19th December 2012

Principles for guiding decision making regarding forestry in the UK

Introduction

UK forestry policy is undergoing a period of transition. The recent report from the Independent Panel on Forestry (IPF, 2012) included the following recommendations:

1. [Recommendation 1] We urge society as a whole to value woodlands for the full range of benefits they bring. We call on Government to pioneer a new approach to valuing and rewarding the management, improvement and expansion of the woodland ecosystems for all the benefits they provide to people, nature and the green economy.

2. [Recommendation 2] Government as a priority needs to adopt policies, and encourage new markets, which reflect the value of the ecosystem services provided by woodland. These include carbon storage, flood protection, biodiversity and habitat provision, and wider ecosystem services. In doing so, it should build on advice from the Natural Capital Committee.

3. [Recommendation 29] The financial accounts [of The new English public forest management organisation] will be scrutinised by the National Audit Office (NAO) in the normal way. In addition we recommend the Natural Capital Committee, or successor, advise the NAO on how to use the natural capital approach to judge whether the best management and investments are being made to meet social, economic and environmental goals, and whether the natural capital is being grown sustainably. This will draw on the balance sheet of economic, social and environmental capital based on the comprehensive valuation we recommend.

Independent Panel on Forestry (2012)

Primarily, in response to the first and second recommendations this paper proposes such an approach for guiding decision making and hence informing the policy process. However, the approach adopted is not strictly 'new'. Rather it blends recent thinking on the integration of natural science, economics and social science (UK-NEA, 2011) with existing decision systems as laid down by H.M. Treasury (2003) and subsequent extensions thereof (H.M. Treasury, 2003; 2011; Fujiwara and Campbell, 2011; Dunn, 2012). As such we contend that this approach both responds positively to the challenge of the IPF and requires only an extension of rather than wholesale rejection of existing decision systems; an attribute which should enhance its acceptability within government while (we believe) addressing the valid concerns raised by the Panel.

Secondly, in response to the Panel's twenty-ninth recommendation, this paper outlines the accounting methodologies that might be used to ensure forest assets are being used sustainably.

From Ecosystem Services to Economic Analysis

From an economic perspective, the essential insight of the ecosystem service approach is to note the vital role which the natural environment plays in the production of the goods upon which human wellbeing depends.

Figure 1 clarifies the basic relationships. Reading this figure from the left hand side we can see the complexity of processes which comprise natural ecosystems (e.g. the cycling of nutrients and water, atmospheric and marine processes, etc.). These 'supporting services' provide the underpinning for a host of further processes culminating in those 'final ecosystem services'[1] which are most directly involved in generating human wellbeing. Note that we can see these services as the flows or inputs obtained from natural capital. Note also that in most cases these have to be combined with other capital inputs (such as manufactured capital, human capital and social capital) before we obtain welfare bearing goods.

Figure 1: Basic relationships between natural capital, ecosystem services and welfare bearing goods

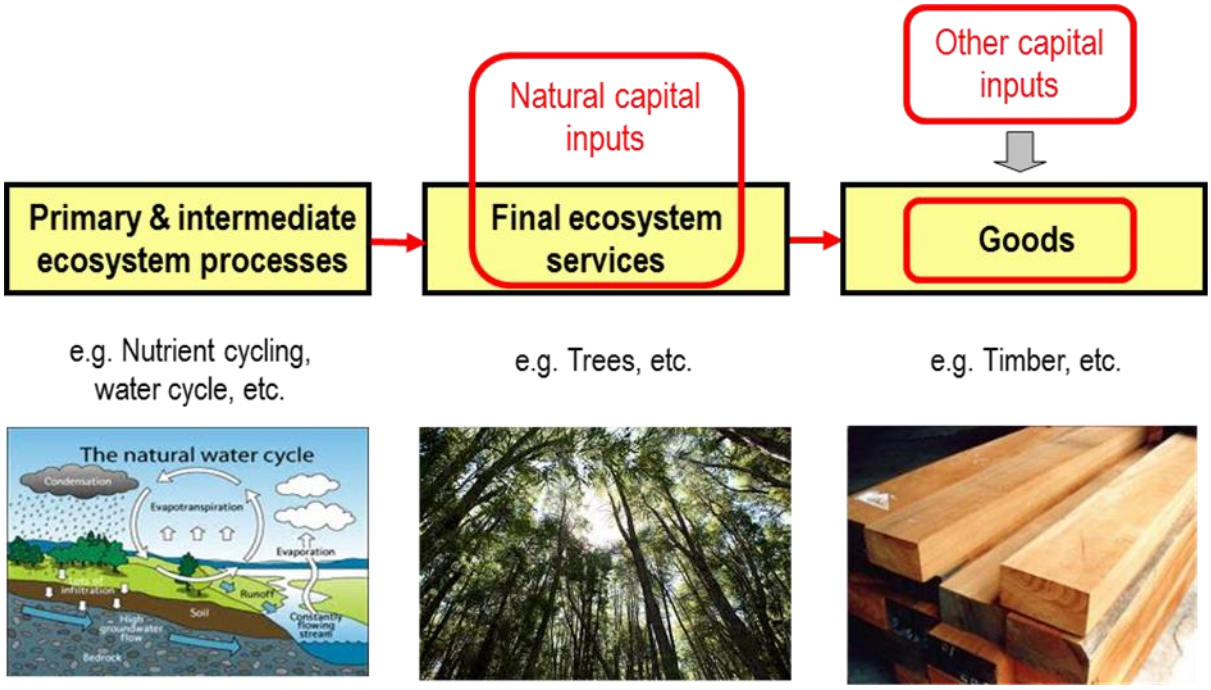


Figure 1 illustrates these basic relationships with respect to a woodland relevant example; the production of timber. Natural processes generate the conditions necessary to make the growth of trees possible. Those trees constitute a final ecosystem service[2] which, when combined with manufactured and human capital provide us with timber.

An important qualifier concerns the definition of the word 'goods'[3]. In common usage this is often synonymous with items that are bought and sold and hence have market prices. However, economic analysis of the type undertaken by H.M. Treasury, recognises goods as anything which contributes to human wellbeing, irrespective of whether or not it is market priced. This is particularly important in the case of woodland as many of the 'goods' it

[1] The Millennium Ecosystem Assessment (MEA, 2005) categorises final ecosystem services into 'provisioning services' (e.g. those connected with the production of food), 'regulating services' (e.g. those connected with removing pollutants) and 'cultural services' (e.g. amenity landscapes and recreation). While this categorisation is referred to in Figure 2 it is not essential to understanding the ecosystem service approach.

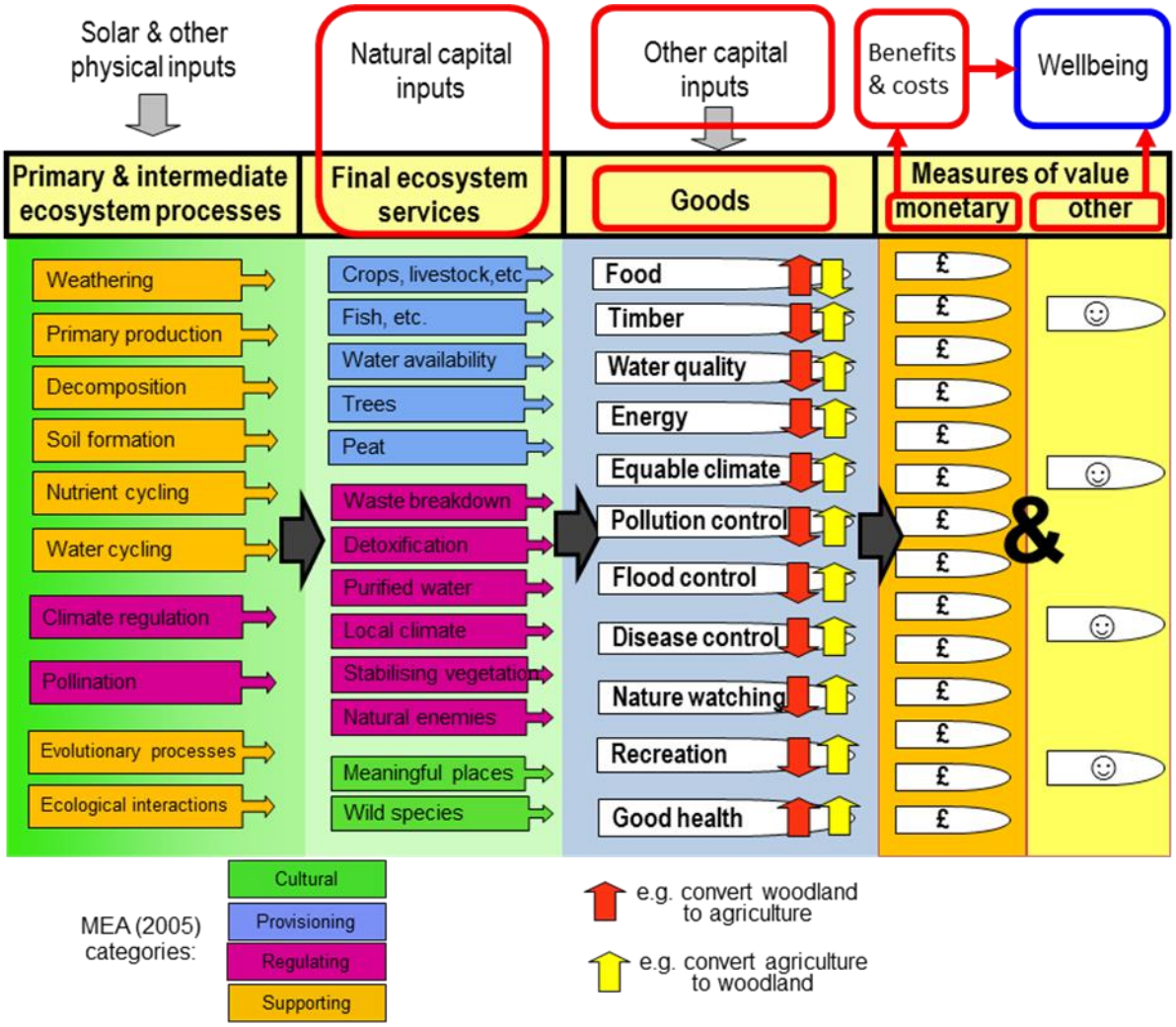
[2] Notice of course that humans have for centuries modified the environment to enhance the level of ecosystem services provided by the environment. Activities such as the addition of fertiliser and the eradication of competitors boost the ability of the environment to yield those services most valued by individuals.

[3] Further discussion of these terms and the wider application of economic analysis to ecosystem service assessments is provided by Bateman et al., (2011).

generates fall outside the market, for example: open-access recreation; the reduction of global warming through the sequestration of carbon dioxide; the regulation and purifying of water, etc.

This wider array of goods and the ecosystem processes and services which underpin them are partially captured in Figure 2. This expands upon the previous figure by listing a range of such processes, services and goods. However, importantly, Figure 2 extends this conceptual framework through to assessment for decision making purposes by noting that each good (by definition) generates value.

Figure 2: From ecosystem services to values



The task of assessing values is non-trivial but vital if the decision maker is to be able to judge between the myriad feasible options available for the use of necessarily limited resources. Clearly the ideal would be to have all values expressed within a common unit. In principle any such acceptable unit would satisfy this requirement. However, decision makers are charged not only with considering how much should be invested in forestry, but also how many hospitals to build, teachers to employ, etc. Given such circumstances, expressing values in what might appear natural units (e.g. tonnes of timber grown, volumes of carbon dioxide sequestered, litres of water purified, numbers of visits made, etc.) is clearly leaving the decision maker with a wholly unreasonable task. In practice only monetary units have the

advantage of transferability which is vital for achieving the goal of (at least reasonably) consistent decision making across options.

Recent years have seen the development of increasingly sophisticated and reliable techniques for assessing the value of many non-market goods in monetary measures (many of which are reviewed in the extension of the H.M. Treasury guidelines mentioned previously). This is a voluminous research literature and so it is not appraised here. In relation to woodland, the majority of both market and non-market goods can defensibly be assessed in this manner. However, it is true to note that consistent assessments for the UK are still a research priority. Furthermore, for defensible economic decision making assessments need to be made not just of the value of forestry but also the loss of alternative use of the land (the 'opportunity cost'). Also, as recognised explicitly at the right hand side of Figure 2, economic valuation methods have not yet advanced to the point where all values can be robustly estimated. For example, the analyses carried out for the UK National Ecosystem Assessment (UK-NEA, 2011) argued that the value which arguably many people hold for the continued existence of species which they never personally see (so called 'non-use' existence value) cannot current be reliably assessed via monetary valuation methods. The UK-NEA argued that in such cases assessments of the costs of ensuring widely held preferences (most obviously that species extinctions should not be allowed to occur) might provide useful inputs to economic analyses[4].

Woodland values

Figure 2 illustrates the values arising from two possible decisions: (i) to increase agricultural production by reducing the area currently under woodland; (ii) to increase the production of forest products by allowing the planting of woods on agricultural land. These demonstrate the underlying principles of economic analysis applied to goods which depend heavily upon ecosystem services.

A first point to note is that both assessments need to be taken from the same baseline; in this case the present distribution of land use. This comparability is further enhanced by ensuring that both assessments take into account what is being given up (those previously mentioned opportunity costs) to obtain the goods in question. Perhaps the most important aspect of the ecosystem service approach is that both assessment consider not just the direct effect of the decision (more or less agricultural or forest outputs), but also the indirect effects of such changes. As Figure 2 illustrates, these indirect effects can be many and varied. Taking the first case of increasing agricultural production by reducing the area currently under woodland, the likely direction of impacts is shown by the red arrows in the 'Goods' column of Figure 2. The direct impacts (shown at the top of this column) are that agricultural production increases while timber output falls. However, as the remainder of this column illustrates, this policy results in numerous indirect effects, the vast majority of which are negative. This example also illustrates the dangers of relying purely upon market prices as a guide to decisions. Agricultural output and timber are the two main market priced goods which alter as a result of this policy. Most of the other impacts concern non-market goods. Only by valuing those non-market goods can we bring their effect into economic decision making systems.

The second case considers an increase in the production of forest products by allowing the planting of woods on agricultural land. Here effects are shown by the yellow arrows in column 2. Again the two direct (and market priced) impacts are a decline in agricultural

[4] A further viewpoint is that economic valuation in some way omits 'social', 'cultural' or 'shared' values. A counter to this view is that all of the values held by any and all individuals are very strongly influenced by social, cultural and shared norms and indeed that such context is reflected to a greater or lesser extent in all behaviour and statements.

output and an increase in timber. Clearly we would not want to get rid of large areas of agriculture and suffer food shortages – however this will be reflected in robust valuation studies which note that the per-unit value of virtually all goods is rarely constant (see Bateman et al., 2011) but tends to increase as supply falls. However, that robust valuation also highlights the important gains in many (typically non-market) goods which such a policy generates.

Taking these examples together we can begin to formulate a list of the various items that would need to be considered in any decision regarding forestry. These include:

- The opportunity cost (what we are giving up)
- Timber
- Changes in greenhouse gases
- Recreation
- Water quality
- Water quantity (potentially including flood regulation)
- Habitat and associated species and biodiversity
- Energy (fuel)
- Educational opportunities
- Landscape amenity
- Cultural heritage

The above is by no means an exhaustive list but does serve to illustrate (a) the diversity of values associated with woodlands (b) the need to consider both the direct and indirect consequences of change (c) the need to consider the value of both market and non-market goods[5].

Further issues and policy relevance

The complexities of forestry and its opportunity costs mean that it is difficult to cover all issues within a short note. However, at least two further issues are worth highlighting.

First, it is important to note that forestry does not enjoy a level playing field when compared to agriculture. While the latter benefits for the support provided through the EU Common Agricultural Policy (CAP), direct and indirect support for forestry is relatively trivial. To address this, economic analyses need to be undertaken in two ways:

(i) A 'financial' analysis assessing the incentives for any farmer or other private land owner to engage in woodland. This focuses upon the market priced values involved and includes all available subsidies. Such analyses serve to partly explain why the UK has one of the lowest rates of afforestation in Europe; financial pressure mitigate heavily in favour of agriculture.

(ii) An 'economic' analysis (sometimes referred to as a social cost-benefit analysis). Here all subsidies and other 'transfer' payments pertaining to both agriculture and forestry are removed to reveal the net value to society of these competing options. This analysis also brings in the value of all non-market goods.

Relative to analysis (i) the assessment conducted under analysis (ii) typically results in the value of forestry increasing and that of agriculture falling. Of course in many (indeed most) areas farming still yields substantially higher values (both market and non-market) than

[5] An initial assessment of some of the key elements of the afforestation of land use is provided by Bateman et al., (2005).

forestry. However, undertaking the later analysis is likely to suggest that the area of woodland in the UK should increase substantially (see results for Wales in Bateman et al., 2005). That said, the financial analysis (i) is a vital indicator of the incentives of any policy change to land owners and farmers. This information therefore conveys the likely response in land use to any new policy.

A second issue is that analyses need to reflect the complexity of the environment and incorporate this within economic assessments. Nowhere is this truer than in the issue of spatial targeting. Despite its relatively modest size, the UK is highly varied, containing almost all of the types of agricultural and woodland landscapes that one might feasible expect at such latitudes. Yet policy making (and in particularly the CAP) typically fails to embrace this spatial complexity. This causes major problems for land use. For example, while forestry generally captures and stores far greater quantities of greenhouse gases than does agriculture, this is less true on peatlands where drainage of the land for tree planting can result in major releases of carbon dioxide to the atmosphere. Similarly the recreational values of forestry vary tremendously by location. Planting woodlands in areas close to urban populations can generate huge values (higher than all other woodland values in such places), particularly if there are few good substitutes for the recreational benefits woods can provide. However, a physically identical forest located far from populations may generate trivial or zero recreational values. This issue flags up the importance of targeting scare resources, particularly in times of financial austerity.

A targeted approach to policy making and resource use may incur additional institutional costs. Furthermore, as per any impacts upon market priced goods (such as agricultural production), such costs are likely to have greater and more immediate visibility than the benefits they generate (especially when the latter are in terms of non-market benefits such as recreation or greenhouse gas storage). Nevertheless, allowing policy to be dictated by the visibility of costs will perpetuate the failures of previous decision making. It is very likely that, by taking into account all of the costs and benefits of different options, targeting scarce resources and combining this with a more refined approach to the CAP, the government has the potential to substantially enhance the value of UK land use at no net cost to the Exchequer.

Forestry Accounting[6]

Having established the approach to valuing changes in the goods from our forest assets, we now consider appropriate accounting methodologies in response to the IPF's twenty-ninth recommendation. This will form the basis of any future advice to the National Audit Office regarding a comprehensive balance sheet of economic, social and environmental capital.

The issue of accounting for forest resources shares commonalities with appraising the value of woodland for the purposes of ecosystem assessment informing project selection. Each is informed by evolving knowledge about ecosystem services and many of the underpinning economic principles are also the same or similar. One distinction, however, is that an accounting approach to this measurement challenge places this information in an explicit measurement framework linked to the way that nations (and, in many respects, businesses) record flows and stocks within a given accounting period. In the context of forestry accounting for ecosystem services, this framework *might* include:

[6] The contents of this section reflect principles of natural capital accounting. In what follows, we focus on these issues as they relate to how to account for woodland assets and ecosystem services. Other elements of the assets that comprise forestry could also be included here. It is worth noting additionally that there are other accounting approaches possibly relevant here. One emerging tradition is the so-called 'triple bottom line', which consists an economic, a social and an environmental element.

- A wealth account or balance sheet: this would describe opening and closing stocks of assets and reconcile these two items by recording intervening (net) changes to assets – e.g. net accumulation – that occur over the accounting period
- An output account: this would describe the flows of services provided over an accounting period. A further distinction could be made here between gross output and net output of the ecosystem services provided by forestry.[7]

Measurement priorities might dictate taking a more partial approach. But while the most straightforward application of existing data might suggest a focus on measurement of (gross) current services, greater policy insights are likely to come from an emphasis on the forestry balance sheet.[8]

The starting point for constructing these accounts is to find a basic unit of account. For forest accounting, following Barbier (2009) and earlier contributions such as Hartwick (1992), this basic (physical) accounting unit could be land. That is, land area in a particular use such as woodland of a particular type or some other ecosystem. An account couched purely in terms of land use is clearly rudimentary although it would remain a useful starting point for organizing data in the first instance. However, these accounts can become detailed depending on how many (a) e.g. woodland types and (b) different categories of 'addition' and 'loss' that might be distinguished.

Moving beyond this basic description requires that we account for the ecosystem services that are provided by woodland assets. Ideally, the balance sheet (and elements within) would be valued.[9,10] Beginning with the opening stock, conventional national accounting principles would typically require that we account for the market value of this asset at the beginning of the accounting period. However, woodland assets typically are not traded (and that even if these trades did take place, these would be unlikely to reflect the social value of the asset). In this case, the value of the opening stock of a woodland asset can be estimated as the (discounted) sum of the value of future services that it provides. The same valuation principle can be applied to the closing stock. Whether there is any meaningful difference between these estimates of opening and closing stocks depends not just on what changes have actually occurred over the accounting period but also the extent to which available data will allow us to infer and estimate these changes. Notwithstanding this empirical

[7] The former refers simply to total flow of current ecosystem services. The latter notion adds to this any positive accumulation in ecosystem assets. Thus if ecosystem assets are lost over the accounting period, this measure of net output will reflect the fact we are unable to enjoy as high a level of ecosystems in the future (other things being equal) as we are 'currently'.

[8] The key indicator, in any case, is accounting for the (net) change in assets over an accounting period. In national accounts, accounting period is typically a year (although some core aggregates in the national accounts are estimated with greater frequency). Whether *annual* asset accounts are required for woodlands is arguable. One factor that is often cited for less frequent accounting is the provision of critical data relating to the physical inventory of woodlands. Another consideration is the time horizon over which meaningful changes occur. If stocks of woodland assets are reckoned to be changing very slowly then there seems to be little benefit in frequent accounting. It is important, however, to have some idea of what the stock of assets is worth.

[9] There are important methodological debates to navigate with regards to valuing these stocks *in their entirety* (see, for example, Bateman *et al*. 2011). The crucial point here is that to do our asset accounting, in monetary terms, we need to find the marginal value of an asset at its current level of 'provision'. It is this (marginal) price which – for national accounting purposes – should be multiplied by the quantity of the asset stock (Nordhaus, 2006). It is important to interpret this calculation correctly. It is an estimate of the value of the stock based on *marginal* valuation rather than *total* valuation. That is, in the latter, what is measured, in effect, corresponds to the the entire area under a demand curve for that asset between some reference point – such as the 'zero' level of provision – and the current level of provision (Nordhaus, 2006).

[10] Broadly speaking, there are two approaches to informing this question about valuation in natural capital accounts. One of these approaches asks what is the value of the services provided by the (forest) asset. The other approach asks what would be the cost of restoring (or replacing) the stock. This distinction becomes most obvious when thinking about the case of depreciation of the forest asset. A value-based approach would account for the (net) change in future services that are lost when the forest asset depreciates. A cost-based approach, by contrast, would account for the costs of restoring the stock to the level that prevailed previously (i.e. prior to the depreciation). On the one hand, these approaches are connected. That is, one looks at the value of lost services and the other looks (in effect) at the costs of restoring those services. On the other hand, the focus (and specific question asked) is very different. In general, it would not be expected that the two approaches will provide the same empirical answer especially in the case of natural capital assets providing non-market outputs. In the remainder of this note, the focus is on the value-based approach to this forestry accounting issue.

consideration, these changes will be several but broadly speaking will consist of volume and value changes.[11] The former, for example, refers to the value of changes in the asset with natural growth being one example. 'Volume' might be a misnomer, however, where these changes might comprise changes in quality of the asset as well.

As an illustration of the valuation issues that arise in accounting for these asset changes, we take the example of the stock of woodland increasing as a result of change in land-use: e.g. where agricultural land is converted to woodland. In this sense, there is a change in the 'quantity' of woodland assets that we need to account for. These can be valued by estimating the present value of the change in ecosystem services and measurement challenges here are, in many ways, similar to those encountered in conducting economic analysis within an ecosystem assessment.

In the case of this particular change, however, we also need to think about its wider ramifications. That is, the increase in the value of woodland has come about as a result of a decline in agricultural land assets. Put another way, what has happened here is a change in composition of the broader portfolio of ecosystem assets. For example, if one ecosystem service provided by woodland is climate regulation (via carbon sequestration and storage services), increasing the amount of woodland will increase the provision of these services. But there is likely also to be some loss in the climate regulation services provided by agricultural land and, ideally, these services that are lost also need to be recorded somewhere.[12]

For other types of woodland asset change, we might be able to focus on what is happening to woodlands (if e.g. the change does not involve a switch in land-use). This is not to say that practical challenges of valuing asset changes, given available data, do not remain. In addition, the portfolio of woodland assets is heterogeneous and there is an onus then on separately accounting for as much of this detail as possible. Woodland is also an asset providing multiple benefits and it is important that as many of these are accounted for as possible.

Conclusions

There are a range of further issues to be considered and a substantial research task to be addressed in responding to the challenge laid out in the report of the Independent Panel on Forestry. However, the NCC feel that the argument laid out within this paper provides a framework for such a response.

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[11] The latter refers to the change in value of the asset. For example, closing stocks might be revised if prices change over the accounting period (although, see Hamilton and Atkinson, 2006, for a discussion of these revaluations for assessing sustainability).

[12] In addition, there are further measurement issues. Clearly, other services that change as a result of the land-use switch need to be accounted for. The broader balance sheet, for example, will reflect the loss in agricultural output and so on. There are also presumably conversion costs associated with changing land use and those investment costs should also be accounted for (Hartwick, 1992, Hamilton and Atkinson, 2006, Barbier, 2012).

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