management consideration for many private woodland owners. Sporting/shooting usage of woodlands is one of the activities most likely to generate significant income, and may thus strongly influence woodland management and contribute to local rural economies. Short (1994) observed that the presence of woodland is a crucial factor in the use of land for shoots. The downside is that there may be conflict between field sports and other benefits e.g. access.

3.4.2. Estimates of woodland game revenues come from a number of sources but two key sources are the study undertaken for the Game Conservancy by Cobham Resource Consultants (1997) and the more recent BASC report on shooting sports based on survey data (PACEC, 2006), which gives some idea of the scale of shooting sports in the UK. The BASC study has estimated the value of shooting to the UK economy at £1.6 billion in an activity which supports 70,000 full time jobs, and shooters are estimated to spend £2 billion per year on goods and services. Shoots include driven lowland game (e.g. pheasant, partridge), walked-up lowland game, upland game (e.g. grouse), deer stalking, coastal and inland wildfowling, and pest control (e.g. rabbit). In addition the indirect effects of shooting mean that an estimated 2 million hectares of land are actively managed for conservation. Estimating the proportion of shooting that occurs in woodland is more difficult. The BASC study estimates that 830,000 ha of woodland in the UK is managed for sport shooting. The study suggests that in 2004 shooters spent £8 million on trees and an average shoot maintains 61 ha of woodland, providing a richer and more varied habitat than woodland where commercial timber production takes place. An estimated £110 million is spent in the East of England by providers and participants on 200,000 ha of land known to be managed for shooting, 40% of which is estimated to be woodland (81.400 ha).

3.4.3. The East of England is estimated to have around 17% of total gun days (1.7 million) and 16% of the total of providers (10,000) in the UK. Using this as an estimate the total gross value added from shooting in the East of England can be estimated at £272 million, of which perhaps 20% - 40% or £54 to £108 million can be attributed to woodland (based on the proportion of woodland among all habitat types used for shooting across the UK). This includes spending by both providers and shooters of game.

3.4.4. The BASC study is thorough and based on postal survey and interviews of over 2,000 respondents from a wide range of shooting and landowner organisations, (including both local clubs and commercial shoots) and individuals who hold shotgun licenses. The data is thus much more representative and broader than previous studies including providers of shooting, suppliers, and those who participate. The estimate of benefits for the East of England might be high (at between £54 and £108 million/year) as it is based on an estimate of the amount of woodland which provides shooting and may not reflect the low levels of woodland in some counties of the East of England, or the level of woodland actually managed for shooting. However, in England, this region is second only to the South West region in terms of the area of land where shooting influences management, and where habitat and wildlife are managed for shooting.

3.5. Biodiversity

3.5.1. This can be categorised as a provisioning service and relates to the environmental pillar of sustainability. A number of valuation studies of woodland biodiversity have been carried out since the 1990s, derived by different methods, indexed to different years and based on different questions. Some examples are provided below:

- an estimate of willingness to pay per household between £35-53 for particular native reforestation schemes (Macmillan and Duff, 1998).
- a University of Newcastle and ERM (UNERM, 1996) study estimated a mean WTP for forest biodiversity of somewhere between £19 and £29 per household.
- Garrod and Willis (1997) estimated the mean WTP of the public for the non-use biodiversity value of remote coniferous forests in Britain under different management scenarios, a generalized figure from this approach was £10-£11 per household per year. Aggregated across the whole population of Britain this equates to about £15 to £48 per hectare of coniferous forest.

3..5.2. More recent studies include Willis et al (2003), who estimate WTP of £0.35 per household/yr for enhanced biodiversity in 12,000ha of Sitka Spruce forest, £0.84/household/year for a 12,000 ha increase in new broadleaved native forest, and £1.13/household/yr for a 12,000ha increase in ancient semi-natural woodland. The researchers report that the concept of biodiversity was not understood by many of the study participants, many were reluctant to engage in the valuation exercise, the sample size was not large, and the procedures followed were not rigorous. Christie et al. (2004) explored willingness-to-pay for policies that reduce biodiversity decline in Cambridgeshire and Northumberland. A choice experiment assessed the value of four attributes of biodiversity (familiar species, unfamiliar or rare species, species interaction and ecosystem services). Values of £53.62 and £105.22 per household per year were found for Cambridgeshire and Northumberland respectively.

3.5.3. The biodiversity value of woodlands was estimated in a meta analysis (Nijkamp et al., 2008). Studies from UK, Netherlands, Sweden and Norway were examined to derive a monetary valuation of €9.4 – €20.1 for woodlands; and a mean WTP/person/year of €18.8 (2006 prices, equivalent to £15.46 in June 2010) for woodland biodiversity and habitat services. The authors suggest that the database used is too small to develop compound valuation rules, and the valuation figures too poor to be used in policy guidance.

3.5.4. The Cydcoed study (Powell et al. 2009) used a figure of £13.40 per household per year developed as a measure of the non-use value of biodiversity in forests by Garrod and Willis (1997) (and adjusted for inflation). This is a figure derived for biodiversity in all UK forests although ecological improvements as a result of activity in Cydcoed woodlands were likely to be very marginal. At the local level, however, it was felt that even very small improvements in woodland biodiversity are significant, and highly valued. The majority of residents in Cydcoed community woodlands may never visit other woodland areas and, significantly, the improvements in local ecological value were commented on in focus groups where improvements had occurred.

3.5.6. Eftec (2010) utilised a range of earlier studies to arrive at a value of £300/ha/yr for ‘high priority’ sites and £30/ha/yr for ‘low priority’ sites, although the exact nature of the biodiversity of such sites is unclear. It has not proved possible to estimate a consistent ‘per hectare’ value of the biodiversity value of woods, and a per household value

seems more appropriate, even though this is insensitive to the actual extent of the East of England's woodland. Given the range of figures and the fact that we are referring to an existing stock of woodland, and also give the preponderance of broadleaved woodland in the East of England, we feel justified in proposing a value of between £15 and £45 per household per year as a broad reflection of people's valuation of the biodiversity of the East of England's woodlands at 2010 prices. This would indicate that for the East of England's ca.2.38 million households, the biodiversity value of the woodlands is around **£36 million to £107million per year**.

3.6. Landscape and property values

3.6.1. This can be categorised as a cultural service and relates to the social and environmental pillars of sustainable development. The public benefits of landscape have never been satisfactorily costed. Some 'privatised' landscape benefits are incorporated into increased house prices, but these are comparatively small relative to public landscape benefits. A further problem is that urban landscape quality and rural landscape quality produce somewhat different benefits – such as house values and industrial location, relative to tourism and spiritual refreshment – and the economic literature appears to make no distinction. As with other non-market valuations, different studies report in different units, such as value per visit, per household, per year, per hectare, etc., and it is difficult to reconcile these.

3.6.2. Key studies with estimates of landscape value are identified below:
Cobbing and Slee (1994) attempted to value the public benefits of the 29,380ha Mar Lodge Estate in the Scottish Highlands using contingent valuation methods, using both 'willingness to pay' and 'willingness to accept' questions provides a value of £15.14 per person (although this appears to be a one-off payment, and would need conversion to an annual rent in order to yield an annual equivalent).

3.6.3. Willis (1994) undertook a contingent valuation study of alternative landscape scenarios in the Yorkshire Dales National Park and found that willingness to pay for the three most clearly wooded landscape options (conserved, sporting and wild) was around £34/household/visitor and about £26/head/resident household.

3.6.4. Benson (1994), assessing forest landscapes by a travel cost method, set a landscape value of around £10.6m for the Forestry Commission estate (800,000ha with tree cover) (£13.25/ha for the whole population of the UK) at 1988 prices. Bergin and Price (1994) using a travel cost method found a consumers' surplus (excluding accommodation costs) per visitor to fine landscapes of around £27/visit to the best landscapes and around £18 for attractive mixed landscapes.

3.6.5. Garrod (2002) presents results from a forest landscape benefits study based on a choice experiment approach. A survey of 400 households was conducted in 2002 in six areas across Britain. Results suggest that people have particular preferences for forest characteristics: small woodlands of mixed broad leaved trees of variable height interspersed with areas of open space (in addition the majority prefer to see woodland on hills and away from towns, although over half respondents also had equal preferences for forests on flatter land or near towns). The study suggested that most important WTP values were for views of broad-leaved woodland in peri-urban areas.

3.6.6. Annual household WTP was estimated at £268.79 for woodland views from home, and £226.56 for views while travelling to and from home. Aggregation of data was accomplished through identification of number of houses in urban fringe areas. Aggregate value of woodland landscape for England was estimated at £1.407 billion for value of woodland view from households, and £2.132 billion for value of woodland view based on journeys per household. The total value of views of urban fringe woodlands in England was thus estimated at £3.54 billion. The capitalised value per household (at 3.5% discount rate) amounted to £7,680. The capitalised value of woodland from travel from households was estimated at £6,473 per household. As we do not have an estimate of the extent of urban fringe woodlands, or the proportion of the regional population that might benefit, this measure of benefits is difficult to apply. However, if we assume the East of England has around 9% of the UK population and 20% of households benefit from woodland views from their households and travel the estimate of value is approximately £70 million per year.

3.6.7. Garrod also cites some previous studies estimating the contribution of trees to house prices. These include the following:

- Local trees add 4% to house price (Anderson and Cordell 1988)
- 20% general tree cover adds 7.1% to property values (Garrod and Willis 1992)
- WTP for the ideal forest landscape is £38.15/household per year (Entec-Hanley 1997)

3.6.8. Watson (2002) compared values for individual trees obtained through a range of appraisal methods, including the 'Helliwell method' for measuring the amenity value of trees and woodland used in the UK. This method rates seven factors related to amenity on a points scale with an assigned monetary value per point (£14 in 2000). Results of a study to compare methods revealed significant variations between methods, appraisers, and locations. Large differences between appraisers suggest the methods rely to a large extent on subjective judgements. The methods appear to be best suited to valuing individual trees in a local landscape, rather than woodland, and provide a wide range of values depending on tree age, species, and location.

3.6.9. Oglethorpe (2005) provided some estimates of the value of increased woodland using an Environmental Landscape Features model based on contingent value estimates of various features and a benefit transfer methodology. Household values for a 1% increase in woodland in the East of England were estimated to range from £4.63 to £6.98 with an average household value of £5.81 (or £13.7 million/yr).

3.6.10. Hanley and Colombo (2006) examined landscape values through willingness-to-pay for public goods in severely disadvantaged areas of England. A choice experiment design was used to explore values of landscape attributes. One interesting finding was that certain attributes were valued differently in different parts of the country. For example only those in the North-west region were willing-to-pay for improvements in rough grassland. Willingness-to-pay for a small increase (3%) in broad leaved and mixed woodland received variable values across regions: (£0.60/household/year in the South West, £0.85/household/year in the South East, and £0.59/household/year in the West Midlands. If the South-East figure is aggregated across the East of England it gives an estimated annual value of just over £2 million per year for a small increment in broadleaved woodland.

3.6.11. The Cydcoed (2009) study utilized the values derived in the Willis et al., (2003) study, which identified a value for households on the edge of urban areas with woodland landscape views. A value of £297/household/year (adjusted to 2008 prices) was utilised. However, the value was based on views of urban broadleaved trees in South-eastern England and there were concerns over the validity of transferring this to Welsh communities. Cydcoed focus group and interview data suggested that in some of the communities there were potentially significant improvements to landscape from planting and improved management in close proximity to residential neighbourhoods. The approach taken was to assume that where new planting has occurred in proximity to residential neighbourhoods there would be a stream of future benefits both to landscape and property values in the immediate vicinity of the new woodland (the Garrod study considered views of mature woodland rather than new planting). A cautionary estimate of 2.5% of houses with improved landscape views was assumed to have benefited in communities where new planting had occurred.

3.6.12. The more recent studies suggest that our 2003 estimate is reasonable but conservative. Garrod's study suggests the existence of woodland, certainly in peri-urban areas has a significant influence on house values and might increase value by 3-7%. Hanley's work, on the other hand suggests WTP for changes in woodland varies across regions and is small, in the range of £0.6 – 0.85 per household/year.

3.6.13. Modifying our 2003 estimate to account for inflation provides a value of approximately £47/household/yr, which would provide a current estimate of landscape value of woodland of £112 million per year (£855/ha/yr). Our figure of £112m would convert to a 'landscape-related' consumer surplus of £1.22 per visit (based on total leisure visits to the East of England's countryside), which seems reasonable when compared to earlier work. An alternative approach can be taken using the benefit estimate of £297 per household (originally derived from Willis et al., 2003) and assuming that 20% of the household's benefit from woodland and trees in the landscape in some manner. This provides an estimated landscape value of trees and woodland of £136 million/yr. We can conclude by stating that the landscape value of woodland lies in the range £112 – 136 million/year.

3.6.14. This is probably an underestimate as more recent studies which have come to light have shown that property prices increase in price by an average of 7% in environments landscaped with trees (CABE 2005). According to the North West Development Agency, a view of a natural landscape can add up to 18% to property in North West England and residents in peri-urban settings are willing to pay £7,680 per household for views of broadleaved woods, equivalent to £4.2 billion across the UK. (Cousins and Land Use Consultants, 2009)

3.7. Physical and Mental Health

3.7.1. This may be categorised as an ecosystem cultural service and relates to both social and economic pillars of sustainable development. The health benefits of outdoor physical recreation have been recognised for some time. Morris (2003) identifies a wide range of studies carried out in the 1980s and '90's exploring physical, mental and social benefits from increased activity and access to green space. She identifies a 2002 report that suggests a 1% per year reduction in inactivity among Scottish people would result in benefits of £85.2 million over five years (based on reductions in coronary heart disease, stroke and colon cancer).

3.7.2. The Forestry Commission have recognised the potential significance of using woodland for improving health benefits. A report from the Social Research Unit (Tabbush and O'Brien, 2002) suggested physical activity could be an effective alternative to standard medical treatment (i.e. with drugs) which might cost £14,635/person over five years for a 50% reduction in the risk of heart attack, stroke and diabetes, and a 30% reduction in the risk of colon or breast cancer. The report also highlights other potential health benefits from physical exercise including higher levels of happiness, self-esteem, quality of life, and optimism.

3.7.3. Other studies have explored the benefits of woodland in absorbing pollutants. Powe and Willis (2002) looked at the capacity for woodland to absorb airborne pollutants (e.g. Sulphur dioxide, PM10) and reduce mortality and morbidity. Analysing a number of European and North American studies they noted the difficulties of identifying does-response relationships, and added uncertainties from transferring such relationships from empirical studies in the USA to areas of the UK. The approach taken to measure health benefits of reduced pollution is rather convoluted. Willingness-to-pay (WTP)

figures from a 1999 Department of Health Reports (based on only two types of health outcome – increases in mortality and increases in respiratory hospital admissions) were utilised as a measure of the value of prevention of a statistical fatality (VPF) from air pollution. Benefits from avoiding/delaying mortality were measured using WTP values in the DoH report.

3.7.4. These figures were derived by 'adjusting' 1996 DETR WTP-based values for avoiding risk of a road fatality. This adjustment provided an air pollution VPF of approximately £2 million which was then adjusted by factors such as age, state of health, futurity (whether mortality from exposure occurs sooner or later) and attitudes to risk. Morbidity estimates were derived using NHS costs for a respiratory hospital admission of £1,400 to £2,500 and for cardio-vascular admission costs of around £1,500 to £1,700. Benefits of reduced morbidity include NHS costs, private household costs (e.g. medicines), lost output from people unable to work, and welfare costs based on pain and discomfort of illness.

3.7.5. A final figure was developed in the 1999 Department of Health Report – WTP to avoid a hospital admission of 8 – 14 days. This was based on a range of different WTP estimates to derive a quality of well-being (QWB) measure (i.e. the willingess-to-pay to avoid deterioration on the quality of well being necessitating hospital admission). Powe and Willis use the mid-point of the range (hospital admission of 11 days) and a figure of £530 (1996 prices). Their study uses National Air Quality Information Archive data on pollution from SO2 and PM10 and data on type and distribution of woodland from the Forestry Commission to come up with estimates of reduced economic costs of pollution due to tree absorption across the whole of Britain. Pollution absorption was estimated from studies on deposition velocities and surface area statistics from the literature (largely based on US studies). Mortality data (county level) and national hospital admissions data were utilised to identify deaths and admissions due to pollution. The authors identify uncertainties relating to absorption rates of pollutants and in the spatial relationship of people and trees.

3.7.6. It should be noted in a 2004 paper the same authors significantly reduced their estimated benefits of trees in reducing pollution. The paper altered the estimated benefits for the East of England significantly through reductions in estimated deaths and hospital admissions. No reasons are provided for the reductions. Given the

complexity of this approach, and the need for air quality monitoring, no estimate of the benefits of tree induced reduction in atmospheric pollutants is made.

3.7.7. However a 2008 study by Lovasi et al founds that tree lined streets have been associated with a lower prevalence of asthma in children, even after adjusting for potential confounding factors including socio-economic characteristics, population density and proximity to pollution sources. Considering that estimates by the Sustainable Development Commission (Health Place and Nature 2008) show that admissions to hospital linked to air pollution cost the NHS between £17 million and £60 million a year trees may have a significant role to play in improving air quality

3.78. A report to the Forestry Commission on economic benefits from access to green space (CJC Consulting 2005) suggested the cost of physical inactivity in England at £8.2 billion per year with an additional £2.5 billion contributing to obesity. Green space is examined for its potential to reduce the negative impacts of poor physical and mental health. The report suggested that a 1% reduction in sedentary percentage:

- could save 1,063 lives/year (or, 343 if population >75 yrs is excluded)
- could reduce morbidity cases by 15,000/year (or, 9,200 if older people excluded).

3.7.9. The annual value of decreased mortality and morbidity was estimated at £1.44 billion per year (or £479 million if older people excluded); an estimated 70% of the benefits are related to reducing coronary heart disease. No estimates were made for improvements in mental health. A 1% unit decrease in the sedentary population is equivalent to 596,000 individuals becoming active (excluding those aged over 75 yrs). The social value of moving someone from a sedentary to physically active state is estimated at £800 per person per year (the benefit to society from reduced morbidity and mortality).

3.7.10. Powell et al. (2009) estimated health benefits arising at the community level in a study of 25 community woodlands in Wales. ‘Average values’ were calculated for a community with the following characteristics: population 2,100; one primary school; a reasonable level of recreational activity in the woodland (including informal play, but no cycling provision or sculpture trail); an average level of benefits from health care; some ecological improvements (but no significant change to landscape).

3.7.11. Health benefits were measured as 'costs avoided' by reducing the incidence of heart disease from higher levels of physical activity related to improvements to community woodlands. Costs avoided were estimated at £2,500 per community per annum (or, £2.73 per household per annum).

3.7.12. Benefits from improved health and well-being are conservative and based purely on expenditure averted from reductions in the number of cases of heart failure. They do not include measures of benefit to individuals from living longer, or being engaged in full-time employment for longer periods, or benefits from avoiding other physical or mental disorders. Increases in physical exercise are also likely to have a positive impact through reduction in the number of illnesses, as well as on overall well-being and quality of life of individuals, all of which were suggested in the study but were not valued.

3.7.13. The Cydcoed study also explored levels of activity among community residents. Survey respondents were asked about the amount of physical exercise they undertook, and its regularity. A high proportion of the sample (88%) indicated they undertook some form of exercise while 12% did no exercise. Slightly over one third of those indicating they engaged in exercise did so at a 'brisk' or 'fairly brisk' level of activity: a level that is adequate to improve physical fitness, while just over a third (37%) exercise at an 'average' rate. The data also suggested that a larger proportion of those exercising at the higher rates are in younger age groups (for example, nobody over 64 yrs old exercised at a 'Brisk' rate).

3.7.14. The survey also examined affects of the woodland projects on physical health, and on overall well-being of those involved in the woodland projects. The results indicated around one third of the sample stated their physical health had improved since becoming involved with the project. A larger proportion of the sample indicated improvements in overall wellbeing (described in the questionnaire as including 'stress levels and attitude to work and life in general'). Around one half indicated an improvement and the other half no change. Nearly one fifth (18.4%) of the sample indicated a 'considerable improvement' and nearly one third (32.6%) indicated a 'little improvement' in overall wellbeing.

3.7.15. Overall the survey data suggest that around 40-50% of respondents involved in the community woodland projects benefited from improved physical health, albeit in a minor way, and a slightly higher proportion (perhaps 50-60%) benefited from overall improvements in wellbeing. Health benefits also require continuation of physical activity levels into the future. This may require development or continued operation of walking groups, or other forms of recreational and exercise support groups to maintain levels of healthy activity.

3.7.16. Care has to be used when interpreting the benefits identified in the literature, as little allowance is made for the value of trees relative to other forms of vegetation, the size of woodland necessary to produce the effect (which is very unlikely to show a simple linear relationship), the location of planting in relation to where people live (found to be significant in the Cydcoed evaluation), and the quality of planting (for example, it has been suggested that monotonous conifer plantations could be depressing).

3.7.17. More recent studies indicate the cost of cardiovascular disease (CVD) in the UK and other developed countries. Luengo-Fernandez et al. (2006) explored the cost of cardiovascular diseases (CVD) in the United including health and non-healthcare costs, and the proportion of total CVD cost due to coronary heart disease (CHD) and cerebrovascular disease. Healthcare costs were estimated from expenditure on community health and social services, accident and emergency care, hospital care, rehabilitation and drugs. Non-healthcare costs were estimated from data on informal care and from productivity losses arising from morbidity and premature death. The study found that CVD cost the UK economy £29.1 billion in 2004, with coronary heart disease (CHD) and cerebrovascular disease accounting for 29% (£8.5 billion) and 27% (£8.0 billion) of the total, respectively (including informal health care and productivity losses). CVD alone was estimated to cost the NHS £15.7 billion in 2004 representing 21% of expenditure. Overall for the UK health care accounted for 60% of the cost, productivity losses due to mortality and morbidity accounted for 23%, with the remaining 17% due to informal care-related costs. In a comparison with other illnesses only the costs of mental illness surpassed CVD costs.

3.7.18. For example the report by the Faculty of Health with Natural England 2010 - Great Outdoors: How Our Natural Health Service Uses Green Space To Improve Wellbeing, Stated that, ‘Almost one in six people in the UK will suffer from mental ill-health, such

as anxiety or depression, in their lifetime. Mental ill-health can cause, and be caused by, health and social inequalities. It accounts for almost 20% of the burden of disease in Europe. Poor mental health also costs the economy an estimated £26.1 billion a year, because of the thousands of people unable to work due to their mental illness. Safe, green spaces may be as effective as prescription drugs in treating some forms of mental illnesses, without the costs of side-effects and ever-rising numbers of prescriptions.' However, the document talks about 'greenspace' and although it is likely to include woodland it is impossible to separate this out. The figures above relate only to one disease, and one aspect of the health benefits of woodland. The NHS improvement plan (Department of Health, 2004) noted the population of England was ageing with an increase in cancers, heart disease and strokes, which "account for 35% of 'life years' lost before the age of 75".

3.7.19. Using a costs avoided approach could provide an alternative measure of health benefits from woodland. The costs of working-age ill-health have a major impact on the economy in the Governments response to Dame Carol Black's review of the health of the working age population they state that 'estimated that the annual economic cost of ill-health in terms of working days lost and worklessness was over £100 billion – equivalent to the annual running costs of the NHS. The Confederation of British Industry (CBI) estimated that last year 172 million working days were lost due to absence, costing employers £13 billion'. (Improving health and work: changing lives - Govt response to Dame Carol Black's review of the health of Britain's working age population) This breaks down to a cost to business of working days lost through ill health in the East of England to be between £1.17 to £1.43 billion/yr.

3.7.20. A recent comparative study of the costs of a stroke (Luengo-Fernandez et al. 2008), identifies significant variability both between and within some countries (e.g. the USA). The mean cost of a stroke across 71 studies was $19,018 (median $14,571) although one third of the studies only reported hospital costs so this might underestimate the total costs. Where studies included more cost categories, 65% of costs were attributed to initial hospitalisation costs. In a study on European health care costs (Allender et al., 2008) CVD was estimated to cost the health care systems of Europe around €110 billion in 2006, or a per capita cost of €223 (10% of total health care expenditure in the EU). Inpatient hospital care accounted for 54% of costs and drugs accounted for 28%. These figures are considered an underestimate of the true costs as they do not take

into account production losses from death and illness. Overall CVD is estimated to cost the EU economy €192 billion per year (or €391 /capita/yr). Total CVD health care costs in the UK are estimated at €18.9 billion or €313 /capita/yr; non-health care costs amount to €20 billion for CVD, €7.4 billion for CHD and €6.8 billion for strokes.

3.7.21. Applying the Cydcoed health care costs avoided figure of £2.73/household/yr to the East of England produces a level of health benefits from woodland of £6.49 million/yr from avoided costs of heart disease alone. However, this is based on the assumption that all communities have access to nearby woodland in which to take physical exercise, which is not the case across the East of England. On the other hand the figure would be higher if other physical diseases (e.g. diabetes) and mental disorders (such as stress) were taken into account.

3.7.22. The figures above relate only to one disease, and one aspect of the health benefits of woodland. The NHS improvement plan (Department of Health, 2004) noted the population of England was ageing with an increase in cancers, heart disease and strokes, which "account for 35% of 'life years' lost before the age of 75". Using a costs avoided approach could provide an alternative measure of health benefits from woodland.

3.7.23. If we assume annual UK per capita costs of CVD are €313 then using the population (2002 estimate) the cost of CVD becomes €1.699 billion (£1.393 billion in June 2010) in health care costs and a further (€307 /capita/yr) €1.6 billion in non-health care costs. A 10% reduction in CVD as a result of increased activity of the population would result in €169.9 million of avoided health care costs, and if 10% of this was ascribed to physical activity in woodland or forest areas it would result in avoided health care costs of €16.99 million (£13.8 million) per year. Total avoided health and non-health care costs would amount to €33 million (£27 million) per year for the East of England.

3.7.24. A more conservative estimate of health benefits can be obtained by applying the Cycoed estimate of avoided health care costs of £2.73/household/yr for communities with access to a local community woodland. This is based on a conservative estimate of the number of households that might benefit from improved health (and thus avoid costs associated with heart disease) through undertaking physical exercise in local community woodland. Aggregating this measure across the East of England suggests

avoided health care costs in the region of £6.44 million/yr, and doubling this amount to £12.88 million/yr if non-health care costs are also included (in line with the Allender et al. 2008 study).

3.7.25. Considering all these figures, we propose that avoided health care costs associated with physical activity undertaken in the East of England lie in the range £6 - 14 million/yr, and if the non-health care costs are included the total avoided costs are in the **range £12 - £27 million per year**. this is a conservative estimate as it only takes into account one disease (CVD) and does not account for the potential reduction in costs associated with a wide range of other illnesses (particularly mental illnesses which have costs exceeding CVD) resulting from exercise taking place in the East of England's woodlands.

3.8. Education

3.8.1. Education may be categorised under the ecosystems cultural category and form part of the social pillar and underpins the economic pillar of sustainable development. Woodlands have important educational values both as immediate settings for schools and as places to visit for outdoor work. Evidence suggests that improving the quality of the space can bring about changes in behaviour and relationships, reduce accidents, ease tensions, reduce bullying and confrontation and provide increased opportunities for learning.

3.8.2. The Cydcoed programme evaluation (Powell, et al. 2009) explored educational benefits of community woodlands through interviews and focus group discussions in 25 communities in Wales, revealing some of the potential problems and costs, as well as the benefits at different educational levels. The involvement of formal education was found to be important in many of the Cydcoed projects. In one community, for example, the local Primary and Secondary Schools were involved in the woodland project itself. In another community the local project board felt there was a need to involve schools in order to bring youngsters 'on board'. The tree planting involved three local schools and school children also designed the gates to the site, which depicted different animals, birds and fish. The provision of disabled access also made it much easier for the local special school to use the site for activities such as pond dipping.

3.8.3. Interviews with teachers showed that school involvement appeared to fall into two groups. Primary schools were able to use the community woodlands to meet some national curriculum requirements, for example, through studying habitats as part of the science curriculum. In one case a series of worksheets for use in the woodland, linking with the national curriculum in science, mathematics, art and geography, were produced as part of the project and made available online. In another community the wood had been used for drama and film activities, as well as science and that most of the classes in the school used it about once per year from everything from a walk to a science lesson. The woodland project in this example had resulted in major improvements to footpaths that actually made access easier and gave teachers more confidence in taking classes there. In the case of secondary schools, the pupils involved in accessing the woodlands had usually been exempted from the national curriculum, and used the woodland for key-skills work.

3.8.4. In one community woodland project the educational element was a central focus. Teachers from five local schools got together to design and establish a discovery trail. They also used a local company to design a website and a printed pack was also produced based on the website and distributed to all 30 schools within 5 miles of the woodland. In National Tree Week, over 200 trees – oak, ash and hazel – were planted, involving over 200 children from 5 local schools. Two local schools were found to be using the woodland regularly but others were 'timid' as the site is steeply sloping and they had concerns about safety (safety issues were cited in several schools as reasons not to use local community woodlands).

3.8.5. The research found that children enjoyed visiting the woodland and, in general, teachers reported that when visiting woodlands the pupils were more visibly relaxed, learned about their local environment, worked together and became more confident. There was a difference of opinion as to whether behavioural improvements were transferred to the classroom with some teachers supporting the idea, and others not so sure. Other benefits mentioned by teachers were development of language skills, creativity and physical development (all for infants); leisure and social skills (for special school pupils); fresh air and having to follow instructions and stick to rules (primary school pupils), looking after each other, gelling as a group and getting ideas for careers (secondary pupils).

3.8.6. Measuring the 'value' of educational outcomes is more difficult and little work has been carried out in estimating the welfare benefits of outdoor education. No welfare estimates were found in the literature for the value of field trips which may have multiple benefits depending on the kind of activities undertaken (e.g. deepening understanding of subject material, physical health, bonding and socialising). Woodland educational visits may also have benefits for teachers in terms of making their teaching more enjoyable, easier, or more effective. Provision of outdoor facilities within walking distance of a school may also reduce the administrative burden of running a field visit (e.g. hiring buses, logistics and disruption of other activities). Despite this a range of educational benefits is evident at all educational levels from primary to secondary, including excluded pupils and special schools. Benefits range from being able to undertake work outside the classroom that can be integrated into the national curriculum at primary level, to developing teamwork, vocational skills and confidence in young teenagers at secondary level.

3.8.7. The approach taken in the Cydcoed evaluation project was based on an averting expenditure (or costs avoided) approach. The evaluation indicated that schools were making greater use of existing woodland through new or improved access, and making use of new woodland through involvement in design, planning, and tree planting. In the absence of monetary benefit estimates the approach taken was to estimate the cost per pupil of a trip to a comparable site where the educational input must be paid to an external provider. For example, a day trip to a local field centre might cost £25 per pupil including transport, while a 4-day stay at an outdoor centre could be as much as £160 per pupil. Where trips involve bus transport pupils might easily be charged £5-10 each. Where access had been improved (or provided) for a local woodland, within walking distance of a school, use of that area represents a 'cost avoided', compared to using a different area further away (no measure of administrative time savings by teachers/secretaries was made). As most of the woodland visits identified in the programme were local and of short duration (e.g. 2-hours to half-a-day) a conservative estimate of value of £5 per visit per pupil was utilised. Many primary schools engage in whole class activities in local Cydcoed project woods, and the evaluation revealed that improvements to woodland access increased this level of activity. Secondary schools benefited from educational visits, vocational teaching (especially for excluded pupils) and a small number of special schools also used some of the woodlands.

3.8.8. The evaluation found that 72 community woodland projects across Wales reported involvement of primary schools with an average of 180 primary pupils per project benefiting; and 33 projects reported involvement of secondary schools with an average 153 of secondary pupils per project benefiting. Where schools utilised the project woodlands the total annual benefits per community in terms of expenditure avoided were estimated to be £2,165 per community.

3.8.9. A small number of special schools also used the woodlands but this was not found to be a common occurrence. Benefits at University level were not included in the study although there was evidence that at least one Cydcoed project had provided university student placements, and another has been used as a study site for environmental science students. One additional indirect benefit that was identified (but not investigated) was greater use of community woodland by other family members resulting from increased familiarity by a pupil through school activities. The Forest Schools website (http://www.forestschools.com/primary-school-forest-schools-case-study.php) also indicates evidence that primary school pupils taking part in projects have taken their parents back to the woodlands where they have studied.

3.8.10. Further evidence of educational benefits of woodland comes in the success of the forest schools that have been established across the UK. In 2006 there were an estimated 100 forest schools in England and 20 each in Wales and Scotland (http://www.forestresearch.gov.uk/pdf/SERG_Forest_School_research_summary.pdf/$FILE/SERG_Forest_School_research_summary.pdf). O'Brien and Murray (2006) evaluated outcomes from forest schools in Wales and England noting positive changes in behaviour as well as contributions to confidence, social skills, language, physical skills, and knowledge and understanding. Forest Schools are identified as activities taking place in woodland settings with high adult to pupil rations and where the activities may or may not be focused on the national curriculum. In many cases they are supported by local education authorities in terms of providing instructors, or through training local teachers.

3..9.11. In the East of England there are a number of Forest Schools established. Forestry Commission evidence suggests 150 schools have been grant aided, although the nature of a 'forest school' varies. The Forestry Commission note that in 2007 a

£100,000 grant was set up to aid the establishment of forest schools with 24 applications being received in the second year of the grant from across the East of England. (www.forest-schools-east.org) A partnership between the Forestry Commission and the Green Light Trust has established 'Forest Schools East' which uses Woodland Improvement Grant money to provide training and support the establishment of forest schools. While the educational benefits have been identified there is little evidence of valuation. One forest school in Northamptonshire indicates the cost of a forest school at £6 per child per session (each session lasts 6 weeks and is for a maximum of 10 children). (http://www3.northamptonshire.gov.uk/NR/rdonlyres/23034E6C-77E0-47A5-8663-D54556CE38FA/0/FantasticfunatTheForestSchool.pdf)

3.8.12. The Forest Schools website for the East of England - http://www.forest-schools-east.org/training.htm cites a training cost of £850 for the OCN Level 3 Forest School Practitioner Training and Assessment by one person. Level 1 Forest School Skills Award - is available to people who only want to work on existing school/nursery/playwork sites Course Fee: £265

3.8.13. The importance of school visits to woodlands can be gauged by reference to the Forestry Commission's website, which draws attention both to specific educational facilities, such as the Forest Classrooms and Education Centre at Cannock Chase, which offers organised programmes designed in accordance with the National Curriculum, and to forest schools, resources for teachers, and more general forest visits by educational groups. All of these are supported within the Forest Education Initiative which aims to increase young people's understanding of the local and global importance of trees and woodland, the forestry industry and the timber trade. The Forest Education Initiative has had various launch events (e.g. the 'Ecofun' festival near Cardiff in 2000), whilst the Scottish education 'clusters' host a website.

3.8.14. Little reliable evidence exists on the non-market economic value of school visits to forests. Using the Cydcoed approach of costs avoided by having access to a local woodland, a conservative estimate of benefits might be in the range £5 - £10 (as it does not include savings in time for teachers and administrative staff, nor does it include reductions in fuel consumption and emissions from avoiding motorised transport, and is not too dissimilar from the £6 per pupil per session cost identified for a

forest school). Assuming 20% of all pupils in any one year benefit from one woodland visit per year, a conservative figure **of £0.82 - £1.64 million per year** can be assigned to the East of England for educational benefits (based on assumption of 0.82 million children in full time education in the East of England; http://www.dcsf.gov.uk/rsgateway/DB/SFR/s000786/index.shtml) This estimate may be too low given the actual number and/or costs of school field trips undertaken to outdoor sites and field centres, and the wide range of benefits identified from forest education, and it may not capture the full educational benefits.

3.9. Physical Environment

3.9.1. The 'physical environment' falling into the environmental pillar of sustainable development and includes various 'regulatory ecosystem service' contributions of woodland:

- carbon sequestration - air quality - water quality

Carbon Sequestration

3.9.2. One area of increasing interest over the past decade has been the amount of carbon 'locked-up' or sequestered in plant woody material and soils. This is a very complex area of benefit estimation that is still under development and subject to change. A significant amount of research has explored both the capacity for different species of tree to absorb carbon dioxide, and the value of that sequestered carbon in terms of benefits from reductions in greenhouse gases. Benefits from forestry arise in the capacity for woody plants and forest soils to extract carbon dioxide from the atmosphere and lock-up the carbon. In managed forests this may be for a relatively short period of time if the timber is harvested and used for fuel or to produce wood products which have a short period of use. However, use of timber in construction extends the period of storage. Old growth, unmanaged, forests represent more permanent carbon storage and, although individual trees may die and decay, they will be replaced and the woodland itself will retain its carbon store, unless natural or human interventions affect the size of the carbon store.

3.9.3. Following planting, trees enter the establishment phase when growth and carbon uptake is relatively slow. They then enter the 'active growth phase' when rates of carbon uptake are high followed by a gradual decline as the tree/woodland matures.

Thus forestry, when practiced as a conventional clear fell silvicultural system, reveals a cyclical pattern to carbon capture and release and can be considered as a 'non-permanent' carbon sink (Valatin, 2010). However, when viewed across a landscape with an even distribution of age classes, afforestation represents a one-off increase in carbon stocks per unit land area; the individual stands of trees may show large fluctuations in the amount of carbon stored, but as a whole, the landscape carbon stock increases to a steady state level after which sustainable forest management will maintain this increased carbon stock. One estimate suggests the maximum rate of carbon accumulation in fast growing stands in the UK is 10 tonnes of carbon per hectare per year (tC/ha/yr), while the average over a full commercial rotation is closer to 3tC/ha/yr. The maximum quantity of carbon accumulation in woodland over the life cycle of a stand of trees is estimated to be 200tC/ha, although commercially managed stands are assumed to average 100tC/ha over several rotations. (Broadmeadow and Matthews, 2003)

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3.9.5. Processes affecting soil carbon are also complex. Ostle et al. (2009) explore the role of land use and land use change in controlling the ability of soils to sequester and store carbon. They note that forest and woodlands account for around 80% of the vegetation carbon stock in the UK. They suggest forest areas sequester on average approximately 110Kg (+ or – 4kg) of carbon/hectare/year and that plant matter is the single most important source of carbon into the soil. Carbon stocks in soil build up slowly through organic matter inputs, but can be released quickly following land use changes through rapid decay of the organic fraction. Losses of soil carbon can occur from changes of native forest to plantation forest and forest land to arable (but not necessarily when the change is from forest to grassland), and that soil carbon can be increased by planting native hardwood species.

3.9.6. In 2007 the UK provided guidance (Defra 2007) following the Stern Review. It used the social cost of carbon (i.e. lifetime damage costs associated with increasing greenhouse gas emissions) to set a value for emissions changes in 2007 of £25.5/tonne of carbon dioxide equivalent (CO_2e) (2007 prices) increasing at a rate of 2% per annum. A more recent appraisal of carbon valuation work (DECC 2009 see Annex 1) identifies short term and long term valuation figures that will be utilised in UK government appraisal work. This presents a new approach to using carbon values based on what is known as 'the traded price of carbon' for policy appraisal policies that lead to increases/decreases in emissions "in sectors covered by the EU Emissions Trading System (ETS). Where policy change leads to changes in emissions not covered by the EU ETS a short term 'non-traded price of carbon' is to be used". The social cost of carbon is the approach taken to establish values based on the marginal damage costs associated with incremental increases to emissions of global greenhouse gases. Central to the selected approach is the use of low discount rates to measure damage over time. Selecting a low discount rate (based on Stern Review arguments) enabled the relationships between emissions and temperature increases, and between damages and temperature, arising from policy changes, to become more apparent. Selection of a low discount rate essentially helps to highlight the present values for a given level of economic damage is higher for policy options where those damages occur far in the future. (DECC, 2009)

A recent update by DECC (2010) provides the following values:

- £22/tonne CO_2e - Short term traded price of carbon for 2010 (£79/tC) for sectors covered by EU ETS
- £52/tonne CO_2e - Short term non-traded price of CO2e in 2020 (£190/tC) for non-ETS sectors

Both the above rising over time to:£308/tonne CO_2e - Long term in 2077 (£1129/tC) at 2009 prices

3.9.7. Estimates are based on target reductions of 34% (compared to 1990 levels) by 2020 and 80% by 2050 (limiting global temperature increase to 2 degrees Centigrade and atmospheric concentrations of Green House Gases (GHG) to within 460-480 parts per million (pmm) CO_2e in 2200. If global emissions accelerate, or impacts are greater than anticipated then the social cost of carbon might have to be revised upwards.

Estimating the Carbon sequestration value of UK forests

3.9.8. Carbon sequestration is generally accepted to be an important non-market benefit of forestry, and carbon sequestered by forestry is rising over time (as the area under woodland increases). The Forestry Commission estimated that carbon sequestration in British forests accounted for approximately 2.9 million tonnes of carbon per year (in 2001) of which 0.4 million tonnes is allowable as an offset under the Kyoto Protocol. (Thomson and Snowdon, 2005) The same paper applied a value of £14.67 per tonne of sequestered Carbon (at 3.5% discount rate) which gave a net present value of £5.92 billion (for Britain) and an average value of £2,098/ha of woodland. At a value of £70 per tonne Carbon the net present value of carbon sequestered in British woodlands was estimated at £28.2 billion (or £10,011/ha). The paper estimated the UK could not become 'carbon neutral' through afforestation alone, which would require creation of an estimated additional 50 million ha forest (or double the land area of the UK).

3.9.9. The 2003 Woodland Wealth study estimated that trees and forest soils in the East of England would sequester about 117,800 t/C/yr, and would have a total mean stock of just over 18.6 million tonnes. Using these figures and the short term non-traded price of carbon of £190/tC from DECC 2010) this would result in a value of £22.38 million per year (in 2010) with a total present value of £3.534 billion based on the current stocking level with values rising over time in line with the predicted value increases in the traded price of carbon. For comparative purposes, using the Thomson and Snowdon (2005) estimates of value per hectare (based on calculations from 2003) gives a range of value from £291.6 million to £1.391 billion for the East of England's current woodland area.

Brainard, Lovett and Bateman (2003) modelled the carbon sequestration benefits of woodland (looking at different species and both public and private woodland), and estimated some net present values of carbon in woodland in the East of England (at 3.5% discount rate) as indicated in Table 2.4 below.

Table 2.4 Net Present Value of carbon in East of England woodland (Present value estimates over period 2003-31 in £millions at 3.5% discount rate)

Carbon Values utilised	2003 value of carbon = £6.67/tonne with £0.067 annual increment to 2031	2003 value of carbon = £14.70/tonne with £0.167 annual increment to 2031	2003 value of carbon = £70/tonne with £0.67 annual increment to 2031
All FC woodland	£24.09	£53.23	£252.7
All private woodland	£111.98	£247.25	£1175.21
Total	£136.07	£300.48	£1427.91

Source: Brainard, Lovett and Bateman (2003)

Note – values in the table are in £millions

3.9.10. They suggest that using the median value of carbon (of £14.70/tonne) and a discount rate of 3.5%, the total value of sequestered carbon is £5.92 billion (in 2003, or £6.97 billion at 2009 values). Average per hectare value of carbon sequestered in woodland (adjusted to 2009 values) were estimated at: Broadleaf £2,687; Conifer £2,325, and a GB woodland average of £2,472.

3.9.11. In the 2003 Woodland Wealth study estimates of the total carbon content of woodland in the East of England were made using the CO2Fix Model developed at Wageningen in the Netherlands (Nabuurs et al, undated). Based on an assumption of 139,112 ha of forest, the mean annual carbon stock was estimated at just under 3mt/C for conifers and just over 13.2mt/C for broadleaves. The mean annual increment provided by the model was just over 200,000t/C/yr for tree biomass. Using these estimates of biomass and the non-traded sector values for carbon from the DECC report; we can derive the following estimates for 2010:

Source	Carbon (million tonnes)	Value (per tonne C)	Total Value (£million)
Conifers	3	190	570
Broadleaves	13.2	190	2508
Total 2010	16.2		3078 (the low estimate)
Increment/yr	0.2	190	38

3.9.12. Estimating the total amount of carbon itself is not easy. The last inventory of woodland in the East of England (published 2002) assessed the area of woodland to be 139,112 ha. The Forestry Commission are now surveying for a new National Forest Inventory but these data are not yet available so this 2002 assessment is out of date. At the same time the detailed age, composition and management of private woodland is largely unknown (although it is known that many areas of woodland are unmanaged) meaning accurate estimates of both annual carbon sequestration and total carbon stock are difficult.

3.9.13. Recent estimates of the potential carbon uptake have been calculated by FC personnel (2010) for the East of England based on data held on the Woodfuel Resource Website. Using the 1998 National Inventory of Woodland and Trees there are estimated to be 46,111 ha conifer/mixed woodland, and 85,006 ha are broadleaf, coppice/coppice with standards in the East of England. The potential net carbon uptake associated with existing woodland, (assuming a uniform age distribution) is estimated to be 484 $ktCO_2$/yr for conifer woodland, and 527 $ktCO_2$/yr for broadleaf woodland (or, a total of 1.1 million tonnes CO_2/yr), excluding soil carbon sequestration. Using Chapter 8 of the Read Report (Combating climate Change – a Role for UK Forests: www.forestry.gov.uk/readreport) two woodland creation scenarios are explored for sequestration in growing biomass only (less emissions associated with establishment and management) over a full rotation.

Case D1: (native Yield Class 4 Sycamore/ash/birch unmanaged woodland, assumed over 100 years): 6.2 and 8.8 tCO_2/ha/yr.

Case E1: (Yield Class 16 Douglas fir/Sitka spruce managed over 60 year rotation):10.5 and 12.0 tCO_2/ha/yr.

Note: Yield class is an assessment of volume increment of a stand of trees, measured as cubic metres/ha/yr. these carbon values are calculated as the standing biomass at the end of the rotation (before felling) divided by the length of rotation. The carbon removed during thinning operations is not included. The carbon uptake associated with woodland planted since 1998 could be included using the same approach, applying a figure of 8 tCO_2/ha/yr. Note also that the species models are those available which best represent conifers and broadleaves, although it is acknowledged that these species are not particularly associated with the East of England.

3.9.14. Using the DECC 2010 non-traded estimates for the value of carbon as follows:

- 2010 £52/tCO_2 e (rounded up figure)
- 2030 £70/tCO_2e
- 2070 £301/tCO_2e

values can be estimated for the level of carbon sequestration in existing woodland in the East of England and for the two different scenarios.

Table 2.4

Social value of annual carbon sequestration for woodland in the East of England	**2010 (£million)**	**2030 (£million)**	**2070 (£million)**
Existing woodland (1998)	57.2	77	331.1
Woodland planted since 1998 (4,900 ha) approximate figure funded through EWGS	2.0	2.7	11.6
Scenarios:	£ per hectare	£/ha	£/ha
Case D1 woodland	322.4 (457.6)	477.4 (616)	1866.2 (2648.8)
Case E1 woodland	546 (624)	735 (840)	3160.5 (3612)

(Figures in brackets are inclusive of changes in soil carbon stock)

3.9.15. The figures above suggest that in 2010 the value for the annual increment in carbon sequestration is just under **£60 million per year**, rising in value to £342 million per year by 2070. The estimated stock of carbon locked up in the woodlands and trees is estimated to have a total present value of **£3.534 billion** based on the current stocking level with values rising over time in line with the predicted value increases in the traded price of carbon.

3.9.16. Case D1 woodland (with soil carbon included), a broadleaved unmanaged option, is similar in its capacity to sequester carbon to the existing woodland stock but over a rotation would give slightly higher total values. Case E1 woodland, a managed coniferous option creates significantly greater value through absorption of higher levels of carbon (even if soil carbon is discounted). However, this value of carbon should not be viewed in isolation, but set against other forest values including timber production, biodiversity, landscape, recreation, and health. Evidence suggests, for example, that biodiversity, landscape and recreation values may all be lower for commercial coniferous woodland than for broadleaved woodland. While woodland will continue to play a key role in managing carbon, it will not solve the problem of greenhouse gas emissions, which will ultimately depend on reductions in fossil fuel consumption. Management options need take into account the multi-functional nature of woodland rather than focus on a single ecosystem service.

Water and air quality

3.9.17. The 2003 Woodland Wealth study noted the potential value of trees and woodland filtering pollutants from both air and groundwater. Some recent studies have emphasized the potential for woodland to improve environmental quality. Eftec - Economics for the environment consultancy ltd (2005) identify a range of ecosystem services provided by woodland, including erosion control and flood risk mitigation. Broadmeadow and Ray (2005) emphasise the potential increased importance of woodland under future climate change scenarios in enabling adaptation and mitigation of negative impacts. Examples include: attenuation of downstream peak water flows, reduction in water temperature (and protection of fish populations) through shading by riparian woodland, reductions in soil erosion (which could become greater through drier summers and wetter winters), shade and reductions of ‘heat island’ effects in built up areas, and removal of pollutants.

3.9.18To measure the economic benefit of woodland relative to pollution we have updated the values in the approach taken in the 2003 Woodland Wealth study. Research by Ecotec (1993; reported by Myers, 1998) found that pollution abatement expenditure in EU countries varied between 0.5 and 1.6% of GDP, with the UK at 1.2%. In the East of England, therefore, the annual costs would be £2.25 billion (2009 values) for all types of pollution. As a first approximation, taking the 4-5% mitigation effect of 20% woodland cover on air pollution as a general indication of all pollution benefits, a 7.3% woodland cover might mitigate costs by around 1 - 2% or around £22 - 45 million annually (2009 values).

3.10. Summary of non-market benefits

3.10.1. Table 5 below summarises data from the text in this section to illustrate the range of annual non-market values provided by woodland in the East of England. The values are dominated by the social value of the stock of carbon locked up in the existing woodland, constantly being added to through annual sequestering of carbon in new growth and forest soils at the rate of £22 – 57 million per year. Recreation and tourism comes second place in terms of value behind the carbon value - being the next largest source of woodland 'wealth' providing benefits in the range £400 – 700 million/yr.

3.10.2. As indicated in the text, varying levels of uncertainty underlies all of these benefit estimates, and assumptions have been made to determine value ranges. In all cases we have been cautious and have taken a conservative approach to estimating values, especially where information is contradictory or missing.

Table 2.6 Summary of non-market benefits

Activity	Range of values (£million/yr)		
	Low	High	Mid-point
Biodiversity	36	107	71.5
Landscape quality	112	136	124
Health costs avoided: health care costs only	6	14	10
Health costs avoided: Health care + non-health care costs	12	27	19.5
Education costs avoided	0.82	1.64	1.23
Carbon sequestration: Annual increment	22.38	59.2	40.79
Water and air quality	22	45	33.5
Total	205.20	375.84	290.52
Carbon sequestration: Value of stock carbon	3,078	3,534	3,306

4. THE MARKET BENEFITS OF WOODLAND

4.1. Introduction

4.1.1 This can be categorized as ecosystem provisioning services and relates to the economic and resource efficiency pillar of sustainable development (Employment also relates to the Social element) This section of the report looks at the woodland and timber industries of the East of England and provides some approximations of the market value of woodland. Estimating employment and market values of timber at the regional level is difficult given the limited information on the private forest sector. The estimates presented here relies to a large extent on the national inventory of forests and woodland conducted at the end of the 1990s, a study by PACEC in 2000 of the contribution of English forestry to rural economies, and some empirical data collected in the Woodland Wealth Survey of 2003. No new data were collected for this report.

4.1.2. The total area of woodland in Great Britain is estimated to be 2,665,125 ha, or 11.6% of the land area (Forestry Commission, 2003); 41% of which is in England; 35% is in Forestry Commission management and 65% in other forms of ownership. The Forestry Commission (2001) estimate that the East of England has 144,428 hectares forest and woodland (7.3% of the East of England's land area), or 12.6% of the total hectares of woodland (>0.1 ha in size) for England. This is 5.2% of the total area of woodland in Great Britain.

4.1.3. Recent Forestry Commission (2010) UK statistics for 2009 suggest a total harvesting of 8.8 million green tonnes softwood and 0.5 million green tonnes hardwood, with a value of £1.5 billion for all wood product exports. For England as a whole, total softwood production has grown over the period 2003-2009, amounting to 1.827 million green tonnes in 2009, while hardwood production has decreased slightly from a high of 0.52 million green tonnes in 2005 to 0.468 million green tonnes in 2009. Currently the East of England accounts for 10% of all sawmills in England (2009 figures) and 9.3% of all sawn softwood production in England. Using the wood production figures for England and the estimated 12.6% share of production from the East of England provides slightly different estimates of output: 230,202 green tonnes of softwood and 58,968 green tonnes hardwood. According to FC statistics, in 2009 the softwood consumption by the existing East of England sawmills was 146,000 green tonnes. Some of this capacity will be imported from other parts of the UK and abroad; some

regional timber will be exported. In addition there will be perhaps 20,000t of conifer used for biomass. Estimates of hardwood (broadleaved) timber are more problematic

4.1.4. Current estimates for the Forestry Commission estate predict that annual thinning and fell volumes for softwoods in the East of England will continue to grow until around 2026-2030, suggesting that the market value of woodland in the East of England will continue to grow. New planting in England has continued, at a declining rate, in England since 2004, accounting for 16,900 hectares of new woodland and restocking has occurred on 15,500 ha over the same period. One unknown is the actual value at sale; market prices tend to be volatile and influenced by imports.

4.2. The Woodland and Timber Economy

4.2.1. The core 'woodland industry' consists of establishment, maintenance and harvesting. Upstream linkages comprise suppliers of seeds, fencing, chemicals and fertilisers, fuel, equipment, and professional services. Downstream linkages comprise mainly the processing facilities (sawmills, paper and board plants, wood-based panel mills, etc.). In regions with large woodland and timber industries, it is likely that these linkages can be provided internally, but the timber industry is characterised by large economies of scale and highly specialised equipment and services, so economic 'leakage' can be extremely high. With regard to employment, a high proportion of direct labour is drawn from a local catchment – PACEC (2000) found this to be as high as 94% - and is thus significant in the context of rural development.

4.2.2. Estimates of market values of woodland rely on application of information found in the benchmark study of the English industry, PACEC (2000), which analysed the role of forest establishment, maintenance and harvesting, together with an economic impact and multiplier analysis for timber processing, across different types of woodland. The study has used these multipliers, along with revised estimates of employment and economic output (through application of a calculator based on the Retail Price Index), to derive two measures of the 'direct' economic impact of timber: the net output (staff costs + profit) and gross output (sales + change in value of stock). The study has also provided estimates of 'indirect' effects (gross and net output and employment arising from supplier linkages outside the forestry industry) and 'induced' effects (gross and net output and employment effects arising from the spending of wage income and distributed profits arising in the forestry/ processing sector and supplier industries).

These estimates are using sources of data that are now, in some cases, over 10 years old, so caution must be exercised in their utilisation.

4.2.3..The key to using the PACEC (2000) calculations is estimating the level of employment in forest and forest related processing industries. The most recent Forestry Commission surveys provide the figures illustrated in Table 3.1, indicating an increase in employment in forestry and wood product sectors, but a decline overall of 12% when other related activities such as panel and pulp and paper production are taken into account.

Table 3.1 Employment in forestry and forest related activities 2003-07 (000 FTEs) in the UK

Activity	Standard Industrial Classification (SIC) Code	2003 (000 FTE)	2007 (000 FTE)	% change
Forestry	02	12	13	+9
Wood products	20			
Saw milling	20.1	11	12	+9
Panels	20.2	6	5	-16
Other products	Other 20	71	69	-4
Total		88	86	-2
Pulp and paper	21	86	67	-22
Total wood processing	20+21	174	153	-12

Note: SIC refers to the UK Standard Industrial Classification of Economic Activities

4.2.4. If we assume that 5.2% of total employment is within the East of England this suggests approximately 7,956 FTEs working in forestry and wood processing activities. Applying the PACEC (2000) multiplier of 1.84 suggests a total of 14,639 FTEs dependent on the forestry and forestry processing sector in the East of England.

4.2.5.. FC statistics (2009) for forestry and wood processing activities (i.e. not including businesses such as timber haulage and government administration) suggest employment has fallen from 174,000 in 2003 to 153,000 in 2007, a decrease of 12% across Great Britain, with the highest reduction in panel production (see Table 3.2).

Table 3.2 Number of VAT registered businesses by SIC (FC 2009 statistics)

SIC	2003	2008	% Change
Forestry 02	3240	3155	-2.6
Sawmilling 20.1	885	760	-14
Panels 20.2	180	140	-22
Pulp and paper 21.1	430	370	-14

4.2.6. The data above suggest a national decrease of 12% in employment across the industrial sector, but less impact, or even a possible increase in employment in the forestry and wood products areas of activity. An alternative estimate of employment in the East of England is identified in Table 3.3 below, using data from the 1998/99 Forestry Commission survey. This provides a lower estimate of 2,057 FTEs in the East of England in 1998/99. Applying the possible percentage changes in employment (from +9% to -12%) we estimate a range of employment in the East of England between 1,811 and 2,242 FTEs.

Table 3.3 1998/99 survey figures indicate for England (FTEs) and Estimates for the East of England 1998/99 and 2010

	England	East of England 1998/99	East of England 2010 (assuming +9% growth)	East of England 2010 (assuming -12% reduction)
Forestry commission	1,331	167	182	162
Private woodland owners	4,242	534	582	513
Forestry companies and contractors	2,077	261	284	230
Wood processing industries	5,581	703	766	619
Other employees	1,508	392	427	345
Total	14,739	2,057	2,242	1,811

(Source: Forestry Statistics, 2009; EE estimate based on 12.6% of total estimate for England)

4.2.7. There is little information on the situation in regards to business and employment. The number of sawmills in the East of England has declined from 12 to 11 over the period 2003-09 while at the same time the consumption of softwood by sawmills increased from 100,000 green tonnes to 146,000 green tonnes. This suggests that remaining sawmills have expanded. In addition, for the East of England, softwood timber production is anticipated to increase from 159,046 cubic metres in 2010/11 to 191,921cu.m. in 2022/26 (an increase of 20%). This data is supported by UK wood production figures which suggest a 5% increase in roundwood production in UK woods between 2008 and 2009; based on a 4% increase in softwood and a 24% increase in hardwood). (FC 2010)

4.2.8. National data also suggest that softwood deliveries over the period 2005-09 increased to sawmills, pulp mills, and fencing manufacturers and decreased to wood based panel processors. Data also suggest a significant increase in both softwood and hardwood being used for woodfuel (softwood increased from 100,000 green tonnes to 600,000 green tonnes, and hardwood from 250,000 to 400,000 green tonnes, i.e. an overall increase of 180%) over the same period, all of which supports a potential increase in the level of employment in forestry and associated wood processing businesses.

4.2.9. Recent data suggest that significant new planting has taken place, woodfuel consumption is increasing, and only one sawmill has been lost in the East of England. At the same time it is clear that across England the number of businesses and jobs has declined. If we assume a 12% decrease in forest related employment across all regions in England and use the 2003 Woodland Wealth figures (derived using the PACEC multiplier of 1.82, applied to those working directly in forestry) we get an estimate of employment in forestry and forestry related sectors ranging from 2,252 to 2,789 FTEs (illustrated in Table 3.4). This is similar but slightly higher than the estimates based on the 1998/99 figures in Table 3.3 above.

Table 3.4 East of England woodland related employment FTEs

	2003	2010 (-12% estimate)	2010 (+9% estimate)
direct employment in woodland and timber production –	825	726	899
direct employment in processing	563	496	613
indirect employment	953	839	1,038
Induced employment	218	192	237
Overall employment associated with the woodland and timber industries	2,559	2,252	2,789

4.2.10. We assume that jobs associated with the crafting/ manufacturing and sale of timber products remains the same as in 2003 at 19,000 FTE jobs. Although overall forest related jobs have declined, the indications are that timber imports, softwood production, and wood fuel consumption have all increased.

4.2.11. The Forestry Commission survey (FC 2009) carried out in 2007 was based on an estimated 11,152 forestry and wood associated businesses in Great Britain (including forestry and logging businesses, sawmills, manufacturers and processors, and pulp and paper activities). In England 29% of the sample surveyed were mainly dependent on softwood for their business operations, 17% were dependent on hardwood, and 49% were mixed. In addition 22% of businesses were dependent mainly on UK grown timber, 44% on imported timber and 18% used a mix of UK and imported timber. Based on annual business turnover in the previous three years (2004-07) nearly half (46%) of survey respondents indicated that turnover had increased and 43% indicated it had stayed the same. Only 10% had seen a fall in profits.

4.2.12. The most Forest Employment Survey (FC, 2009) does not provide any breakdown of employment. The 2003 Woodland Wealth study used an estimate (from the Forestry Commission 2000 survey of employment) of 8.5% of total employment for the East of England. Recent statistics, however, suggest that businesses and employment in forestry and wood product activities have declined by around 12% while at the same time statistical data indicate wood production in England has also altered. Data suggest that total softwood sawnwood production has increased from 1.629 million green tonnes in 2003 to 1.827 million green tonnes in 2009 (12% increase), while total hardwood sawnwood production has declined slightly over the same period from 0.493 to 0.468 million green tonnes (a 5% reduction).

4.2.13. In England an additional 16,900 ha were planted over the period 2004/05 to 2008/09 and roughly the same area of land was re-stocked. Data suggest an overall increase of 8.7% in woodland area for England over the period 1995/99 to 2009. PACEC (2000) note that the main employers in England are the private estate owners, followed by wood processing companies (e.g. sawmills, pulp and paper mills, and board panel plants). If we keep in mind that the majority of the woodland in the East of England is privately owned (although a significant proportion is estimated to be under-managed or unmanaged) then it is possible that the number of jobs in private forestry may have increased slightly (as a result of increased planting), but overall the number of jobs may have declined due to a decrease in hardwood sawnwood production. However in practice woodfuel production will have outweighed any losses in sawnwood production

4.2.14.This study has used a similar approach taken as in the 2003 Woodland Wealth report to estimate woodland values based on employment data and PACEC's (2000) figures (adjusted to 2009 values using the UK Retail Price Index). The figures presented below are based on a 12% reduction in employment in the forestry sector overall:

measures of net annual economic impact	
output associated with the woodland and timber industries	£15.8m
output associated with the processing industries	£14.5m
total	£30.3m
output associated with the indirect impact of the industries	£44.2m
output associated with the induced impact of the industries	£5.2m
total	£49.4m
measures of annual gross economic impact	
output associated with the woodland and timber industries	£47.8m
output associated with the processing industries -	£67.3m
total	£115.1m
output associated with the indirect impact of the industries	£119.7m
output associated with the induced impact of the industries-	£28.7m
total	£148.4m.

4.2.15. Thus, the total net direct impact is in the East of England of £30m and the indirect and induced net impact together around £49m annually, with corresponding figures of £115m and £148m annually for gross impact. These are approximate figures that do not take into account the actual value of timber/wood product sales.

4.2.16. The woodland economy supports a range of Forest Industry Businesses (FIBs), conventionally defined in the narrow sense of being directly associated with timber, rather than the wider economy associated with recreation, tourism and so forth. These are mainly sole traders, family businesses and partnerships, such as nurseries arboricultural businesses, forest managers, charcoal and coppice workers, harvesting contractors and timber haulage contractors.

4.2.17. The Woodland Wealth (2003) study empirical data collected from a range of forest related businesses has not been updated in this report. The types of activity are unlikely to have altered significantly although there is evidence of increased planting, and suggestions that levels of woodfuel use (and production) have increased.

4.2.18. The 2003 Woodland Wealth Study found that forestry contractors were engaged mainly on coppicing, maintenance, firewood and game management, and most opportunity appeared to relate to conservation, pest control, scrub clearance and sporting management, rather than the more specific forestry operations (e.g. fencing, access, timber work), though planting operations were more widely reported and a sizeable proportion of 'other' work was associated with coppicing. It also appeared that most of the 'timber' operations were being conducted on the largest woodlands: most opportunities for contracted out work arose in relation to planting, where contractors carried out about half of the work, and harvesting and thinning, where they undertook about one-third. Contractors were also engaged for pest and weed control, pond restoration, ride management and coppicing.

4.2.19. The 2003 Woodland Wealth study explored patterns of expenditure made by woodland owners and timber processors in the public and private sectors. Analysis revealed substantial leakage of expenditure given the lack of 'upstream' linkages such as forestry nurseries and equipment suppliers, and 'downstream' linkages related to major processing facilities, in the East of England. Balance of payments also appeared to be adversely affected by the comparatively unreliable quality or quantity of locally produced timber, relative to imports arriving through the main ports in the East of England.

4.2.20. We have no evidence to suggest that the situation regarding survey respondents is any different in 2010 than it was in 2003. We assume that those involved in activities such as coppicing, thinning, firewood production and charcoal production continue to purchase their timber-based inputs from, and sell their products within the East of England, indicating a high level of economic retention.

4.2.21. Sales of timber within the East of England were mostly described as 'low grade' (almost 70% of respondents stating that their timber sales were mostly low grade, and some 25% stating that these were mostly high grade), and around 40% of respondents stating that they also sold some timber residues within the East of England. Those selling outside the East of England (17 out of 66 respondents selling timber) mostly sold high grade timber, whilst very few (less than 10 on average) sold low grade

timber, timber residues or other by-products beyond the East of England in any significant quantity.

4.2.22. The economic impact of principal FIBs, is included in the multiplier calculations previously discussed. The Woodland Wealth (2003) study used Intermark's 2002 study to analyse sales of wood products in the East of England. This information has not been updated since then. If we assume an annual growth rate of 5% (based on a continuation of the 9% per annum growth rate found in 2002 but tempered with a decline since 2008 due to recession), then the value of wooden products for the East of England would total £33.5m

4.3. Timber as Fuel

4.3.1. Provisioning category in eco systems services and resource use under sustainable development pillars. Woodfuel was identified in 2003 as a major opportunity, especially for private woodland owners based on the estimates of undermanaged woodland in the East of England and poor quality roundwood production. Evidence suggests the market for woodfuel has expanded since 2003 and will continue to grow into the future based on grants for woodheating and concerns over fossil fuel price rises. The 2003 study indicated the major market was firewood, but more recent developments suggest the market for wood pellets and woodchips is growing. Woodfuels East a project to stimulate the woodfuels industry in order to encourage woodland management has a target of 110,000 green tonnes timber harvested per year (log value of £11 million/annum gross) and a target of stimulating120 fte jobs.

4.3.2. However, for this report no hard evidence to indicate the current size or value of the market was evaluated. Without knowledge of the level of woodfuel production and consumption it is difficult to make estimates of market values. We also assume the charcoal market has not altered and that the majority of charcoal is still imported. We have no evidence on which to estimate the number of charcoal producers or the level of home production in the East of England although there is one big producer - BIG-K in Norfolk.

4.3.3. Using the Retail Price index to calculate current values for firewood we can arrive at the estimates for 2010 expenditure illustrated below, based on data collected in the 2003 Woodland Wealth Survey. Costs of producing a load of firewood lie in the range £27.40 – 32.41. Costs tend to be variable year to year and do not necessarily include depreciation costs of machinery. Annual expenditure per business is in the range £3,300-£42,197 (mean = £15,364); Mean tonnage of firewood produced per business is 313 tonnes/year which provides an average expenditure of £49.10/tonne firewood produced. Expenditure is mainly within the regional economy, although specialised forestry equipment is purchased externally, and some businesses purchase vehicles and even chain saws outside the East of England.

4.3.4. Using the following assumptions applied in the 2003 Woodland Wealth study and assuming a 9% increase in activity over the period 2003-2010, we can calculate a value for firewood based on:

- one very large producer (>4,500t),
- 26 large producers (600t/yr),
- 51 small producers (200t/yr)
- 470 very small producers (75t/yr).

Note: 2/3 of producers were small scale, part-time producers operating firewood production in conjunction with other operations, and averaging an output of 150 t/yr; A 'load' is not a standard measure and varies from producer to producer as there are many small producers figures are likely to be underestimates.

1/3 of producers were large-scale, full time operating year round, and producing on average 600t/yr.

4.3.5. Additional small, part-time producers (selling up to 75 t/yr, i.e. equivalent to approximately 100 loads, typically operating during the heating season only and advertising locally)

4.3.6. This does not include those who might be producing firewood for their own consumption, such as farmers or landowners with their own woodlands, and these users could represent a sizeable level of activity if we assume that they might consume 1-2 cu.m. /year/household.

4.3.7. Estimates of the economic impacts of firewood production can be made, based on the following assumptions:

- All wood is produced within the East of England
- Average distance for delivery of firewood is 16km
- Mean expenditure per tonne of firewood produced is £55.13
- Mean income per tonne of firewood produced is £92.06
- Mean expenditure per business is £17,250/yr
- 66% expenditure takes place within the East of England.
- Assumptions about Very Small Producers
- 100% expenditure takes place within the East of England
- Mean expenditure/tonne firewood produced within the East of England is estimated to be £26.19
- Mean income is likely to be lower than that for large businesses as they will sell below the commercial rate to local customers, so we estimate average prices at £59/load (£73/t).

4.3.8. On this basis we estimate firewood-related expenditure within the East of England to be c.£1.83m/yr (with about £0.52 occurring outside the East of England), and total regional income from firewood sales to be around £5m/yr. These figures do not include farmers and other woodland owners who might be producing firewood for their own consumption. (See Table 3.5 below).

Table 3.5 Estimated expenditure and income from firewood production for 2010

Category	Estimated No. in East of England	Total Production (tonnes)	Total expenditure (£)	Total income (£)
Very large producer	1	4,905	144,697	451,554
Large producers	26	15,600	460,200	1,436,136
Small producers	51	10,200	300,900	939,012
Very small producers	470	35,250	923,197	2,354,250
Total	548	65,955	1,828,994	5,180,952

4.3.9. These are likely to be conservative estimates (given the comparison with Intermark figures for 2001 indicating total sales of firewood of about £5.037 million), although Intermark's estimates were based on wood brought into the East of England as well as locally produced wood. Given the Woodfuel East targets this is likely to be a significant underestimate. It is also probable that part of the income stream from firewood will be in the hidden economy. The estimates of UK hidden economy activity indicated in the literature vary from 8 to 30%. Using the mid-point of this range it is estimated that a further £0.97 million of income from firewood is in the hidden economy.

4.4. Housing and Industry

4.4.1. This would fall mainly under the Ecosystems Services cultural category and relates to the economic and social pillars of sustainable development. Woodland has a number of values as a setting for built development as indicated in the 2003 Woodland Wealth study. There have been few additional studies in the intervening years although, as noted above (under the section on Landscape), Garrod (2002) conducted a choice experiment approach of 400 households in six areas across Britain. The study suggested that the highest WTP values were for views of broad-leaved woodland in peri-urban areas. Annual household WTP was estimated at £268.79 for woodland views from a respondent's home. The total value of views of urban fringe woodlands in England was estimated at £3.54 billion and the capitalised value per household (at 3.5% discount rate) amounted to £7,680. Garrod also noted previous studies estimating the contribution of trees to house prices varying from 4 – 7%.

4.4.2. The 2003 Woodland Wealth study noted that whilst the benefits of woodland to inward investment are somewhat unclear, it is possible to make a number of generalisations:

- many business owners, especially those already in a scenically attractive area, state environmental quality as a significant influence on location;
- woodland can be an important and cost-effective means of improving the physical environment of industrial areas;
- there is a general shift in the relative importance of intangible factors in business location decisions; quality of life factors are significant for those areas dependent on the retention of highly footloose businesses;

- ‘rising sun’ industries, whilst principally seeking the agglomeration/cluster effects of major centres of population, tend to locate in well designed business parks with good environmental quality.

4.4.3. A number of studies have provided some insight into the value of woodland for inward investment. The creation of the National Forest for example increased the number of local jobs by 4.1% and local regeneration using green infrastructure attracted £96million of investment (CESR, 2004). The 2003 Woodland Wealth study used the residential tax base of the East of England (based on local authority websites) to estimate a value. The residential tax base (in 2003) was about £250 per head of population, amounting to around £1.35bn annually. Consequently, for every 1% added to the tax base by well designed and located tree cover, an additional £15.9m of annual revenue could be created (updated to 2009 values using the Bank of England inflation calculator).

4.4.4. The 2003 Woodland Wealth study indicated that around 125,000 properties in the East of England are at risk from flooding, affecting about 5% of the population. No economic studies have been undertaken on the effects of woodland establishment on flood damage to buildings. However, in 2001 the insurance cost of flooded properties in England and Wales was around £1.1bn. It is not known how much of this was in the East of England, but as noted the East of England has 125,000 properties at risk out of a total of around 1,830,000 homes and commercial properties in England and Wales. This is about 6.8% of the national total, suggesting a potential bill of some £88.2 million (2009 values). If the woodland in the East of England were to reduce this by 1%, they would have an annual worth of £880,000.

4.4.5. Although there is no reliable basis to calculate the industry and residential benefits of woodland for the East of England, an illustration can be offered by combining the ‘percentage points’ for the local tax base (£15.9m) and flood mitigation (£0.88m), and the £14m ‘avoidance cost’ of not having to remediate damaged land. A figure of **£30.6million per year** seems conservative but at least indicative of these various roles.

4.5. Summary of market benefits

4.5.1. Table 3.6 below summarises data from the text in this section to illustrate the range of annual market values provided by woodland in the East of England.

4.5.2. As indicated in the text, varying levels of uncertainty underlies all of these benefit estimates, and assumptions have been made to determine value ranges. In all cases we have been cautious, taking a conservative approach to estimating values, especially where information is contradictory or missing.

Table 3.6 Summary of market benefits.

Table 3.6

Activity	Range of values (£million/yr)		
	Low	High	Mid-point
Timber production and processing	87		115
Indirect and induced effect	133		148
Arboriculture (including indirect and induced effect)	42		49
Retail wood products and crafts (includes woodfuel)	24		33.5
Recreation and tourism	400	700	550
Field sports	54	108	81
Housing and industry	26		30.6
Total	740		976.5

Annex 1

DECC 2009

This paper sets out a revised approach to valuing carbon in policy appraisal, following a review undertaken within Government in the course of 2008 and early 2009. It concludes that the approach, based on estimates of the SCC, should be replaced with a target-consistent approach, based on estimates of the abatement costs that will need to be incurred to meet specific emissions reduction targets. The case for change is motivated by the considerable uncertainty that exists surrounding estimates of the SCC. The change will have the effect of helping to ensure that the policies the UK Government develops are consistent with the emissions reductions targets that the UK has adopted through carbon budgets and also at an EU and UN level. Under the new approach, the precise valuation methodology differs according to the specific policy question being addressed:

- For *appraising policies that reduce / increase emissions in sectors covered by the EU Emissions Trading System (ETS),* and in the future other trading schemes, a „**traded price of carbon** will be used**.** This will be based on estimates of the future price of EUAs and, in the longer term, estimates of future global carbon market prices;
- For *appraising policies that reduce / increase emissions in sectors not covered by the EU ETS* (the „non-Traded *sector„)* **a non-traded price of carbon** will be used, based on estimates of the marginal abatement cost (MAC) required to meet a specific emission reduction target;
- In the longer term (2030 onwards) consistent with the development of a more comprehensive global carbon market, the traded and non-traded prices of carbon will converge into a single traded price of carbon;
- For the purposes of *setting emissions reductions targets and global stabilisation goals*, **formal modelling evidence, including evidence on the social cost of carbon** will continue to be an important input. In practice, given the imperfect nature of our knowledge, these will be supplemented by political judgement and the outcomes of international negotiations.

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