Accounting for Environmental Flows Comparing the principles of UNFCCC and the SEEA

Manfred Lenzen and Joy Murray

Integrated Sustainability Analysis, School of Physics A28, The University of Sydney, NSW 2006, Australia

Abstract –The System of Environmental and Economic Accounting (SEEA) views CO_2 sequestration as an ecosystem service, the Framework Convention on Climate Change (UNFCCC) allocates CO_2 removals to forestry sectors. In effect, UNFCCC accounting provides the foundation for sequestered carbon to be owned and traded. Such ownership is not explicit in the SEEA. Moreover, interpretations of human inducement that are used to justify the classification of sequestered carbon as 'anthropogenic' differ substantially between the UNFCCC and the SEEA. Accounting dissonances and uncertain ownership rules can affect industry perspectives on their operations. Global markets for carbon from forests are still small, but with increasing pressure for abatement measures and increasing demand for forest space, problems surrounding the accounting for human-induced change, customary ownership of forests, and the allocation of property rights are likely to hamper the transition of carbon from collectively owned ecosystem input to individually owned commodity.

Keywords: Carbon accounting, ecosystem input, human-induced change, trading and ownership

1 Introduction

This paper looks at two UN carbon accounting systems. One identifies the environment as actor providing a service to economic activity; the other transfers ownership of environmental resources to economic sectors. We discuss accounting for environmental services first using the example of carbon in forestry industry accounting then speculating on outcomes should similar principles be applied to other industries.

The United Nations Framework Convention on Climate Change (UNFCCC; UN 1992) requires that nations report on their greenhouse gas emissions. Regular reporting is underpinned by "[A]ccurate, consistent and internationally comparable data"[1]. Guidelines for the compilation of national inventories by economic sectors are provided by the Intergovernmental Panel on Climate Change (IPCC). Each nation's emissions' total "is calculated by summing up emissions and removals for each gas … according to the sector actually generating emissions or removals" (IPCC 2006, Vol.1. p.5-6). Reporting under the UNFCCC means, for example, that the carbon sequestered in managed forests is offset against the emissions generated by the forestry industry during harvesting. In reporting net emissions the forestry industry is likely to return a negative balance with sequestration outweighing the carbon emitted during the industry's operation. The effect of applying the UNFCCC accounting principle is a transfer of 'ownership' to the forestry industry of the carbon sequestered through the trees' natural process of growing.

In contrast to the UNFCCC the System for Environmental and Economic Accounting (SEEA; UNSD 2003; Lange 2007) accounts for carbon in forests as an ecosystem input provided by an entity called 'the environment'. It separates physical flow data into supply (by the environment) and use (by the economy), and reports gross flows. The forestry industry is not allocated any credit for sequestering this carbon – it is supplied by the environment. Emissions are not reported as net figures (emissions minus removals), and the forestry industry's emissions are not negative. Hence, the SEEA does not lead to the apparent 'ownership of nature' by the forestry industry and

[1] UNFCCC: http://unfccc.int/national_reports/items/1408.php (accessed 21/05/09)

the input of environmental services (i.e. sequestration service rendered by forests) is clearly visible.

The IPCC guidelines were developed for the UNFCCC to ensure participating countries report their emissions in a consistent and comparable way. They are used for reporting of National Greenhouse Gas Inventories to the UNFCCC towards an agreed (net) target. They have also, however been used to underpin policy development for example in the development of the Australian Government's emissions trading scheme (Fensham & Guymer, 2009). The SEEA environmental-economic accounting framework was developed to provide an international statistical standard[2]. It is intended for use in policy development and strategic planning[3] and as such it is widely used by governments[4]. However it has also been used for reporting purposes (Foran et al, 2005a; ABS 2001). Although one standard has been developed for reporting purposes, the other as an accounting framework both are used for both purposes. However an examination of the two systems reveals that they have different implications for the way we see the environment as a player in the economy. In reporting net flows the UNFCCC methodology serves to conceal management issues because it has the potential to obscure abatement opportunities. In reporting gross flows the SEEA methodology keeps all flows separate and thus enables decision making about both emission and removal components.

The UNFCCC-SEEA accounting dissonance was highlighted following publication of the *Balancing Act* report (Foran et al. 2005a) in 2005. Below we outline that example to illustrate some of the repercussions of applying recognized accounting practices.

1.1 The *Balancing Act* study

The *Balancing Act* (*BA*) is a Triple Bottom Line (TBL) analysis of the Australian economy commissioned by the Australian Government. This analysis uses the monetary National Accounts, physical satellite accounts, and input-output techniques in order to characterise 135

[2] http://unstats.un.org/unsd/envaccounting/EnvAcc_Brochure_FINAL1.pdf (accessed 21/05/09)
[3] http://unstats.un.org/unsd/envaccounting/histbground.asp (accessed 27/05/09)
[4] e.g. a training session on the SEEA held by UN in 2008 attracted delegates from 10 countries http://unstats.un.org/unsd/envaccounting/workshops.asp (accessed 26/05/09); the UNSD has used the SEEA in 12 countries http://unstats.un.org/unsd/envaccounting/cprojects.asp (accessed 26/05/09)

industry sectors in terms of 11 indicators.[5] For each of the 135 sectors, every indicator is expressed as an *intensity*, that is, as an effect per dollar of final demand. The indicators are enumerated in a full-supply-chain context, where all upstream effects are *embodied* in the final demand from the 135 sectors. Together the 11 indicators provide a macro-landscape of the Australian economy against which many industry management issues can be benchmarked (Foran et al. 2005b).

The *BA* study distinguishes three forestry-related industry sectors: State forestry, hardwood plantations and softwood plantations. For the greenhouse gas emissions indicator, these sectors are characterised within *BA* by relatively high values of about 95, 15 and 25 kg CO_2-e/$, respectively, which exceed by far the economy-wide average of about 1 kg CO_2-e/$. Most of these emissions are caused during harvesting; they are reported in the Australian National Greenhouse Gas Inventory (NGGI; AGO 2007) under category class '5.A. Changes in Forest and Other Woody Biomass Stock'. While *BA* follows the SEEA in reporting gross emissions, the Australian NGGI reports net (emissions minus removals) as well as emissions and sinks. In *BA*'s 2005 report gross emissions during harvesting are reported as a positive figure. In the NGGI (AGO 2007), emissions for 2005 are more than offset by removals from CO_2 sequestration during forest growth: Class 5.A. shows a total net removal from the atmosphere of about 19.6 Mt CO_2.

As a consequence of adopting the SEEA, *BA* portrays forestry as one of the highest emitters in the economy. This conflicts with the perception of forestry as a green industry that helps to sequester carbon. The forestry industry criticized the way that Foran et al. 2005a used the environmental accounts triggering discussions that led to publication of the rationale for following SEEA instead of UNFCCC (Centre for Integrated Sustainability Analysis 2005). The authors' argument was that *BA* contained many macro indicators, amongst them water and energy, which are predominantly accounted according to the SEEA, and that for the sake of consistency, greenhouse gas emissions were also treated according to SEEA principles.

[5] The eleven indicators comprise positive ones (+, more is better) and negative ones (–, less is better); they are: Primary energy consumption (MJ, –); Greenhouse gas emissions (kg CO_2-e, –); Water use (L, –); Land disturbance (ha, –); Gross operating surplus (A$, +); Exports (A$, +); Imports (A$, –); Employment (emp-y, +); Income (A$, +); Government revenue (A$, +); Upstream linkage (no unit, +). For more information see http://www.isa.org.usyd.edu.au/balancingact.

BA had unintentionally opened a debate that put environmental accounting into the focus of national environmental policy. The discrepancies, and resulting potential for confusion in reporting on environmental flows warrants a closer look at ownership of and accounting for carbon. Hence, this paper explores the tensions arising out of differing accounting standards. Section two analyses carbon sequestration accounting in the UNFCCC and the SEEA. Section three discusses different accounting principles. Section four offers an explanation of how carbon has turned from ecosystem input into commodity and some of the issues surrounding questions of ownership. Section five concludes.

2 Accounting for carbon: UNFCCC and SEEA frameworks

2.1 *UNFCCC accounting framework*

The UNFCCC (United Nations 1992) was opened for signature in 1992, as a response to the findings of the First Assessment Report of the IPCC (IPCC; Houghton et al. 1990). Parties to the Convention are obliged to prepare National Greenhouse Gas Inventories (NGGI), based on methodology and guidelines provided by the IPCC (2006). The UNFCCC asks participating nations to publish national inventories of anthropogenic emissions by sources and removals by sinks (UNFCCC Arts. 4§1a, 7§1a, 12§1a). The Kyoto Protocol to the UNFCCC (UN 1997, Art. 3§3) talks explicitly about "net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities".

The term *human-induced* is important. Whether a change in carbon stocks is human-induced is not easily definable (Watson et al. 2006b, Arts. 26 and 44), different interpretations exist. Accounting principles used for reporting emissions and removals under Art. 3§3 of the Kyoto Protocol are more stringent than those used for national inventories reported to the UNFCCC, in the definition of human intervention. Amongst other differences, Kyoto target projections include under *human-induced* only new forests established by direct human action on land forested after 1990, whereas Convention inventories include all *managed lands* as anthropogenic, and do not count *unmanaged lands* (IPCC 2006, Vol.4. p.1.4).

What is relevant here is that in the UNFCCC/IPCC view there is no actor called *the environment*, no matter which accounting system: Reported sequestration is always considered *human-induced*, because the concern is with anthropogenic, not natural, climate change.

2.2 *How the SEEA deals with environmental flows*

The SEEA emerged from the 1993 United Nation's System of National Accounts (SNA) as a satellite system (Smith 2006). In creating the SEEA, the UN sought to elaborate and extend the principles, concepts, and classifications used by the SNA in order to represent environmental as well as economic data (UNSD 2003). One of the purposes was to create an integrated system of accounts providing consistency between sets of environmental statistics and compatibility with the SNA's economic data. It was to provide a standard framework and accounting system to lever better data collection and elevate environmental accounting to the status of economic accounting, with its concomitant impact on public policy. The SEEA accounting framework is therefore designed to provide policy makers with a system in which to evaluate which ecosystem inputs are the most critical to the economy as well as the reciprocal effects that economic activity has on those ecosystem inputs. In addition, this system provides information to elucidate the relative contributions of different industries to environmental degradation. The SEEA provides a way of integrating physical and economic data in a hybrid flow account helping connect environmental and economic fields (Smith 2006).

Physical flow accounts are comprised of flows within and between environmental and economic fields. The SEEA distinguishes four types of flows: products, natural resources, ecosystem inputs, and residuals (UNSD 2003, Sec. 2.31). Products are economic goods and services that are both used and supplied by the economy. Natural resources are mineral, energy, water and biological resources that are demanded by the economy and supplied only by the environment. Ecosystem inputs such as water, air and carbon are also supplied by the environment. Finally, residuals are the negative byproducts of economic activities that result from production and consumption and that flow from the economy back into the environment. This paper concentrates on natural resources and ecosystem inputs, which we summarise as *environmental flows*, since these flow types originate in the environment.

Hybrid flow accounts combine physical flow accounts and national, monetary accounts. In these accounts *the environment is an actor* providing inputs such as minerals, water, or carbon. Flows from the environment to industry as ecosystem inputs and natural resources are used to produce

commodities for downstream use. Hybrid flow accounts record physical flows in the same way as economic transactions are presented in the National Accounts. Thus hybrid flow accounting is able to connect environmental burdens to economic benefits and environmental benefits to economic costs (UNSD 2003). An important feature of hybrid accounts is that inputs and outputs balance both in monetary and physical terms.

The SEEA (UNSD 2003, Sec. 3.172) accounts for carbon as an ecosystem input supplied by the environment, and for the natural growth of plants as a metabolic output. This output can either result in a non-cultivated (wild) plant, or a cultivated plant. The latter is regarded as having "*come into being as a result of economic production*" (Sec. 7.28), and therefore as a product supplied by the economy (Secs. 3.171, Sections 3.177-3.180). Irrespective of the cultivation status of the plant, carbon is always classed as an ecosystem input, or a "non-product substance required for biomass growth" (Sec. 3.115 and Tab. 3.21). Even for cultivated products, the SEEA wording is very clear, saying that

> "*the growth of some cultivated assets such as timber or agricultural plants is largely the result of ecosystem inputs from the environment. These ecosystem inputs (in a gross concept) or the resulting biomass growth (in a net concept) have to be recorded as inputs from the environment*" (SEEA, Annex 2).

3 Discussion: Environmental accounting and industry perspectives

The example of the *BA* study demonstrates how diverging accounting principles can significantly affect industry and community perspectives on their operations.

3.1 *Diverging interpretations of human inducement*

The general understanding of human inducement of carbon emissions and removals is mostly shaped by Article 3§3 of the Kyoto Protocol. This understanding affects forestry industries, which can report human-induced removals of carbon as offsets against emissions. In this respect, Kyoto projections only recognize reforestation activities on lands forested since 1990, while the Convention includes all managed forests under *human-induced* (see Marrakesh Accords rules, Penman et al. 2003, Sec. 4.2.7).

Watson et al. 2006a (Sec. 2.3.3.1) summarise the problems in separating human-induced from natural changes in managed forests. Especially they say that "*management might be taken as a token of human inducement*" so that any activity in a managed forest could be classed as human-induced. They go on: "*several commentators have suggested that only intentional activities should be regarded as human-induced*" and conclude that "*even if such definitional issues can be resolved, in practice distinguishing natural stock changes from those that are directly or indirectly human-induced may be difficult*". Both measurement (Sec. 4.3.4) and baselines (Sec. 2.3.4.1) are affected by these uncertainties.

The SEEA (UNSD 2003) confirms this view. It classifies timber as cultivated versus non-cultivated. The criterion for classifying timber concerns how far the production process is controlled by human intervention (UNSD 2003 Sec. 7.55). This throws up problems about what is cultivated and what not:

> "*A virgin forest in a remote area is non-produced. One which is planted, tended, felled and replanted on a regular cycle with continual labour inputs is produced. But which category applies to a forest where, once the initial planting is done, nature is*

> *left to take its course with little if any human intervention until it is mature enough for felling?*" (Sec. 7.56).

Cultivated or plantation forests on one hand, and non-cultivated or natural forests on the other

> "*may resemble one another very closely so that it is not always easy to distinguish one from the other. It is important to develop accounts which make the distinction apparent and may allow for cases where an alternative view is possible about whether the extent of human intervention is sufficient to be classified as 'cultivation' or not*" (Sec. 8.12).

As a consequence, the SEEA has adopted stringent definitions of cultivated biological assets that classify most semi-natural forests[6] as non-cultivated (Sec. 8.159). The SEEA (Sec. 7.57) makes it clear that control over the harvesting is insufficient to establish that a biological asset is cultivated (i.e. produced). "*If it were, any legislation controlling the use of virgin forests would be sufficient to cause a designation of 'produced'*." This statement conflicts with UNFCCC practice, which classifies any activity in a managed forest as *human-induced*. The SEEA requires that: *cultivated* trees yield repeat products whose natural growth and/or regeneration is under the direct control, responsibility and management of institutional units (Sec. 7.58); forest management must not consist of just legislative control; and the level of production activity has to be significant relative to the value of the resource (Sec. 7.59). The SEEA's Sec. 8.160 and following contain guidelines for measuring the degree of naturalness of forests.

The UNFCCC practice of defining as removals all CO_2 sequestered by managed forests appears to rest on the technical inability to separate – in definition as well as in measurement – natural from human-induced change. This practice contradicts that of the SEEA and has profound consequences for carbon accounting: In forests that are officially classed as managed but where management activities are limited, most of the sequestered carbon would be a result of natural growth, and the 'managing' forestry sectors would be able to claim ownership of valuable carbon

[6] Forests in which management has substantially altered the structure and ecological processes but where growth is still mainly a natural process with no regular and continuous human intervention (Sec. 8.158).

credits for minimal action. Given these uncertainties it seems inconsistent that the UNFCCC allocates to the forestry sectors carbon removals worth millions of tones whereas other sectors' emissions are reported at much higher detail and accuracy. This is highlighted by Watson et al. 2006a (Sec. 2.3.3.1): "*policymakers should be aware that the phrase "human-induced" has no scientific meaning and that further guidance will be needed …*".

Definitions of human inducement have consequences for industry. In the case of Australia, forestry sector carbon removals according to Convention accounting are more than 50% higher than those according to the Kyoto Protocol (DCC 2008). Applying the SEEA timber rules to carbon may result in removals being even lower than in Kyoto projections. In light of discussion on a National carbon offset standard (Commonwealth of Australian 2008) and the development of a carbon trading scheme (Commonwealth of Australian, 2008a) in which Kyoto definitions pertaining to forestry are to be used, ownership of valuable carbon offsets has the potential to become contentious. This is particularly so when there is a general assumption that forestry "tends to be a net carbon sink rather than a net source of emissions" (DCC,2008a:1)

3.2 ***Inconsistent sectoral allocations***

In IPCC reckoning emissions and removals associated with fuelwood use are determined on the basis of changes in ecosystem carbon stocks (IPCC 2006, Vol. 4, Secs. 2.2 and 2.3). This means that, even though CO_2 emissions from fuelwood combustion occur in a range of industries as well as in the residential sector, they are reported in the Land-Use, Land-Use Change and Forestry (LULUCF) category of national inventories (Vol. 1, p. 1.6). However, the IPCC Guidelines (Vol. 2, Secs. 2.3.3.4) ask for 'information items' about CO_2 from fuelwood to be allocated to the various sectors in the energy use category. These information items are not counted towards the national total, in order to avoid double counting with regard to the LULUCF category.

Carbon flows from fuelwood use are reported as gains of, losses from, and transfers between the above-ground biomass, deadwood, and harvested wood products carbon pools (IPCC 2006, Secs.

2.3.A.2 and 12.1). Fuelwood combustion represents a loss of carbon from the harvested wood products pool. It is lumped together with other losses from this pool, such as decay of wood products and paper. The entire loss is described using an exponential decay function featuring one decay constant. This decay constant is calculated from a mix of half-lives of products in the carbon pool. Whilst fuelwood is assumed to be burned in the year of harvest, other products have longer half-lives (IPCC 2006, Sec. 12.2.1.1 and Tab. 12.2). The IPCC Guidelines acknowledge that these calculations "simplify a more complex real world process".

The IPCC Guidelines (Vol.1 p. 1.6) also state that CO_2 emissions from biomass combustion for energy are an exception to the general practice of reporting in the sector actually generating emissions and removals. However the total absorption of fuelwood emissions into the LULUCF net removals matters in that it conceals the removing and emitting entities. To be consistent with other reporting categories, removals – if human-induced – leading to fuelwood should be allocated to forestry, whilst emissions should be allocated to the combusting sectors, even if the total cancels out. This is important since emissions from fuelwood combustion are significant compared to LULUCF totals, and forestry sectors should not report emissions that they are not responsible for. Once again, IPCC practices conflict with SEEA practices: The Australian Greenhouse Gas Emissions Accounts constructed according to the SEEA (ABS 2001) list CO_2 from fuelwood combustion under direct residential emissions, and include these into the national total.

The above inconsistency is also important for fishing industries. Like firewood, marine life represents a short-lived carbon pool, which is reported as zero net emissions (IPCC 2006, Vol. 1, p. 1.6). If removals and emissions were not lumped into one sector but allocated to different sectors, the following picture would emerge: Fishing industries would count carbon sequestered in their products as removals towards their sectoral emissions account. The emissions from carbon in seafood when it decays in human bodies and as waste would be allocated to the consuming sector, mostly households. Such accounting would be of significant benefit to fishing industries. The Australian fishing industry for example emits about 680 kt CO_2-e annually mainly by combusting fuels in their vessels (Foran et al. 2005a), whilst catching about 250 kt of fish (ABS 1999). Assuming a 20% carbon content of living beings, this catch amounts to 50 kt

C, or 200 kt CO_2. If these removals and emissions were accounted for, the fishing industry would be able to offset almost a third of their emissions, in the same way as the forestry industry does, which could be of value in a emissions trading regime.

Just as under UNFCCC rules for forestry, fisheries would have to demonstrate human inducement of carbon sequestration in marine life. Like plantations, fish farms would readily comply with Convention definitions. Trawling, capture fishing and other types of harvesting could invoke the precedent set for managed forests, and claim that any intervention in open-sea fish stocks amounts to these areas being classed as *managed*, and hence carbon stock changes as *human-induced*.

Once again, applying the SEEA would not lead to such a situation. Whilst like forests, fish exist both in cultivated (fish farms) and non-cultivated forms (open sea), this distinction only refers to the natural biological resource *fish*, and not to the ecosystem input *carbon*, which is always accounted for as coming from the environment (UNSD 2003, Secs. 7.55, 8.15 and 8.269).

3.3 *Net accounting and management issues*

Net carbon accounting has profound implications for industry and government. Being able to report net, and hence to offset emissions with removals, can be a valuable industry asset for public communication. Similarly government can report lower emissions figures.

A net figure of, say, 10 Mt CO_2-e has implications for abatement planning that are vastly different to those of two gross figures of 100 – 90 Mt CO_2-e. This is especially the case if emissions and removals occur in different sectors. Accounts and inventories must spell out gross flows in order to allow the full extent of information to enter decision-making and to make explicit the flow of environmental services into the economy. This is particularly important in light of recent policy development around emissions trading schemes.

3.4 *Quantities other than carbon*

The above examples demonstrate how diverging accounting practices can affect industry perspectives on their operations. The implications reach beyond carbon. In addition to sequestered carbon, water, energy, materials, and non-cultivated living beings are natural resources dealt with by the SEEA, and harvested resources are shown to flow from the environment into the economy (UNSD 2003, Secs. 2.38 and 3.88). Governments have started to compile natural resource accounts according to the SEEA.[7] However applying the logic of the UNFCCC's net accounting for natural resource flows the water supply industry could net its own water use with the water it collects as rainfall on its catchments. Or, moving to resource use indicators, coal-mining industries could net their energy use with the energy content of coal they extract from mines. Industries would be able to report a negative net use figure, and hence appear as water-generating, or energy-generating industry sectors. Under SEEA rules, water, mineral and energy resources are classed as natural resources, always originating from the environment (UNSD 2003, Sec. 8).

Fossil coal, oil and gas resources are a natural energy resource that can be harvested in almost useful form, whilst renewables such as wind, waves and light need to be transformed because of their low energy densities. We argue that UNFCCC/SEEA-type accounting systems would treat energy as they treat carbon: In a UNFCCC-type system, fossil and renewable energy-transforming industries would report negative energy use on the grounds of human intervention in the extraction, generation and transformation processes. The SEEA treats fossil energy and renewable energy as natural resources (Annex 2, Sec. EA.11) hence flows originate in the environment. Once again, whether energy industries would be able to report negative energy use would depend on the accounting system.

[7] Australia: water (ABS 2006), energy (ABS 2001), minerals (ABS 1998), and fish (ABS 1999).

4. **The transition from ecosystem input to product: a story of ownership**

With climate change the dominant global concern, carbon has become a valued commodity. To be tradeable carbon needs to be ownable, and ownership requires an explicit allocation of carbon to economic entities. It seems that this transfer from environmental input to tradeable commodity already exists. Carbon can be generated by industries (for example plantations) as a product and owned by organisations and people, it can be traded and used for offsetting. This reality is reflected in UNFCCC accounting, but not the SEEA, which lists carbon under ecosystem inputs. In this light, it is interesting to see *how* carbon has actually become a commodity and how these trends may affect other natural resources.

Whilst the United Nations 2008 is custodian of global forest there exists no collective ownership. Ownership of forests and their products is assumed by the peoples where those forests exist. Ownership rules and understandings therefore differ and while a global perspective may assume a collective responsibility as part of planetary health, a national perspective may be concerned with accounting for forest products and, more recently, carbon credits.

In Australia, as in other countries, natural resources such as forests are owned by the public. However, State and Territory Governments manage these resources by licensing access and distribution. Thus the forestry industry has *legal rights* to harvest on public land. Plantations are largely privately owned, as is the timber that they produce. In addition to timber ownership all Australian states now have legislation, either new (e.g. Western Australia[8]) or adapted (e.g. New South Wales[9]) to recognise sequestered carbon as product (AGO 2005, p. 35) and hence as a property right that can be traded separate from the underlying land interest (AGO 2007)[10]. This legislation has led the world in creating, and assigning ownership to, a commodity that did not previously exist (Hepburn, 2009).

[8] http://www.austlii.edu.au/au/legis/wa/consol_act/cra2003143/ (accessed 22/05/09)
[9] http://www.legislation.nsw.gov.au/fullhtml/inforce/act+85+2006+cd+0+Y? (accessed 22/05/09)
[10] Under the European Emissions Trading Scheme forestry offset programs are excluded (EC 2007) because they only temporarily store carbon, which at some time will be released.

The legislation made the owners of trees also the owners of their carbon (AGO 2005, Secs. 4.1.3 and 4.2) and enabled the trading of carbon offsets from forestry projects through the NSW Greenhouse Gas Abatement Scheme (GGAS) and the Federal Government's Greenhouse Friendly Program (Downie 2007).[11] However legislation to create the commodity *carbon* does not specify what counts as carbon sequestration. The Western Australian Government[12] for example asks only about the land, ownership status, freehold or Crown, and any encumbrances on the title deed. It is not concerned with when the trees were planted, how much carbon there is or whether or not forests are managed or unmanaged. Similarly the New South Wales legislation refers only to the granting of forestry rights by the relevant Minister or by the Forestry Commission. The legal creation of a tradeable commodity still needs a framework within which the trading can take place. In Australia this is likely to be the Carbon Pollution Reduction Scheme, a cap and trade scheme which adheres to the Kyoto framework (Fensham & Guymer, 2009).

Ownership of carbon and anticipation of global trading has given rise to a new industry. Worldwide there are now companies whose purpose is to remove CO_2 through increasing forests (Riddell 2008). Traditional forestry industries include climate change in their goal statements (Flint 2007; Department of Agriculture Fisheries and Forestry 2008) symbolically staking claim to sequestered carbon. *CO_2 Australia*[13] exemplifies companies with a mission to remove CO_2. Through its sequestration program, *CO_2 Australia* pays landholders to take grassland out of production to grow trees. Costs associated with planting, cultivation and monitoring are paid by the company. A Forestry Right is endorsed on the certificate(s) of title so that even if the land changes hand the commitment will continue. A Forestry Right in New South Wales is a form of *profit-à-prendre* – the right to the produce or soil of another's land (Registrar General 2007), in this case, the legal right to claim the carbon sequestered in the trees. The trees provide the company with fully auditable carbon certificates. The organisation can claim credits for emissions savings, while the landowner has the benefit provided by the tree belts. Carbon credits

[11] In 2006 certificates from carbon sequestration surrendered to the NSW GGAS constituted 0.4% of certificates or 50,050 tonnes (Independent Pricing and Regulatory Tribunal 2007). The Department of Climate Change could not disclose the specific amounts of abatement created by Greenhouse Friendly Program (personal communicaton, 4 June 2008).
[12] http://www.landgate.wa.gov.au/docvault.nsf/web/FOR_DLI_CR1/$FILE/FOR_DLI_CR1.pdf (accessed 22/05/09)
[13] http://www.co2australia.com.au/.

generated by forestry can be used to offset emissions in Australia where carbon sink forests attract a tax break[14], even though tree planting is thought to be the least effective way of dealing with climate change (Downie 2007).

Under the Clean Development Mechanism (CDM) the Kyoto Protocol has provision for small-scale afforestation/reforestation (AR) projects as a means of carbon sequestration. Local communities wishing to deal in carbon offsets must do so through their country's Designated National Authority set up to handle CDM offsets from approved projects. However access to this carbon market depends on well-defined property rights, which may not exist (CDMcapacity.org 2008). In Mexico for example, communal property rights and lack of a land tenure legal framework have inhibited investment in CDM forestry projects (Brown et al. 2004, p. 20). This may account for the fact that as of May 2009 only four such CDM projects had been approved[15].

In fact, a fundamental problem exists in reconciling carbon trading with customary rights of indigenous forest dwellers, who often regard trees as amenities that are owned collectively. For example, the Forest Peoples Programme (FFP 2008) is distrustful of the ability of the Forest Carbon Partnership Facility (FCPF; Carbon Finance Unit 2008) set up by the World Bank, to negotiate indigenous forest dwellers' legal rights to tenure of the forests, to the trees, and the carbon . The FCPF's aim is to provide a mechanism for assisting countries to reduce emissions from deforestation and forest degradation (REDD). It operates at a national government rather than project level, in that it will provide funding for governments to ready themselves for carbon trading. This readiness process includes defining who owns Emissions Reductions (ER) along with analysing the potential for improvements to forest law enforcement and land tenure structures. Once emissions have been reduced the country can apply to the FCPF's Carbon Fund for payment for their Emissions Reductions. This transaction will transfer carbon rights to World Bank's Carbon Fund Participants such as governments and private entities contributing to the fund.

[14] http://www.climatechange.gov.au/land/tax-deduction.html and http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/framelodgmentattachments/488B04F6988DE11ECA25751400197F31 (accessed 22/05/09)
[15] http://cdm.unfccc.int/Projects/projsearch.html (accessed 19/05/09)

Even though one of the FCPF's stated principles (Carbon Finance Unit 2008, p. 4) is to ensure countries will consider forest dwellers in policy-making, the REDD scheme has been challenged by the Forest Peoples Programme (FFP 2008). The main arguments relate to the lack of consultation with indigenous forest dwellers (Carbon Finance Unit 2008, p. 30), the requirement for participating countries to address the development of policies and regulations around land reform and land tenure, and the possibilities for what the FCPF refers to as 'reduced impact logging' (Carbon Finance Unit 2008, p. 30).

Global markets for carbon from forests are still small[11], but with increasing pressure for abatement measures and demand for forest space, the transition of carbon from collectively owned ecosystem input to individually owned commodity is likely to be fraught with problems surrounding customary ownership of forests, and allocation of property rights. These issues are likely to compound the accounting inconsistencies described in the previous Section.

5. Conclusions

The UNFCCC-SEEA accounting dissonance reflects the turning of an ecosystem input – carbon – into a commodity that can be owned and traded. It also illuminates the issue of ownership with the UNFCCC guidelines making ownership of sequestered carbon possible while obscuring the source of emissions. The SEEA accounting system on the other hand makes explicit that carbon is always an input from the environment; in accounting for environmental inputs as well as emissions it provides the full extent of information for decision making. While the UNFCCC's framework was intended for reporting progress towards a target, in which case calculation of net emissions makes sense, it is now being used as the basis for policy decisions. The SEEA on the other hand was produced expressly to support policy and strategic planning – something that it is eminently suited to – yet in the case of Australia at least, it is not being employed in that most crucial area of national policy development: Emissions trading.

We are used to naturally grown timber being a commodity on which monetary value can be placed. We have also witnessed this happening to water and fish (compare UNSD 2003 Sec. 2.165) and we are now witnessing this happening to carbon. The value of sequestered carbon has

been brought about by the realities of climate change and the abatement action it demands. Value in turn has led to ownership and trade. Carbon may be owned separately from trees and can be claimed as a national or private benefit in carbon reporting, offsetting and trading. In Australia, carbon in trees can be owned and traded by a carbon offset company. At the same time all sequestered carbon can be owned by government for example for demonstrating progress in meeting Kyoto targets. However, sharing ownership may not necessarily proceed harmoniously, especially when there are diverging needs between customary owners and governments. As Hepburn (2009) points out "[T]he enormous potential of such rights to trade as offsets within a national carbon trading scheme provides a firm imperative for a clear, consistent and uniform legislative articulation", something that does not seem to exist and is fraught with fundamental difficulties that hinge on carbon accounting practices.

That we acknowledge and explicitly account for environmental flows to the economy is necessary not only for the sake of fairness in economic dealings but more importantly it reinforces the reality that economic activity and human living ultimately depend on the continuing health of our environment.

Acknowledgements: The authors thank Barney Foran and Shauna Murray for insightful comments and ideas on earlier drafts of this paper.

References

ABS, 1998. *Mineral Account, Australia*. ABS Catalogue No. 4608.0, Canberra, Australia: Australian Bureau of Statistics.

ABS, 1999. *Fish Account, Australia*. ABS Catalogue No. 4607.0, Canberra, Australia: Australian Bureau of Statistics.

ABS, 2001. *Energy and Greenhouse Gas Emissions Accounts, Australia*. ABS Catalogue No. 4604.0, Canberra, Australia: Australian Bureau of Statistics.

ABS, 2006. *Water Account for Australia 2004-05*. ABS Catalogue No. 4610.0, Canberra, Australia: Australian Bureau of Statistics.

AGO, 2005. *Planning Forest Sink Projects • A Guide to Legal, Taxation and Contractual Issues*. Internet site http://www.climatechange.gov.au/land/forestsinks.html, Canberra, Australia: Australian Greenhouse Office.

AGO, 2007. *National Greenhouse Gas Inventory 2005*, Canberra, Australia: Department of the Environment and Water Resources, Australian Greenhouse Office.

Brown, K., Adger, W. N., Boyd, E., Corbera-Elizalde, E. and Shackley, S., 2004. *How do CDM projects contribute to sustainable development?* Technical Report 16, Internet site http://www.tyndall.ac.uk/research/theme2/project_overviews/it1_13.shtml, Norwich, UK: Tyndall Centre for Climate Change Research.

Carbon Finance Unit, 2008. *FCPF Information Memorandum*. Internet site http://carbonfinance.org/docs/FCPF_Info_Memo_05-30-08.pdf: World Bank.

CDMcapacity.org, 2008. *What can be done to encourage appropriate CDM projects in the land-use sector?* Internet site http://www.cdmcapacity.org/how_prepare_CDM/encourage_land_use.html, Edinburgh, UK: The Edinburgh Centre for Carbon Management.

Centre for Integrated Sustainability Analysis, 2005. *Clarification of the derivation and meaning of figures relating to greenhouse gas emissions in the Balancing Act report on three forestry sectors*. Internet site http://www.isa.org.usyd.edu.au/publications/documents/clarification_on_forestry_accounts.pdf, Sydney, Australia: The University of Sydney.

Commonwealth of Australian, 2008. *National Carbon Offset Standard Discussion Paper*. Department of Climate Change, Canberra

Commonwealth of Australian, 2008a. *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future*. Attorney General's Department, Barton ACT

DCC, 2008. *Forestry sector greenhouse gas emissions projections*, Canberra, Australia: Australian Government, Department of Climate Change.

DCC, 2008a. *Emissions Trading Stakeholder Consultation*, Canberra, Australia: Australian Government, Department of Climate Change.

Department of Agriculture Fisheries and Forestry, 2008. *Forestry*. Internet site http://www.daff.gov.au/about/contactus/fish-forestry/forestry, Canberra, Australia.

Downie, C., 2007. *Carbon Offsets: Saviour or cop-out?* Research Paper No. 48, Internet site http://www.tai.org.au/documents/downloads/WP107.pdf, Canberra, Australia: The Australia Institute.

Driscoll, D., Milkovits, G. and Freudenberger, D., 2000. *Impact and use of firewood in Australia*, Canberra, Australia: CSIRO Sustainable Ecosystems.

EC, 2007. *EU emissions trading: an open system promoting global innovation*. Internet site http://ec.europa.eu/environment/climat/pdf/bali/eu_action.pdf, Brussels, Belgium: European Commission.

Fensham, R.J. and Guymer, G.P., 2009. Carbon accumulation through ecosystem recovery. *Environmental Science and Policy* 12, 367-372.

FFP, 2008. *The Forest Carbon Partnership Facility: Facilitating the weakening of indigenous peoples' rights to lands and resources*. Internet site http://www.forestpeoples.org/documents/forest_issues/fcpf_fpp_briefing_feb08_eng.pdf, Moreton-in-Marsh, UK: Forest Peoples Programme.

Flint, L., 2007. Forest carbon credits important part of business. *Bush Telegraph Magazine* Spring, Internet site http://www.dpi.nsw.gov.au/aboutus/news/bush-telegraph-magazine/spring-2007/carbon-credits.

Foran, B., Lenzen, M. and Dey, C., 2005a. *Balancing Act - A Triple Bottom Line Account of the Australian Economy*. Internet site http://www.isa.org.usyd.edu.au, Canberra, ACT, Australia: CSIRO Resource Futures and The University of Sydney.

Foran, B., Lenzen, M., Dey, C. and Bilek, M., 2005b. Integrating Sustainable Chain Management with Triple Bottom Line Reporting. *Ecological Economics* 52(2), 143-157.

George Wilkenfeld & Associates Pty Ltd and Energy Strategies, 2002. *Australia's National Greenhouse Gas Inventory 1990, 1995 and 1999 - end use allocation of emissions*, Canberra, Australia: Australian Greenhouse Office.

Hepburn, S., 2009. Carbon Rights as New Property: Towards a Uniform Framework. *Sydney Law Review* 31(2) Forthcoming

Houghton, J. T., Jenkins, G. J. and Ephraums, J. J., 1990. *Scientific Assessment of Climate change – Report of Working Group I*. IPCC First Assessment Report, Cambridge, UK: IPCC/WMO/UNEP.

Independent Pricing and Regulatory Tribunal, 2007. *Scheme Reports* Internet site http://greenhousegas.nsw.gov.au/Documents/syn59.asp, Sydney, Australia: NSW Greenhouse Gas Reduction Scheme.

IPCC, 2006. *Guidelines for National Greenhouse Gas Inventories*. Internet site http://www.ipcc.ch/ipccreports/methodology-reports.htm, Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Jackson, T. (2009). *Prosperity without growth? The transition to a sustainable economy*. Sustainable Development Commission, UK.

Lange, G.-M., 2007. Environmental accounting: Introducing the SEEA-2003. *Ecological Economics* 61(4), 589-591.

Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F., 2003. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Internet site http://www.ipcc-nggip.iges.or.jp, Hayama, Japan: Intergovernmental Panel on Climate Change.

Registrar General, 2007. *Profit a Prendre And Forestry Rights*. Internet site http://rgdirections.lands.nsw.gov.au/dealing/dealingsinvolving/profitaprendre#forestryright, Sydney, Australia: NSW Department of Lands.

Riddell, L., 2008. Investors jump into forest carbon credits. *San Francisco Business Times* 16 May, Internet site http://www.bizjournals.com/sanfrancisco/stories/2008/05/19/story8.html?b=1211169600%5E1636890.

Smith, R., 2006. Development of the SEEA 2003 and its implementation. *Ecological Economics* 61, 592-599.

UN, 1992. *Framework Convention on Climate Change*. Internet site http://unfccc.int/resource/docs/convkp/conveng.pdf, Rio de Janeiro, Brazil: United Nations.

UN, 1997. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. Internet site http://unfccc.int/resource/docs/convkp/kpeng.pdf, Kyoto, Japan: United Nations.

UNFCCC, 2008. *Distribution of registered project acivities by scope*. Internet site http://cdm.unfccc.int/Statistics/Registration/RegisteredProjByScopePieChart.html, Bonn, Germany: United Nations Framework Convention on Climate Change.

United Nations, 1992. *Framework Convention on Climate Change*. Internet site http://unfccc.int/resource/docs/convkp/kpeng.pdf, Rio de Janeiro, Brazil: United Nations.

United Nations, 2008. *United Nations Forum on Forests*. Internet site http://www.un.org/esa/forests/, New York, USA: UNFF.

UNSD, 2003. *Handbook of National Accounting: Integrated Environmental and Economic Accounting*. Internet site http://unstats.un.org/unsd/envAccounting/seea2003.pdf, New York, USA: United Nations Statistics Division.

Vidal, J., 2008. *The great green land grab*. http://www.guardian.co.uk/environment/2008/feb/13/conservation (accessed 30/05/09) also http://www.rightsandresources.org/blog.php?id=77 (accessed 30/05/09)

Watson, R. T., Noble, I. R., Bolin, B., Ravindranath, N. H., Verardo, D. J. and Dokken, D. J., 2006a. *Land Use, Land-Use Change And Forestry*. IPCC Special Report, Internet site http://www.ipcc.ch/ipccreports/sres/land_use/index.htm, Montréal, Canada: IPCC Plenary XVI.

Watson, R. T., Noble, I. R., Bolin, B., Ravindranath, N. H., Verardo, D. J. and Dokken, D. J., 2006b. *Land Use, Land-Use Change And Forestry - Summary for Policy Makers*. IPCC Special Report, Internet site http://www.ipcc.ch/pdf/special-reports/spm/srl-en.pdf, Montréal, Canada: IPCC Plenary XVI.