Financial Accounting Calculation in relation to Nature

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Abstract

Controversies drawn from the main thesis research question – asking what is the relationship between financial accounting calculation and nature – lead to the specification of research sub-questions. Firstly, how does financial accounting calculation communicate and/or construct the reality of humanity's economic relationship with nature? Secondly, what is the role of financial accounting calculation in building markets for the purpose of addressing specific environmental problems? Thirdly, what kind of ontological relationship exists between financial accounting calculation and nature? These controversies are examined via two empirical case studies, utilising the principles of actor-network theory, and a conceptual discussion that draws from these cases and from literature on financial markets.

The first empirical case study seeks to examine how the biodiversity comprising a tropical forest ecosystem in the Kasigau Corridor in Keyna is protected as a result of having its conservation brought into financial accounting calculations by constructing, via processes of objectification and singularisation, a greenhouse gas emissions offset product to sell on the voluntary over-the-counter carbon markets.

The second empirical case study seeks to examine the performativity of financial accounting in the construction of markets in tropical forest carbon. The analysis describes and explains the conflicts surrounding the translation of carbon market calculative devices by networks of organisational actors to extract a tradable accounting inscription from the world of tropical forests.

A conceptual discussion then places economic markets on a flat ontological landscape with natural systems. This theoretical conception allows for a direct comparison between the roles of financial accounting calculations in markets and that of other forms of calculation and emergent computation in natural systems, finding that they are ontologically equivalent. This then provides a new theoretical frame for considering issues such as pluralism of accountings and accounting for sustainability.

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Chapter 1.
Introduction

> What is the link between nature and accounting?
>
> I must confess, I do not know. (Hines, 1991b, p. 27)

The research question that this thesis seeks to address is: What is the relationship between financial accounting calculation and nature? The question of the relationship between financial accounting calculation and nature is important because the economic activities of humanity appear to be causing the greatest extinction of species in the history of planet Earth (Jones, 2013). Understanding the connection between natural ecosystems and financial accounting calculations, which define the recognition and measurement of our economic activities, may provide a new and potentially useful theoretical framework for thinking about humanity's place in nature.

The thesis will seek to make original empirical and theoretical contributions to knowledge by examining the experimental construction of markets (Callon, 2009) in tropical forest carbon and then using this analysis to draw out a new theoretical frame for considering controversies in accounting in relation to nature.

Chapter two will review some basic controversies regarding financial accounting calculation in relation to nature by drawing on a representative debate on financial accounting in emissions markets. From this review, a number of sub-questions to the main research question will be drawn.

Chapter three will review the methodology and methods that will be employed in the empirical research and then chapters four and five will provide the empirical core of this thesis, with each describing and analysing an account of construction of markets in tropical forest carbon. These chapters aim to be standalone case studies regarding financial accounting calculation in relation to nature.

Chapter four will focus on a single project in the voluntary carbon trading markets that is seeking to bring the tropical forest biodiversity of the Kasigau Corridor ecosystem in Kenya into financial accounting calculation. It will examine the role of standards and black-boxing (MacKenzie, 2009a) in the extraction of calculable goods (Callon and Muniesa, 2005).

Chapter five will seek to trace a struggle within and between international institutions over the translation (Callon, 1986) of financial accounting calculations that define the recognition and measurement of transactions in new experimental markets for tropical forest carbon. The case will witness the emergence of indigenous peoples as a significant calculative agency in the formation of these markets. The existing connections that indigenous peoples have with the forests will prove necessary for the production of the required accounting inscriptions. The analysis of this case will establish that struggles over the objectives of market innovations are fought in terms of the performativity (MacKenzie and Millo, 2003) of financial accounting calculations.

Chapters six and seven will draw on the analyses of the case studies in chapters four and five, and on literature concerning financial markets, to discuss a theoretical conception that places financial accounting calculations of market actors onto a flat ontological landscape (Latour, 2005) with the calculations of diverse components of the complexity of nature. From this, the thesis will aim to provide a new perspective within pluralistic debate on environmental accounting (Dillard and Brown, 2012), such as what it might possibly mean to seek to account for sustainability.

Chapter 2.
Controversies in Accounting in relation to Nature

2.1. Introduction

There exist a number of basic controversies in financial accounting research regarding how financial accounting relates to companies' interactions with – and their impacts on – the natural environment. These include how specific financial accounting treatments both communicate and construct an economic reality, the role of financial accounting in markets that are destructive of nature, and ontological incompatibilities between accounting and nature. This section will explore these issues by examining a representative debate over the reporting of transactions related to emissions markets.

The first large-scale emissions market was constructed in the United States to control emissions of sulphur dioxide (SO_2) from coal-fired power stations. It was considered necessary to do something to reduce the overall amount put into the atmosphere as it was causing a great deal of acid rain that was destroying woodland and crops. The SO_2 markets were a forerunner to carbon trading – they were a market innovation specifically and explicitly designed and built to address an identified environmental problem. All large power stations were issued credits and told they could use them up as they emit SO_2 or they could sell any that they didn't need. The aim was to encourage companies to innovate ways of producing power such that they did not emit as much SO_2, so they could get the benefit of selling surplus credits. Thus, low-sulphur power generation would have a competitive advantage over high-sulphur power generation, and the overall emissions would be controlled and reduced with more economic efficiency that a regulatory approach. In a special section of *Critical Perspectives on*

Accounting, Wambsganss and Sanford (1996) presented a suggested financial reporting treatment for the activities involved in engaging with the scheme, and then Gibson (1996), Lehman (1996), and (Milne, 1996) reviewed and criticised the paper.

2.2. Communication and Construction of Economic Reality

The Wambsganss and Sanford (1996) paper was written in response to the suggested financial accounting treatment of Federal Energy Regulatory Commission guidelines that emissions allowances should be recognised on a cost basis. This had the effect that those allowances purchased by companies would be recognised as costs in the business, but those allowances that were issued for free (i.e. zero cost) to companies by the government would not be recognised in the accounts at all. This, it was argued, did not properly reflect the new economic reality brought about by the scheme in which these companies operated. The inconsistency of the treatment of purchased and issued allowances meant that the "cost of polluting", that the scheme was designed to introduce, was only partially visible in financial statements. An alternative treatment is suggested:

- Purchased allowances are recognised as current assets at cost (DR current assets, CR cash)
- Allowances issued by the government are recognised as donated assets at the market value of allowances on the day of issue (DR current assets, CR equity: contributed capital)
- Allowances used in compensation for recorded emissions are debited (on the basis of a weighted-average of initial market value of allowances held by the company) to cost of sales (DR cost of sales, CR current assets).
- Gains and losses on sale of allowances are included in the income statement (e.g. for a loss then DR expense, CR current assets).

This treatment has the effect of introducing a cost of polluting. It thus reduces the reported profits of companies participating in the scheme and their ongoing retained earnings, even though the companies' cash flows may not necessarily have changed at all. The treatment effectively results in the accumulation of a contributed capital equity account to the detriment of retained earnings. This reflects 'a more realistic cost of production' (p. 649) with the costs of polluting included, thus the financial reporting treatment more faithfully represents the economic reality in which companies that participate in the scheme are operating. This more realistic treatment should lead to more optimal decisions by users of the financial statements, thus 'allowing the market to function more efficiently relative to the cost of pollution' (p.652). Indeed, it has been shown that capital markets did consider a company's bank of SO_2 allowances relevant in its determinations of share value (Johnston *et al.*, 2008).

The implication of Wambsganss and Sanford (1996) that a correct financial accounting treatment is determined on the basis of producing economic efficiency is picked up and criticised by Milne (1996). It is argued that suggested treatment, by recognising allowances as assets on companies' balance sheets, indicates an assumption that companies can own rights to pollute the environment. This is consistent with a neoclassical economic assumption that environmental resources are commodities that can be privately owned, rather than a common good to which all of society is collectively entitled. An alternative treatment is proposed on the basis of society owning a right to clean air.

- Purchased allowances are recognised are recognised as current assets at cost (DR current assets, CR cash).
- Issued allowances are recognised at market value as current assets but also as a liability to society (DR current assets, CR current liabilities).
- When the allowance is used to compensate for emissions, the use of the allowance is recognised as a cost, and the generation of electricity

is recognised by writing down the liability to society (DR cost of sales, CR current assets, and DR current liabilities, CR cost of sales: subsidy from society)

The overall net result of this treatment will be that there are separate lines in cost of sales that reflect, firstly, the true cost of production including the cost of polluting and, secondly, the subsidy from society which has granted the privilege of polluting the air in return for the generation of electricity. The adoption of this financial accounting treatment properly reflects the economic reality that society is giving up its right to clean air in return for electricity. The treatment may not result in the most economically efficient market but it is consistent with the moral and ethical argument upon which the emissions trading scheme was (or should have been) based.

Controversy over the correct financial reporting treatment for emissions allowances arose again with the introduction of carbon emissions trading as a result of the Kyoto Protocol. Cook (2009), MacKenzie (2009a), and Bebbington and Larrinaga-Gonzalez (2008) each critically assess an attempt by the International Financial Reporting Committee (IFRIC) to produce an application of International Accounting Standards (IASs) to properly reflect the transactions that companies were undertaking under the carbon trading scheme. IFRIC approached the problem by making determinations regarding what it saw as each of the kinds of transactions that occurred.

Firstly, IFRIC determined that emissions allowances certainly met the definition of being assets: a resource controlled by the entity as a result of past events and from which future economic benefits are expected to flow to the entity. It was further determined that they were intangible assets: identifiable non-monetary assets without physical substance. Thus they should be treated in accordance with IAS 38.

Secondly, IFRIC determined that allowances allocated to companies free of charge fell within the definition of government grants: transfers of resources to an entity in return for past or future compliance with certain conditions

relating to the operating activities of the entity. Government grants need to be treated according to IAS 20.

Thirdly, IFRIC determined that participation in the scheme meant that a company's emissions of carbon dioxide created a liability: a present obligation of the entity arising from past events, the settlement of which is expected to result in an outflow from the entity of resources embodying economic benefits. It was further determined that these liabilities were provisions: liabilities of uncertain timing or amount. Thus they should be treated in accordance with IAS 37.

This proposed treatment closely follows that suggested by Wambsganss and Sanford (1996) for SO_2 trading. Unfortunately for IFRIC, their proposal was met with anger and derision because it appeared to violate the matching concept of financial accounting – matching the recognition of costs to associated income – and produced artificial volatility in accounting earnings. This was down to two problems. Firstly, if the market value of emissions allowances changed since a company had purchased or been allocated them then that change in fair value of the tangible asset would need to be recognised in equity (revaluation reserve), but the change in fair value of the liability would be recognised in profit and loss. Secondly, an imminent change to IAS20 would mean that the income from a government grant of issued allowances would need to be recognised immediately upon receipt, whereas the costs of emitting would accumulate over time. These accounting mismatches led the European Financial Advisory Group to declare that the interpretation would not result in economic reality being reflected, and the International Accounting Standards Board withdrew it.

Underlying the criticism of the interpretation lay a basic disagreement about the "economic reality" brought about by participation in the scheme. The purpose of carbon trading was to make emission of greenhouse gases a costly activity, rather than a costless (to the emitting entity) externality. The economic rationale for using a market rather than, say, a tax is that it presents participants with an opportunity to profit by cutting emissions and

selling surplus allowances which should mean that the market is an economically efficient way of reducing overall greenhouse gases (Braun, 2009). The IFRIC proposal is consistent with this purpose as it makes both the cost of emissions and the potential opportunity for profit (the intangible assets) visible in the accounting of participating companies. However, as Engels (2009) demonstrates, companies participating in the scheme tended to regard it very much as a compliance problem, with the emphasis on making sure they had sufficient allowances to cover their emissions and thus avoid costly fines. Given this mindset, the economic reality of participation in the scheme looks different. Some form of hedge accounting seems appropriate, which would reflect the fact that the company's only additional costs as a result of participating in the scheme are the costs of purchasing extra allowances to cover emissions that are not already covered by the allowances they were first issued with.

Hedge accounting would make the costs of carbon emissions invisible in the accounts of companies, thus maintaining its status as an externality. The opportunity costs associated with utilising allowances rather than cutting emissions and selling the surplus allowances would also remain hidden (Hopwood, 2009a). With the costs and opportunities not visible in the accounts of companies, they may be less likely to act in ways that the scheme was designed to encourage, such as seeking to cut their own emissions, and actively trading allowances. MacKenzie (2009a) conjectures that the invisibility of costs and opportunities, following rejection of the IFRIC treatment, contributed to a dynamic in the first phase of carbon trading whereby companies held on to allowances that were surplus to their needs even though they could have sold them for significant profits. This meant that only right at the end of the phase did the price of allowances drop effectively to zero when it became clear that there was a large overall surplus of allowances in the market.

The controversy over the reporting of emissions allowances then (both SO_2 and CO_2) arises out of concern both that financial accounting should reflect

economic reality but also that financial accounting can contribute to the construction of economic reality. How transactions are accounted for can affect the actual dynamics of market activities.

> We create a picture of an organization, or the 'economy', whatever you like, and on the basis of that picture … people act. And by responding to that picture of reality, they make it so (Hines, 1988).

The body of knowledge that comprises financial accounting is concerned with the recognition and measurement of capital, assets, and liabilities and so the way these are recognised and measured will (at least partially) determine the economic reality of an organisation's financial performance and position (Hines, 1991a). Argument and debate over proper financial accounting treatment, then, is not confined to how best to communicate some objective reality but rather is over who's reality should be reflected and thus projected by that treatment. The accountant's picture of reality will be represented in the accounts they produce, which will always be incomplete, and thus ambiguous (McSweeney, 1997), interpretations.

> Accountants are enmeshed in a process of reality construction. They grasp and articulate complex realities in partial ways, and these graspings and articulations help to sustain the realities as perceived (Morgan, 1988).

For markets designed for an environmental purpose, the financial accounting treatment of activities in those markets could therefore make a significant difference to the effects those markets have on nature. Which particular aspects of the complex reality of nature will/should be "accounted for"? Which aspects will/should be left out? Controversies over financial accounting treatments are indeed controversies over competing economic visions.

2.3. Markets

In her critical review of Wambsganss and Sanford (1996), Gibson (1996) chastises them for focussing on a problem that pales into insignificance when compared with the folly of an economic mindset that is, in itself, destructive of nature.

> The reporting is irrelevant. What is of concern is the underlying philosophy which believes that the environment in which we live can be constrained within the artificial constructs of "the market" (p.665).

Rather, then, than play along with the idea that by expanding the domain of markets as a way of solving an ecological problem, accounting researchers 'need to look beyond the ontological assumptions of neoclassical economics and market instruments' (p.664).

Neoclassical economics is a system of thinking that conceptualises markets as consisting of self-interested, independently acting, rational, utility-maximising agents. This conceptualisation allows for market behaviour to be analysed mathematically by summing over all the independent actions of the agents in the same way that a physicist might use statistical mechanics to sum over all the individual behaviours of independent particles of a gas to derive its thermodynamic properties. A great deal of accounting research, including capital markets research into how equity prices are affected by accounting information (Ball and Brown, 1968; Beaver, 1968), and positive accounting research into the reasons for managers to choose particular accounting policies and methods (Watts and Zimmerman, 1978; Watts and Zimmerman, 1979; Watts and Zimmerman, 1990; Fields *et al.*, 2001), rely on neoclassical principles to produce quantitative analyses. Such research holds itself to be "scientific" because hypotheses derived from its theories are tested against quantified empirical evidence. This means that it is research into real accounting practice. Critical accounting researchers, however, argue that such a stance is implicitly normative because it endorses and reinforces the system of capitalist markets that neoclassical economics depicts and envisions (Tinker *et al.*, 1982; Tinker and Neimark, 1988). They point out that the emergence and rapid dominance of neoclassical

economics-based accounting research coincides with the rise of the political right, particularly in America, and that the deregulatory conservative implications of such research served this agenda (Mouck, 1992). Indeed, by adopting the neoclassical economic paradigm, accounting researchers become a part of the mechanisms sustaining the exploitation of social and natural capital for those privileged with wealth and power at the top of society.

> We see … growing evidence of accounting and finance's complicity in an increasingly unjust world; a continuing resistance by systems of vested interest to stark evidence of that injustice and a growing (apparently deliberate) complicity in academe's suppression of diversity in the interests of "business" (Tinker and Gray, 2003, p. 728).

Neoclassical economics, and the accounting research based on its principles, has no place for moral decency, fairness, or justice – only the selfish accumulation of personal wealth at the expense of all else (Murray *et al.*, 2006). This, of course, includes nature. Market agents can increase their personal wealth by appropriating natural capital as their own. A neoclassical economic response to a problem such as acid rain caused by sulphur dioxide emissions, or global climate change caused by greenhouse gas emissions (Andrew *et al.*, 2010) is to create new markets that will create a scenario where it is in the self-interests of these agents to act in less destructive ways (by, for example, reducing their emissions of harmful gases). The critical assessment of this response is a plea, appealing to basic ethical standards, that nature must surely be protected from the markets (McNicholas and Windsor, 2011), not subsumed into them.

> Pragmatically, the over turn – or at least a massive reinvention – of capitalism is the least that is needed to make much real progress (Tinker and Gray, 2003, p. 750).

As markets grow in scale and scope, they encounter new actors. Encounters between markets and indigenous peoples, which may have previously been

relatively protected by their geographical remoteness (Graham, 2009), can be devastating for those cultures. Accounting techniques have been used throughout history to as a tool for colonialism and imperialism, to dominate and oppress indigenous cultures (Davie, 2000; Gibson, 2000; Neu, 2000; Constable and Kuasirkun, 2007). With markets now expanding their sphere to take in more and more of the natural environment, further such encounters appear to be inevitable.[1]

Some civil society campaigns (e.g. FERN et al., 2013) argue that emissions trading is a fundamentally flawed tool for tackling global climate change. This is because what is being traded – a right to emit a tonne of carbon dioxide – is a commodity akin to medieval indulgences where people could pay a priest for permission to commit a sin. This means that the whole system is rigged in favour of big polluters who can simply pay to carry on as usual without actually doing anything to contribute to tackling climate change. The burden of global climate change, then, is borne by the world's poor who can least afford to adapt to a degraded natural environment.

> Carbon trading has set in motion the creeping commodification of nature that offers profits for traders, but paltry protection for the natural environment or communities living on and around the territories affected by either the offset projects or the industrial facilities that are allowed to continue polluting in the first place (p. 4).

The carbon market, therefore, is a 'fraudsters' paradise' (p. 13) that is entirely blind to the injustices it creates. Bringing nature within the sphere of markets only furthers those injustices by turning what should be a common public good into a privately owned commodity. Those against the use of market mechanisms are particularly alarmed that governments appear to be rolling out the idea to other aspects of nature. Biodiversity offsetting, for example, allows developers to create new habitats for species that then provide

[1] Chapter five will give an account of one collective response of representatives of forest-dwelling indigenous peoples to an encounter with the carbon trading markets as they expand to take in tropical forest carbon.

compensation for habitat they destroy as a result of their developments. The problem, of course, comes in the quantification and valuation of the health and importance of natural habitat, and of particular species, in deciding what counts as adequate compensation (Tregidga, 2013).

Another consequence of the neoclassical economic approach to accounting research is that it's believed that there is no need to regulate business reporting because it is regarded to be in the interests of managers to reduce the information asymmetry between themselves and investors. This is because investors will demand a premium return for the uncertainty that arises from such asymmetries and so that will reduce the resources available for managers' remuneration (Jensen and Meckling, 1976). A great many companies now choose to report on their environmental performance (KPMG, 2011). However, a lack of compulsory requirements for such reporting has led to a great disparity of practice, with very few choosing to consider and report their impact on ecosystems and biodiversity (Rimmel and Jonall, 2013; van Liempd and Busch, 2013). Indeed, critical accounting researchers hold that the environmental reporting project (R. Gray, 2002) has been "captured" by business and by market capitalism such that it is now little more than an exercise in public relations (Spence, 2009). Accountants and accounting researchers, then, who choose to adopt a pragmatic perspective on environmental accounting, perhaps in the hope that better reporting will lead to better behaviour (R. Gray *et al.*, 1995), are again complicit in the subjugation of ecological concerns beneath economic ones.

There does, therefore, remain ongoing controversy regarding the relationship between markets and nature, and regarding the role of financial accounting in defining and sustaining this relationship.

2.4. Ontological Mismatch

The final critical review of Wambsganss and Sanford (1996) came from Lehman (1996), who argued that attempts to represent nature in the economic language of accounting would always be incomplete.

> Ultimately, environmental accounting will prove destructive of nature because it does not contextualize the relationships between humanity and nature (p. 667).

Placing a monetary (or indeed any quantitative) value on nature, as the accounting in emissions markets aims to do, implies a straightforward economic relationship with the environment, but the problem is 'that nature has value to people which cannot *always* be explained in numerical terms' (p. 674, emphasis in original). This goes to very heart of the main research question of this thesis. The ontology of something is its basic specification or conceptualisation (Gruber, 1992). Lehman's criticism is that nature and accounting have fundamentally incompatible ontologies – that nature cannot be conceptualised by accounting without losing that which losing the basic meaning – the intrinsic value – of nature. Furthermore, accounting for the environment suggests an element of control over that environment. However, nature's reactions to humanity's interventions are fundamentally chaotic.

> That is, a small change to any individual component in the ecosystem could lead to small and inconsequential changes. Alternatively, a small change in an ecosystem variable could cause large and irreversible processes (p. 674).

So individual components of nature cannot be manipulated without the possibility of that having consequences way beyond what was intended. Environmental accounting seeks to isolate specific components of nature but cannot possibly represent the role that component plays in the ecosystems of which it is a part. Nature is 'a potentially meaningful whole which cannot be reduced to its constituent parts' (p. 675). This ontological hurdle has formed

the basis of criticism aimed at all manner of attempts to account for the natural environment.

> All in nature are interdependent … But accounting, like any language, names, bounds and thus separates (Hines, 1991b, p. 27).

It has, indeed, been noted that the basic concepts of financial accounting are incompatible with consideration of ecological issues (Maunders and Burritt, 1991). For example, the accruals concept seeks to match income to associated costs but this implies an identifiable causal relationship between expenditure and receipts, whereas in ecology causal relationships are often highly complex and so difficult/impossible to isolate and match.

Attempting to account for the natural environment can be conceptualised as a way to operationalise the desire for economic activity to be sustainable (Burritt and Schaltegger, 2010), defined by the Brundtland Report (WCED, 1987) as meeting 'the needs of the present without compromising the ability of future generations to meet their own needs' (p. 15), which sounds like a worthy goal but comes with its own philosophical quagmire.

> Of course … [sustainability] is impossible (almost any action by man depletes the biosphere to some degree), unrealistic (it assumes that there will be no advances in technology, energy sources, etc.), underspecified (it does not clarify the question of whether substitution between elements is permitted) and imprecise (it assumes a static mode of action and does not allow for systemic change in social life) (Rob Gray, 1992, p. 416).

The basic problem here, then, is that there is no single way of being "sustainable" and, given that we cannot know what technologies future generations will have access to, or how they will organise themselves, then how can we possibly account for any one form of sustainability. Any number of potential stakeholders will have any number of objectives for an organisation that they believe would contribute to what they hold to be sustainability, and there will be tension between all of these and the firm's

own goal of maximising its profits (Joseph, 2012). How, then, could a firm possibly produce an account demonstrating its sustainability?

> As we do not know what the point of sustainability looks like, one can only ever produce an account of an organization's unsustainability (Bebbington and Gray, 2001).

R. Gray (2010) argues that sustainability surely refers to sustaining natural ecosystems. This stands in contrast to accounting, which refers to the performance of individual firms. So the boundaries delimiting these biological and economic entities will almost never coincide. Only organisations whose actual purpose is the stewardship of particular ecosystems (e.g. Jones, 1996; Jones, 2003; Siddiqui, 2013) will have organisational boundaries that encompass a whole ecosystem. For the vast majority of companies, their organisational boundaries – their sphere of influence and control – will only partially overlap identifiable ecosystems. The sustainability of any particular ecosystem, then, will not wholly depend on the activities of one organisation, but of many. Accounting for the sustainability of an ecosystem at the level of the firm, then, proves to be an ontological impossibility.

All these ontological troubles make it practically impossible to hold firms accountable for their environmental impacts. Spence *et al.* (2010) argue that the main explanatory theories utilised in the study of environmental accounting – Stakeholder Theory, Legitimacy Theory, and Political Economy Theory – have all been interpreted in accounting research in ways that have been severely limiting with regard to the exploration of environmental accounting. Stakeholder theory explains corporate reporting practices in terms of the relative power of different stakeholder groups to coerce the organisation into complying with their expectations (O'Dwyer, 2005). Legitimacy theory explains corporate reporting practices in terms of the perceived social contract that exists between the firm and its respective society, such that the firm must be seen to operate within the bounds of that contract in order to maintain its legitimacy (Deegan, 2002). Political economy theory explains corporate reporting practices in terms of the firm's desire to

transmit to society, or to sections of society, particular ideological themes and narratives that serve to build and sustain its own political identity and status (Guthrie and Parker, 1990). The focus in dominant environment accounting theory, then, on accountability has been taken as a given, forcing researchers to focus upon 'what crumbs corporations throw from the table' (Spence *et al.*, 2010, p. 85) when firms include particular disclosures in their accountings.

> The corollary is to preclude discussion over whether or not accountability remains a realistic or desirable demand to make of corporations (p. 77).

Spence *et al.* (2010) call for meta-theorisation in relation to accounting and the natural environment that moves beyond a struggle to impose such accountability. The controversy over the ontological basis for accounting for the environment, then, goes to the heart of the question of the relationship between (financial) accounting and nature. Is there any way that the apparent ontological chasm that separates them can somehow be bridged?

The answer, according to both R. Gray (2010) and Spence *et al.* (2010) might be to bring about some form of democratic pluralism of accountings to re-politicise debate within accounting in relation to nature. Agonistic pluralism (Brown, 2009; Brown and Dillard, 2012; Brown and Dillard, 2013) rejects claims of "objectivity" made in monologic accounts and instead advocates a form of accounting in which the multiple, heterogeneous, indeed diverse, voices of society are brought together in a way that highlights the conflicts between them. Thus rather than seek a consensus in which all political debate is subsumed within a single agreed narrative, agonistic pluralism seeks to explicitly set differing political perspectives against each other in rival accountings of reality. Where mainstream financial accounting deliberately privileges the information demands of capital markets, an agonistic pluralism approach would give equal weighting to the participation of all stakeholders. If such a thing could be achieved then it may go a long way towards bridging the ontological gap between accounting and nature.

The accountings of firms would be recognised as only one perspective on reality. Conflicting accounts produced by, say, grassroots environmental organisations could offer a counter-perspective from the viewpoint of the natural environment or a particular ecosystem. Groups could essentially speak for – give a voice to – nature. Those voices could be heard alongside those of individual firms, thus placing the various conflictual accountings onto the same ontological level. The debate, then, within agonistic pluralism is how, specifically, humanity could bring about this kind of democratic engagement with nature. This thesis will return to the issue of pluralism in accounting – presenting a possible alternative to the agonistic variety – in chapter six.

2.5. Conclusion

The above review has highlighted three basic controversies concerning the relationship between financial accounting and nature. Controversies over financial accounting treatments, conscious of accounting's ability to simultaneously communicate and construct economic reality, were seen to be struggles over differing visions of humanity's relationship with nature. Controversies over the desirability or otherwise of using markets as a way to address environmental problems point to the role of financial accounting in building and sustaining those markets. Controversies over the ontological mismatches between financial accounting and nature imply a need for meta-theorisation to find some solid basis for connecting them. Addressing these three identified controversies form sub-questions for to the main research question of this thesis. At the end of this review, then, the following have therefore been identified as the research question and sub-questions:

2.5.1. Research question

What is the relationship between financial accounting calculation and nature?

2.5.2. Related sub-questions

(i) How does financial accounting calculation communicate and/or construct the reality of humanity's economic relationship with nature?

(ii) What is the role of financial accounting calculation in building markets for the purpose of addressing specific environmental problems?

(iii) What kind of ontological relationship exists between financial accounting calculation and nature?

Following a discussion about methodology and methods in chapter three, the rest of this thesis will seek to address these sub-questions and, in turn, the main research question of this thesis. Each chapter will speak to some degree about all of the sub-questions and the main research question but there will be particular focus in chapters four, five and six to sub-questions (i), (ii), and (iii) respectively. Chapter seven seeks to conclude the thesis by drawing together the significant contributions to knowledge made regarding the relationship between financial accounting calculation and nature.

Chapter 3.
Methodology and Methods

3.1. Introduction

This chapter will outline the methodology and methods employed in this thesis in its attempt to address the research question. The chapter holds that it is difficult to draw a clear line between matters of methodology and of methods and that it is useful, instead, to consider a spectrum of considerations regarding how research is done, ranging from broad principles (the domain of methodology) through to specific techniques (the domain of methods). The chapter is structured so as to attempt to move through this spectrum, beginning with the basic beliefs about the meaning of research and finishing with specific considerations regarding data collection, analysis, limitations and ethics.

3.2. Research Philosophy

The purpose of this thesis is to make a contribution to knowledge. This has been interpreted to mean a contribution to theory in the financial accounting literature. In seeking to do this, this thesis has broadly adopted Daft's (1983) principles regarding *research as a craft*. The starting point for this philosophy is that research into "natural" and "social" phenomena are fundamentally similar. Daft refers to the physicist Oppenheimer's (1956) address to the American Psychological Association:

> We are all in this together, facing similar problems, suffering the same human limitations, trying to probe into the apparent randomness of a

> vastly complicated physical and social world to see patterns and make sense of it (quoted in Daft, 1983, p. 539).

It is in this making sense of the apparent randomness of reality that a theoretical contribution is made. Daft's prescription for achieving this includes the need for the researcher to 'build in plenty of room for error and surprise' (p. 540). This means asking open questions and being prepared to encounter unexpected answers. This was the driving force behind the choice of research question addressed in this thesis: what is the relationship between financial accounting and nature? The difficulty, then, is how to go about discovering these unexpected results. Daft's prescription is to seek out and tell stories. In telling stories, the researcher will be explaining the data upon which they are based. A researcher's stories bring data to life by describing what it means and why it is as it is.

> Research is storytelling … Stories are theories (p. 541).

To address the research question, then, this thesis must set out to tell stories about the relationship between financial accounting and nature. It was the seeking out of such stories that led to an encounter with the experimental markets in tropical forest carbon. It was hoped therefore that, by telling stories about these markets, a theoretical contribution addressing the research question would surely emerge. Such stories, though, the researcher is warned by Daft, should more resemble poems than novels. This means that stories should aim always to deploy as few variables as possible to construct insights explaining the data. 'Simple means fundamental, not trivial' (p. 542) so the researcher should avoid the temptation to introduce more and more ideas to properly reflect the complexity of the data. It is in this spirit that chapters four and five tell their stories. Both of these – drawn from different data sources derived from extremely complicated realities – seek to extract strands of that reality and tell a story that is meaningful and insightful regarding a limited, delineated aspect of a much bigger picture. The choices of what stories to tell, out of the countless possibilities presented by a myriad of potential data, are of

course a vital research decision. It is Daft's contention that such research decisions are not linear. There is no standard process that a researcher can go through to guarantee good results, but they must instead follow a 'more random and messy' (p. 542) path in search of insight. It is often the "beauty" of an insight that will cause it to be judged worthy of a central place in the researcher's story-telling. This is certainly the kind of path taken in the production of this thesis. The work to produce the stories in chapters four and five, and indeed the discussion in chapter six, was highly iterative and a process of random discovery, as new connections were made and remade.

3.3. Forms of life

The research question that this thesis seeks to address concerns the relationship between financial accounting calculation and nature. The review of the financial accounting literature in chapter 2 highlighted some of the difficulties encountered in attempts to capture and represent nature in the language of financial accounting. A similar concern motivated the *Philosophical Investigations* of Wittgenstein (1953), who sought to find a way to capture and represent the meanings complicated phenomena such as music, ethics, art, and religion – all the complexities that comprise a human culture. Wittgenstein found that such meaning could only be expressed in language in as much as that language was actually used in the performance of a culture. He rejected attempts to specify any general metaphysical theory, and instead accepted that we humans think, communicate, and act on the basis of language games. In keeping with this notion of the endogeneity of language, Wittgenstein does not impose an explicit definition of 'language game', but does explain that the idea is 'meant to bring into prominence the fact that the *speaking* of language is part of an activity, or of a form of life' (p. 10). This idea rejects the need to impose upon the universe some choice of an ontological unit of analysis of which we assume it is comprised, and instead devolves the process of breaking down the world into manageable parts to individuals acting in some form of life. Ontological

assumptions arise endogenously from specific forms of life. To attempt to extract the essence of that form of life changes the logic of the language used and so produces meaningless expressions.

All forms of life – all cultures – are seen to be performed using an interconnected web of overlapping language games. Each language game has its own logic and is used by its participants to allow them to engage in the activities that comprise their form of life. Thus there is no general theory to be had about the logic of all language, because the logic of language is different depending on the form of life in which it is used. Philosophical investigations must, therefore, restrict themselves to uncovering and elucidating the logic of particular language games used in particular forms of life.

3.4. Actor-network Theory

Actor-network theory (ANT) can be regarded as an attempt to implement the spirit of Wittgenstein's prescription for meaningful philosophical investigations into the logic of different forms of life. Specifically, ANT was invented in science and technology studies (STS) as a way to understand the activities of scientists. On the one hand, STS had so-called Whig histories of science, and positivist interpretations of science, which saw scientific facts as representing basic truths about the world. On the other hand, were the constructivist sociologies of science, which held that scientific facts were socially constructed by self-interested groups for ultimately political purposes. ANT recognises that these two opposing views stand on either side of a false dichotomy. Both sides hold that there is a clear ontological distinction between the scientists and the world that they are studying. ANT seeks to dissolve this dichotomy and recognise that scientists are a part of the world and that their work requires them to establish a network of connections within the world.

This idea is referred to as ANT's principle of symmetry because there is no *a priori* ontological distinction to be made between human and non-human actors. All actors are material objects, physically located somewhere in the world. Each actor is able to act within and upon the world because they have physical connections (of whatever form) with other actors in the world. Thus the actors and the connections between them form an actor-network. With all actors materially existing and being physically located somewhere in the world, there can therefore be no top-down *a priori* theoretical distinctions between global and local actors. All actors are seen to exist on the same ontological level – the same "flat landscape" (Latour, 2005).

In the study of the activities comprising the cultures or forms of life of scientists, ANT sees that fact construction is a process that requires scientists to establish new connections within an actor-network. These connections may well be with other scientists, or with interested parties such as funders or other human stakeholders. However, the scientists must also establish connections with the actors they are studying – in the case of natural scientists these may well be non-human actors. Thus the new connections formed in the scientists' activities are all ontologically equivalent, and their forms of life are seen to be performed on a flat ontological landscape. The places that allow scientists to establish their connections within the actor-network, such as laboratories, are centres of calculation. These are the places where information about the world (both "natural" and "social") can be drawn together and transformed by specific calculative practices such that a result can be extracted and used to identify and establish new connections, or even new actors, in the world.

> An actor-network is traced whenever, in the course of a study, the decision is made to replace actors of whatever size by local and connected sites instead of ranking them into micro and macro. The two parts [of "actor-network"] are essential, hence the hyphen. The first part (the actor) reveals the narrow space in which all of the grandiose ingredients of the world begin to be hatched; the second

> part (the network) may explain through which vehicles, which traces, which trails, which types of information, the world is being brought inside those places and then, after having been transformed there, are being pumped back out of its narrow walls (Latour, 2005, p. 179).

Burrell and Morgan (1979) seek to classify ontological assumptions into four distinct paradigms of sociological research described using a two-by-two matrix. The axes of the matrix divide objectivist versus subjectivist assumptions, and regulatory versus radical change assumptions. Whilst neoclassical economics-based research falls neatly into the functionalist (objectivist-regulatory) paradigm, critical research can occupy any of the three remaining quadrants: interpretive (subjectivist-regulatory), radical humanist (subjectivist-radical change), or radical structuralist (objectivist-radical change). ANT does not fit into this classification system. It effectively denies both the dichotomies that define the two-by-two matrix. ANT holds that there certainly exists an objective reality in which all actors are physically located, and is therefore in this sense objectivist. However ANT also holds that theories about the world cannot be imposed upon actors but are instead endogenous to their forms of life, and so in this sense is subjectivist. Similarly, ANT is concerned with innovation and change, but recognises that these things are built upon existing structures and are restricted – regulated – by the present material reality.

This idea, that actors make their own reality, defines the constructivist theoretical perspective. Within this perspective, social constructivism theories hold that, beneath the surface of what we can observe, there exists some true reality that explains those things we observe (Latour, 2005). Structuration theory, for example, differentiates between “social systems” which are made up of the observable activities of human actors in particular time-space settings, and “social structures” which make up the disembodied properties of signification, legitimation and domination that have only a virtual existence outside of time and space (Englund and Gerdin, In press). Reality,

in structuration theory, is constructed out of the recursive interrelations between this duality of social systems and social structures.

The problem with structuration theory, and social constructivism more generally, for explaining relationships between knowledge-building disciplines, like science or accounting, and the nature that they are building knowledge about, is that the unobservable under-layer of social reality is something that must be imposed by the researcher upon the material reality that they have actually witnessed. Thus the researcher is privileged at the expense of the actors being observed. As part of actor-network theory's principle of agnosticism which demands that an explanation must remain impartial with respect to all actors, the researcher, too, is considered just one more actor. They have no more right to impose *a priori* theoretical explanations upon the actions of others than does any other actor in the network.

Latour (2005) contains an imaginary dialogue between a professor and his student in which the student complains that ANT does not allow him to theorise about, and thus explain, the activities of the actors in the actor-network he is witnessing.

> [Professor]: You should panic only if your actors were not doing that constantly as well, actively, reflexively, obsessively. They, too, compare; they, too, produce typologies; they, too, design standards; they, too, spread their machines as well as their organizations, their ideologies, their states of mind. Why would you be the one doing the intelligent stuff while they act like a bunch of morons? What they do to expand, to relate, to compare, to organize is what you have to describe as well. It's not another layer that you would have to add to the 'mere description'. Don't try to shift from description to explanations: simply *go on with* the description. (p.150)

ANT holds that where there are properties of reality – such as, for example, structuration theory's signification, legitimation and domination – these can be explained through the observable interactions of material actors.

> […] the capacity of certain actors to get other actors – whether they be human beings, institutions or natural entities – to comply with them depends upon a complex web of interrelations in which Society and Nature are intertwined (Callon, 1986, p. 4).

It is the actors themselves who theorise about how the world is, about the configuration of the interrelations between society and nature, and then act in ways so as to materialise and realise these theorisations. The researcher's role in this is to trace the actors in their work, to learn from actors rather than impose structures upon them which restrict the analysis. It is this stance that makes ANT the necessary choice of theoretical framework for an empirical investigation into the relationship between financial accounting calculation and nature. It is not the role of this thesis to attempt to prescribe some structure for the relationship between financial accounting calculation and nature, but rather to seek to understand how that relationship is emerging from the work of particular actors in the world.

3.4.1. Finance

Following the apparent success of ANT in describing the forms of life of scientists, and explaining the relationships between natural scientists and nature, STS researchers turned their attention towards the forms of life of economists, to identify and elucidate the relationships between economists and markets. This meant placing economists onto a flat ontological landscape with all other economic actors. Markets are regarded as configurations of material actors physically located somewhere in the world, with material connections between them such as to form an actor-network. Economists are actors in these actor-networks, and to perform the activities that comprise the form of life of an economist, they must establish connections with other market actors. Economists, like all actors, act as

centres of calculation, taking in information about the markets to which they are connected, performing specific procedures – which are contingent upon the economic models to which they subscribe – and extracting results that are then used to establish new connections, or new actors, within the market actor-network. This means that economic models do not just describe the economic reality of markets, they also have a "performative" role (MacKenzie, 2008b) in shaping the configuration of markets.

The ANT perspective on markets, then, demonstrates the power of the flat ontological landscape. Market actors individually perform their calculative practices based on their own conceptual equipment, which was born of economic theories. This is the mechanism of performativity of economics.

3.4.2. Accounting

The power of ANT to place calculation – as a process of establishing new actors and new connections in an actor-network – at the very centre of analysis (Justesen and Mouritsen, 2011) has drawn the attention of accounting researchers. Just as economists, with their economic models, can be recognised as market actors on the flat ontological landscape of the market actor-network, so can accountants. Accountants can be recognised as centres of calculation, taking in information about a particular economic entity to which they are connected, performing specific calculative practices – which are contingent upon the accounting rules and techniques to which they subscribe – and extracting results that are then used to establish new connections, or new actors, within that actor-network.

ANT can therefore be used to show that the relationship between accounting calculations and economic reality (or, indeed, just reality) does not lie on one side or the other of a dichotomy between communicating it and constructing it. Rather, accounting calculations form a part of economic reality – they are shaped by and, in turn, shape the configurations of actors and connections that comprise an economic entity.

> Accounting calculations are understood to be inscriptions that are contingent effects of specific procedures rather than a more or less precise mirroring of the world. Inscriptions are interesting not because of what they say, but because of the kind of action they enable, by being material, mobile and combinable (Justesen and Mouritsen, 2011, p. 177).

The majority of ANT accounting research has focussed on the calculative practices of management accounting techniques, and their effect on the configurations of actor-networks comprising profit-making businesses (e.g. Briers and Chua, 2001) or public sector organisations (e.g. Preston *et al.*, 1992). A small slice of the accounting literature – most notably MacKenzie (2009a) – does, however, point to a parallel role for financial accounting calculations in the actor-networks that comprise economic markets. Financial accounting can often be regarded as synonymous with financial reporting. However, the conception of financial accounting offered by ANT, points to a much broader interpretation of the calculative practice of financial accounting, of which financial reporting is a special case. Financial accounting comprises all calculative practices that establish or alter the configurations of actor-networks that comprise economic markets. Thus financial accounting calculations are performed so as to frame and define market transactions. Given this picture of financial accounting, it is clear to see how financial reporting is a special case. Corporate financial reporting, for example, is performed to properly frame and define the equity products transacted on capital markets.

It is this ANT view of financial accounting calculation, as a calculative practice performed by actors (accountants, broadly defined as anyone who performs accounting calculations) on a flat ontological landscape with all actors (human and non-human) in the market actor-network, that will inform the empirical work of this thesis in chapters 4 and 5, and the theoretical discussion in chapter 6.

3.5. Data collection

In order to address the research question regarding the relationship between financial accounting and the natural environment, this thesis will examine a particular case study of some experimental market mechanisms collectively referred to as Reducing Emissions from Deforestation and Degradation (REDD), which explicitly seek to bring part of the natural environment – tropical forests – into account in carbon emissions trading markets. Chapters 4 and 5 will examine the particular chosen case studies in detail. Given the ANT perspective on markets and financial accounting that will be adopted in this examination, this section will present an overview of the approach to the case study methods employed here. Chapters 4 and 5 also contain sections detailing specific methods of data collection and analysis used in the respective projects.

The REDD initiative is an attempt by actors to bring tropical forests within the economic sphere (Hopwood, 1992) of carbon markets. It provides a case study of humanity seeking to redefine its relationship with an aspect of nature by designing and building specific calculative devices. MacKenzie (2009a) and Callon (2009) both argue that the experimental markets in carbon emissions trading are rich sites for researchers to develop understanding of the materiality of calculation, and of market-making, particularly with respect to civilising markets designed so as to shape economic forces in order to have some specific social effect. REDD is an attempt to change the economics around tropical forests.

> Without a more complete market valuation, standing forests cannot overcome the economic opportunity costs associated with their conservation (Papua New Guinea, 2005, p. 5).

By tracing the construction of the REDD market mechanisms, this research will seek to follow actors' attempts to invent and implement new calculative practices – new financial accounting calculations – that frame and define

market participants' transactions – their economic interactions with this component of nature.

Chapter 4 will trace a single REDD project set up to conserve the tropical forests of the Kasigau Corridor in Kenya. This project was chosen as a case study because of the availability of detailed data regarding the calculations the project performed in order to construct its product. The project was pioneering in that it was the first REDD project within the voluntary carbon markets. This meant they had to describe and justify their calculations at length as they did not have access to established "black-boxed" calculative practices specific to REDD to which they could refer. Thus the issues they were dealing with were still "hot" (Latour, 2005) in that they had to invent ways to implement the basic principles of REDD and carbon accounting to a particular tropical forest conservation project. The availability of this data presented an opportunity for this research to trace the attempt to create a new economic relationship between a specific society of human individuals and a specific natural ecosystem.

Chapter 5 seeks to open out the research to a planetary view. It traces a small part of the international negotiations over the formation of a large-scale market mechanism to finance the conservation of the world's tropical forests. This, again, is a case study of a "hot" situation, where the calculative practices are being created *ex nihilo* and many of the issues around this are highly controversial amongst the actors involved. This hot state means that there is a great deal of data available exploring the various problematisations (Callon, 2009) of the actors and the interaction of these competing visions for reshaping humanity's calculative practices in respect of these global natural assets. This has presented an opportunity for research that traces a basic, fundamental, conflict over how financial accounting calculations – the calculative practices framing and defining market participants' transactions – should be configured so as to bring about change in the relationship between the whole of humanity and the planet's tropical forests.

A basic requirement of ANT research is that the researcher must not impose top-down theories or generalisations upon the actors.

> [ANT's] main tenet is that actors make everything, including their own frames, their own theories, their own contexts, their own metaphysics, even their own ontologies (Latour, 2005, p. 147).

In order to trace the actor-networks comprising markets the researcher must establish their own connections within that actor-network. This is the role of data collection. Once the researcher has established sufficient connections, the resulting data must be analysed to make sense of it. The ANT researcher thus is a kind of centre of calculation within the actor-network. They are themselves an instrument in the research, such that total objectivity is not really a possibility. Instead, the research should strive to deliver a kind of rigorous subjectivity (Wolcott, 1994) whereby the researcher seeks to equitably identify and elucidate multiple relevant perspectives or truths from the actors they encounter.

The markets that will form the case studies examined in chapters 4 and 5 are actor-networks of organisations located in diverse locations around the globe. The problem for data collection, then, is how the researcher can best establish their own connections within this actor-network. During preliminary forays into the subject of the REDD markets, it became clear that one of the most important means by which organisations established connections with each other in these actor-networks was via the internet. Organisations have their own websites, which they use to communicate their own missions and the activities they engage in to achieve those missions. There are also a number of key hubs of online information, set up by organisations for the explicit purpose of coordinating the work of different actors across the markets. These rich sources of data provide an opportunity for a researcher to establish a wealth of connections with actors. Such connections do not need to intrude on the activities of the actors so the researcher can get an actors'-eye view of the actor-network. The extremely rapid proliferation of the use of the internet for coordinating globally distributed activities such as the

REDD markets makes the use of the internet, not just a convenient method, but indeed a necessary method for researchers seeking to trace these actor-networks. Data collection involved compiling a large bank of documents related to the construction of the markets in tropical forest carbon, reading those documents and taking detailed notes of what were considered to be important observations. These included observations regarding the role of particular actors in the development of the emerging narratives, important quotations that highlighted relevant issues or provided exemplars of one side of the controversies being tackled within the case studies, comments regarding possible connections that might be established between different documents, and remarks on potential directions of further examination for developing the emerging narratives. This process was highly iterative, with data analysis occurring simultaneously to data collection, such that the emerging narratives informed the searches for further data.

The data for chapter 4 was mostly collected from the online databases of the two certification bodies that certified the Kasigau Corridor REDD project. These were the Verified Carbon Standard (VCS) and the Climate, Community and Biodiversity Alliance (CCBA). Preliminary searches for possible sources of data were conducted using the Google search engine, using simple keyword searches such as “REDD” and “tropical forests + carbon markets” to identify a range of potential data sources. The first aim was to find documentation that would set out the actual calculations that a REDD project performed to generate measures of carbon offset. This turned out to be quite a long process. There was a lot of information that spoke in general terms about the potential benefits and risks of REDD, but not the actual calculations that would connect tropical forest conservation to carbon markets. A document called State of the Forest Carbon Markets: From Canopy to Currency (Ecosystem Marketplace, 2011b) referenced the VCS database. Following this connection, it was found that, at the time, there were only a small number of REDD projects registered with the VCS. There were a number that had started the process of certification, but the Kasigau Corridor project had been through all stages of certification and so all the

certification documents were available for inspection. These were highly detailed and set out the specific calculations that were carried out by the project in its work. It was therefore decided that this represented an excellent opportunity for the research to trace a particular attempt by this project to establish new calculative practices in order to try to reshape the economic relationship between people living in that area and the tropical forest ecosystem under threat there. The VCS documentation referenced the CCBA, and it was found that this CCBA documentation also contained useful information for addressing the concerns of the case study. It was strongly felt that the document-based empirical data collected was sufficient to construct the case study and address the stated research questions. It was felt that the potential benefits of seeking further empirical data on this case were likely to be outweighed by the additional costs, in terms of time and resources, of doing so.

The data for chapter 5 was largely collected from the online database of the United Nations Framework Convention on Climate Change (UNFCCC). Other documentation was collected by performing searches on organisations or events referenced in the UNFCCC documents, such as “Forest Carbon Partnership Facility”, “United Nations Permanent Forum on Indigenous Issues” and “Anchorage Declaration”. Within the UNFCCC database, the data collection focussed on tracing the activities of the Subsidiary Body for Scientific and Technological Advice (SBSTA), and specifically their agenda item dealing with methodological issues in REDD. It became clear that the activities of this body – their meetings and workshops – formed a hub connecting the various efforts of different organisations around the globe to materialise and realise this idea of REDD. The documentation of these activities, created primarily for the benefit of the various actors who felt they had a stake in those activities, provided an opportunity for this research to trace the negotiations over how to establish calculative practices that would bring about the benefits that REDD was promising. The use of this form of data provided a unique window into these activities, allowing the research to gain insights that spanned both space (with activities taking place in locations

around the globe) and time (with activities occurring over a four and a half year period between the initial proposal of a global REDD mechanism and the attempt at the Copenhagen Climate Conference to secure agreement on the details of such a mechanism). This form of data therefore provided an opportunity to address the research questions by examining an attempt to create calculative practices that would change the whole of humanity's relationship with natural tropical forest ecosystems.

3.6. Data analysis

The aim of this research will be to trace certain actor-networks comprising the REDD markets so that the role(s) of financial accounting calculations in relation to the natural environment can be identified and examined. In tracing an actor-network the researcher is seeking to provide a narrative account of the forms of life of the actors. To seek to describe the actors' forms of life is to describe their culture.

> "Culture" simply refers to the meanings and practices produced, sustained, and altered through interaction (Van Maanen, 2011, p. 155).

To aim to produce a narrative that describes and explains a culture is to aim to write an ethnographic account. Ethnography is usually closely associated with data collection by participant-observation work. However, the very same principles of ethnographic analysis can be applied to data derived from any method of collection (Wolcott, 1990). Ethnographic accounts share ANT's commitment to respect the ontologies of actors themselves, and its desire to produce narratives that richly describes the actors' forms of life. Toren (1996) defines ethnography as a 'descriptive analysis of … what is taken for granted' (p.102). We are asked, in producing an ethnographic account, to take those things that are considered by a people (and even perhaps to the researchers themselves) to be self-evident, and render them strange. This is an equivalent notion to MacKenzie's desire to open black boxes. By rendering strange those facts and mechanisms that are widely accepted by

market participants, an ANT researcher can extract an account of how those things came to be, and continue to be, accepted.

Van Maanen (2011) describes the purpose of ethnography as being to make culture visible, through its representation in the researcher's account.

> A culture is expressed (or constituted) only by the actions and words of its members (p.3).

Van Maanen describes three of the most frequently constructed types of ethnographic account: realist, confessional, and impressionist.

Realist ethnographies seek to focus on the everyday, mundane details of a culture in the hope of bringing to light the world-view of a typical member of that culture. Adopting an authoritative tone, realist ethnographies present the researcher's interpretations of the culture under study and 'culls its facts carefully to support that reading' (p.53). Whilst the no-nonsense style of the realist account is clearly appealing and may sit well with the similarly no-nonsense requirements of ANT, the implicit generalisation within realist accounts does not. By seeking to represent a typical member of the studied culture, realist accounts deny the crucial importance of individual agencies. ANT demands the recognition of specific actors working to generate and circulate specific facts. To then make the reductive leap to describing a 'typical' actor (something which cannot be directly observed) is to impose some outside theoretical constraint upon them.

Confessional ethnographies are autobiographical in nature, and are intended to show how the ethnographic work was done. It describes the difficulties encountered by researchers, their mistakes and doubts, such that 'cultural knowledge may rest securely on the testimony of personal experience and can be presented to readers in the form of explicit behavioral norms or interpretive standards' (p.78). The researcher can describe exactly how they were able to successfully attain mastery of the language games that represent the actors' forms of life. Whilst a confessional ethnography would reflect the way that ANT requires the researcher to make connections with

actors in the network under study, the explicit focus on this reflexivity does not appear to be appropriate for addressing specific research questions such as the relationship between financial accounting and nature.

Impressionist ethnographies are narratives that seek to represent specific fragments of cultural knowledge. Such an account elucidates forms of life by describing specific actions that constitute them at particular instances in time and space.

> By holding back on interpretation and sticking to the story, impressionists are saying, in effect, "here is this world, make of it what you will" (p.103).

The commitment to telling stories of the actors' lives as witnessed by the researcher, without imposing an *a priori* theoretical frame, makes impressionist ethnography consistent with the principles of ANT research. The events described need not be obviously exciting or unusual, but they may represent important moments in the process of knowledge generation, standard-setting, and controversy resolution that contribute to an enlightening ANT account.

The aim of the chapters four and five will be to produce impressionist ethnographic accounts that elucidate the uses of financial accounting calculation for producing, sustaining and altering the meanings and practices employed by market actors as they interact with each other in the performance of the particular cultures of markets in tropical forest carbon. The construction of these markets was a matter of international negotiation amongst nation states, intergovernmental institutions, and multinational non-governmental organisations. Taken together, these could be described as the 'international community', such that the impressionist ethnographic account will seek to elucidate some small part of this community's culture.

> What distinguishes globalisation in our era is the speed with which it is occurring; the tools that are driving it forward; the rules that exist – or do not exist – to manage it; and the actors who will determine its

> course and our fate … What binds us into an international community? In the broadest sense there is a shared vision of a better world for all people, as set out, for example in the United Nations Charter. There is our sense of common vulnerability in the face of climate change and weapons of mass destruction. There is the framework of international law. There is equally our sense of shared opportunity, which is why we build common markets and, yes, institutions – such as the United Nations. (UN, 1999, p. 2)

The huge global nature of these markets, with the myriad of actors involved in their construction, means that a researcher can only hope to provide an account of their own impression of some small part of the this large and complicated culture. The data analysis will therefore remain restricted by the requirement to seek to provide an impressionist ethnographic account. To seek to go beyond this would require a researcher to impose their own grand generalisations upon that larger culture, and this would stand in stark contrast to the principles of ANT, and of ethnographic analysis.

The data collection and data analysis stages will not be entirely separate. Data collected early on will be analysed by attempting to organise it in such a way as to identify themes (Creswell, 1998). These themes will then inform further data collection, which will then be followed by a further round of organisation and theme identification, and so on. In this way, both the specific design of the qualitative study and the resulting analysis will emerge from an iterative interpretation of the subject.

3.6. Limitations

One limitation of these chosen methods of research is that the kinds of connections established by the researcher within the actor-network, using the online data collection techniques, do not provide the researcher with an opportunity to get feedback from the actors themselves regarding the account they are constructing about those actors' forms of life. More

traditional methods of data collection, such as interviewing and participant observation do provide conduits for the account to be communicated back to the actors to test their reactions. It is also highly likely that there will be actors in the markets who do not have a strong (or perhaps any) presence on the internet, and so the researcher will be unable even to establish any connection with them using this data collection method. In addition, given the vast amount of potential data available online, it is very difficult to draw boundaries around the data collection and establish a clearly delineated dataset from which results are drawn. By its nature, the network of documents available online is an open one, with connections branching out in multiple directions. It is impossible for a researcher to trace all these connections and some attempt has to be made to carve out a limited set of documents that form the collected data. These limitations are mitigated to some degree by appreciating that the accounts constructed in this research represent only impressions (Van Maanen, 2011) of the actor-networks being studied. What is produced is one account – one interpretation – of the data, collected via the connections the researcher is able to establish with actors.

A limitation of the case study approach to research adopted in this thesis is the difficulty with regards to generalising results. It is not clear whether any one case study is representative of some population or whether it is a special, unique case. This is certainly a limitation of the present study. The markets under study here are those in tropical forest carbon. They were chosen because they are a clear case of explicit confrontation of natural and market actors. It will, however, be very difficult to be able to draw general conclusions about properties of markets in general from the observations and analysis of these particular markets. The thesis is therefore restricted to drawing only speculative theoretical conclusions, predicated upon the specific cases studied, regarding the relation between financial accounting calculation and nature. The study explores the margins of accounting to explore how it intersects with those parts of nature that come into contact with its ever moving boundaries (Miller, 1998).

A perceived limitation of the use of ethnographic analysis and of actor-network theory may be that the study does not appear to be explicitly political or critical. Other constructivist theories, and particularly social constructivist theories, can be more explicitly political and overtly challenge existing political and economic structures. Structuration theory, for example, concerns itself with those systems in society that give rise to domination and control. The social constructivist idea of a true reality lying beneath what is observed gives the researcher a lot of scope to craft a political message within the research. Actor-network theory, on the other hand, restricts the analysis to consideration of observed material reality. By focussing attention on specific details of market construction and of financial accounting calculations, actor-network theory may be seen not to be addressing macro issues regarding the basic organisation of society. This perception, though, is based upon a desire to impose a political theoretical view upon a study. By contrast, actor-network theory, and the ethnographic-style analysis utilised in this study, both seek to allow the politics of a study to emerge from the actors themselves. The structures and balances of power are recognised to arise from the material configurations of actor-networks, and are specific to individual cases. The politics is therefore inseparably entwined with the technicalities identified and elucidated in the descriptions and analysis.

3.7. Ethics

Leedy and Ormrod (2010) set out four aspects of ethics that must be considered when embarking upon research. These are protection from harm, informed consent, rights to privacy, and honesty to professional colleagues. The research I have set out above is not dangerous to the researcher or to anyone else. It is almost entirely desk-based and so no additional precautions are required to ensure protection from harm. All the documents used in the research have been publicly available. They have been created by market participants, intended to be read and utilised by other market participants. No informed consent is required for their use in

this research. This research will not invade the privacy of any individuals. Quotations used are taken only from publicly available documents that were created for use by market participants. Finally, it is incumbent upon all researchers to produce work that faithfully represents their data. It can sometimes be difficult to know if the story one is telling really is representative of reality. This research has sought always to follow the data and be bounded by it. In this sense it is hoped that professional colleagues will find the stories told in this thesis, and the theoretical contributions that come from them, to be honest.

Chapter 4.

Bringing Tropical Forest Biodiversity Conservation into Financial Accounting Calculation[2]

4.1. Introduction

Tropical forests contain about half of the species on Earth (Lindsey, 2007). This immense biological diversity of trees, shrubs, animals and micro-organisms exists as a highly complex interconnected web of life and death comprising the tropical forest ecosystem. The destruction of tropical forest ecosystems, by humans, is resulting in the loss of approximately 100 unique species every day (IUCN, 2011). This loss of tropical forest biodiversity is an externality. It is not brought into the accounting calculations that are used to assess business performance. People making decisions based on accounting calculations are therefore not provided with any information about how their decisions will affect tropical forest biodiversity, or how tropical forest biodiversity could affect the outcomes of their decisions. This chapter examines the idea that if the conservation of the extremely biologically diverse tropical forest ecosystems were somehow to be brought into accounting calculations, then this might stem the rate of the mass extinction of species currently being wrought by humankind.

It is important to stress that this chapter does not make any attempt to quantify or value biological diversity *per se* – as in some abstract measure of variation. Rather, the term "biodiversity", which is used commonly in

[2] A paper Cuckston, T. (2013) 'Bringing tropical forest biodiversity into financial accounting calculation', *Accounting, auditing and accountability journal*, In Press. drawn from this chapter has been published in *Accounting, Auditing and Accountability Journal* in June 2013 as part of a special issue in Accounting for Biodiversity.

conservation 'as a convenient shorthand for the total complex of life in some given area' (Groombridge and Jenkins, 2002, p. 1) refers, throughout this chapter, to the physical existence of living things in a natural ecosystem (Convention on Biological Diversity, 2004). The discussion in this chapter revolves around a specific case study that brings the conservation of Kenya's Kasigau Corridor tropical forest ecosystem into financial accounting calculation by using carbon accounting to construct a financial product to sell on a carbon trading market. Thus, a market that has been designed to facilitate corporate responses to climate change is used, in this case study, to generate financing for a project to conserve biodiversity.

Through analysis of this case study, this chapter will seek to address the research sub-question regarding the role of financial accounting calculation in both communicating and constructing the reality of humanity's economic relationship with nature. Before describing and discussing the findings of this case study, the links between biodiversity loss and climate change will be considered, and then the theoretical underpinnings of two broad approaches to accounting for biodiversity will be explored.

4.1.1. Biodiversity loss and climate change

Biodiversity loss and climate change represent two great ecological crises for our living planet at this time. These are inextricably linked. The extremely rapid changes in climate conditions, resulting from global warming, are threatening the integrity of ecosystems around the world. Climate change is projected to be the direct cause of 15-37% of terrestrial species being committed to extinction by 2050, depending on the extent of the warming (Thomas *et al.*, 2004). Conversely, the destruction of natural habitat by humans makes the impacts of climate change worse, as ecosystems are less able to adapt (Naumann *et al.*, 2011). In addition, the loss of forest ecosystems plays a significant role in accelerating climate change because

deforestation is the cause of about 20% of global greenhouse gas (GHG) emissions (World Bank, 2010).

The Kyoto Protocol is an international treaty that sets binding targets for developed countries to limit their GHG emissions. The Protocol also established the Clean Development Mechanism (CDM), in which organisations in developing countries can earn Certified Emissions Reductions (CERs) by implementing projects that demonstrably reduce their GHG emissions. CERs can effectively be sold to developed countries. These developed countries can then offset the CERs they buy against their own GHG emissions to help them meet their Kyoto Protocol targets.

The CDM has strict rules regarding the kinds of project that can earn CERs. There are many forestry projects earning CERs under the mechanism but only afforestation and reforestation are allowed. Afforestation is the planting of trees on land that has not recently been forested. Reforestation is the planting of trees on land that has been recently deforested. Both afforestation and reforestation result in new plantation forests. This means that the only forests that are valuable under the CDM regime are new plantations. Plantations are not natural ecosystems and are much less biologically diverse than primary forests (Convention on Biological Diversity, 2011), which have developed through natural processes (Convention on Biological Diversity, 2012). Tropical forests, in particular, have evolved in ecological complexity over tens of millions of years (Groombridge and Jenkins, 2002). The CDM, in its current form, recognises no value whatsoever in natural primary forests.

In order to address this rather perverse state of affairs, a concept referred to as *Reducing Emissions from Deforestation and Forest Degradation* (REDD) has emerged as a way ‘to create a financial value for the carbon stored in standing forests’ (UN, 2011b, p. 1). REDD projects undertake activities that protect primary standing forests from the threat of destruction. Deforestation causes the emission of carbon dioxide as the carbon stored in the organic matter comprising the trees, shrubs, and soils that together make up the

forest is released. REDD projects seek to halt, or reduce, deforestation in a given area. The GHG emissions that would have occurred as a result of deforestation are therefore halted or reduced because of the REDD project.

The exclusion of natural primary forests from the CDM is due in large part to an accounting difficulty encountered in the design of REDD projects. CERs are earned for demonstrable reductions in GHG emissions. For a project that establishes a new plantation forest, the reduction in GHG in the atmosphere as a result of the project is a fairly straight-forward calculation. A new "carbon sink" has been created by the project, and the amount of carbon that has been extracted from the atmosphere and stored in the new forest becomes larger each year as the seedlings in the plantation grow into larger and larger trees. Eventually the plantation will reach a mature state where its carbon-content is stable and so no more CERs can be earned from it. Primary forests, on the other hand, are already in a mature state. Any given area of primary forest has a carbon-content that will not change significantly from year to year. Actions taken to protect a natural forest do not increase its carbon-content. Instead, they avoid emissions of carbon dioxide that would have occurred had the protective actions not been taken. The accounting difficulty, therefore, is that REDD projects must find a way to account for hypothetical emissions. To do this, a REDD project must construct an accounting model of the GHG emissions that would have occurred had the REDD project not been in place to prevent them. REDD could, therefore, be understood to be a way of valuing tropical forest biodiversity based on the ecosystem service of carbon sequestration.

Implementation of some kind of global REDD mechanism is forming a part of ongoing negotiations at the United Nations Framework Convention on Climate Change (UNFCCC) for a post-Kyoto agreement. As at the conclusion of the Conference of the Parties in 2012 in Doha, no such agreement has been achieved. However, individual REDD projects, set up to protect relatively small areas of tropical forest ecosystem, are finding financial backers on the voluntary over-the-counter (OTC) carbon markets.

The OTC carbon markets are not regulated by global agreements between governments and so it is up to the buyers and sellers to decide for themselves what kinds of projects can produce carbon offsets and how those offsets should be calculated.

4.2. Two Theoretical Approaches to Accounting for Biodiversity

There are multiple emerging visions regarding how humanity might turn the loss or conservation of biodiversity from an externality into something that is included in accounting. These can be organised into two broad theoretical approaches. The first approach seeks to design a new form of accounting that can bring biodiversity into a new kind of accounting calculation. The second approach seeks a way to bring biodiversity conservation into financial accounting calculations. After a brief review of the first, it is the second approach that will be the focus of discussions in this chapter.

4.2.1. First approach: A new form of accounting

The first theoretical approach to accounting for biodiversity is to try to design a new form of accounting that can properly represent the interactions between organisations and the natural world. Conventional accounting is held to be complicit in the capitalist notions of profits and private ownership, which underpin the causes of biodiversity loss. What is needed, therefore, is a form of accounting that instead encourages stewardship of nature (Jones, 2010b). 'Nature is excluded from accounting calculations' (Hines, 1991b, p. 27) because it is a public good that is not owned by any one individual or organisation. Indeed, the boundaries of ecosystems very rarely coincide with the boundaries of organisations (R. Gray, 2010). Full-cost environmental accounting (Herbohn, 2005) is one attempt to build a new form of accounting that captures an organisation's impact on natural ecosystems. It attempts to show the true costs of an organisation's impact on nature or, conversely, the

value that has been extracted by the organisation from nature. It does therefore require some kind of monetary valuation of nature's contribution to the organisation.

One system for valuation of biodiversity has come from a project, led by the United Nations Environment Programme (UNEP), called *The Economics of Ecosystems and Biodiversity* (TEEB). The project aims to combat the 'commodity fiction' (TEEB, 2010, p. 158) in economic markets that biodiversity and ecosystems are infinitely consumable. It lays down a framework for measuring and valuing biodiversity, and specifically the "ecosystem services" that biodiversity underpins. Ecosystem services are the benefits that an ecosystem provides to humankind. Tropical forest ecosystems, for example, provide services of purification and regulation of water flows, regulation of climate (including moderation of extreme climate events), provision of food, fuel and fibres, biological control of pests and disease, prevention of soil erosion and maintenance of soil fertility, regulation of air quality (including oxygen production), and the provision of cultural services such as spiritual experience, inspiration for art, and being a destination for tourism. The rationale for valuation is that if the true value of the services provided by ecosystems was made visible, then policy-makers would be able to take that value into account when making decisions. A TEEB framework valuation is meant to represent the amount that society would be willing to pay to receive the services provided by the ecosystem. Conversely, such a valuation represents the true cost to society of a decision to destroy or degrade an ecosystem to the point where it no longer provides those ecosystem services.

Similarly, Jones (2003) seeks to establish recognition of the value of biologically diverse natural assets in an organisation's reporting model. This 'natural inventory model' (p. 767) requires organisations to adopt a mindset of stewardship over the environment. As part of their stewardship function, organisations must recognise and value the habitats, flora and fauna which they have responsibility to protect, and report these valuations to

stakeholders. Stakeholders, and society at large, will then have the information that enables them to assess the organisation's environmental performance, as well as its economic performance. They will therefore be in a position to hold it accountable for the natural assets that have been entrusted to it.

The construction of new models of environmental accounting is an intriguing and potentially hugely useful avenue of research. The progress in environmental accounting is evident in the quantity of environmental information that is now reported by many companies. This has had the effect of opening up new lines of discourse between companies and environmentally concerned stakeholders. However, there is concern that environmental accounting and reporting has been captured by companies and is treated much more as a public relations exercise than a genuine engagement on environmental issues (O'Dwyer, 2003; Hopwood, 2009a). Whilst there is hope that, over the long term, environmental accounting may help to bring about a shift in thinking towards an economic model that is more in harmony with nature, the rate and scale of biodiversity loss makes it an immediate ecological crisis. Something needs to be done now to stem the onslaught of capitalism upon the natural world. This line of thought has led to a second theoretical approach to accounting for biodiversity.

4.2.2. Second approach: Bringing biodiversity loss/conservation into financial accounting

The second theoretical approach to accounting for biodiversity is to find a way of bringing it into the calculations that comprise financial accounting. This approach accepts the current dominance of the capitalist economic system.

> Capitalism and its destructive tendencies are manifest through its greatest creation – the corporation ... the nature of the publicly held corporation is such that its room for discretion is slight compared to

> the pressures upon it to deliver short-term financial return at almost any price (R. Gray, 2010, p. 57).

This situation is extremely unlikely to change in time to provide a solution to stopping the current mass extinction. Financial accounting is the language of capitalism. It is ultimately the system of calculation of earnings for the owners of corporations. In order to force change in the behaviour of corporations, at the pace required by this ecological crisis, then something must be done that will change the rules of the game of capitalism so that the scores – the net profits – of its players are significantly affected by their interactions with nature. Two possible ways of achieving this are through taxes, or through market construction.

4.2.3. Taxes

One proposed way of changing the rules by which capitalism keeps score is to change the way that corporations are taxed. A tax system could, for example, be devised that taxes corporations on the basis of full-cost environmental accounting. Such a system would have governments imposing a tax on corporations that is equivalent to the cost of restoring the damage done by those corporations on the natural environment. This would have the effect that markets would have to set prices that reflected the full costs (including environmental damage) of production. At present, any one corporation that decides to act responsibly, and voluntarily pay to restore the damage it does, will face higher costs than its competitors who take what they want from nature at no cost to themselves. That corporation will therefore be undercut in the market:

> businesses must – must – be able to make money sustaining living systems, or global restoration will never happen … It shouldn't be so hard to do the right thing (Hawken, 1993, pp. 89-90).

By imposing a mandatory tax, costs will rise for everyone and consumers will be faced with a market price that reflects all the costs of production, including the costs of services provided by nature. The imposition of such a tax, perhaps based on TEEB framework valuations of ecosystem services, would turn biodiversity loss from an externality into a true recognised cost – an outflow of economic resources – for corporations. The tax would have a direct effect on corporations' financial accounting calculations of profit and loss. Investors would insist that directors change the behaviour of their businesses in such a way as to try to avoid the tax as much as possible, hopefully by limiting their negative impacts on nature so that the calculated costs of restoration would be lower.

Whilst a full-scale environmental degradation tax currently seems politically unfeasible, many taxes are justified by governments on environmental grounds. Fuel duty on petrol and diesel discourages the consumption of this natural resource and the subsequent emission of carbon dioxide into the atmosphere. Landfill taxes discourage the disposal of waste and so provide incentives to reduce waste production and increase recycling/reuse. A Europe-wide carbon tax was the EU Commission's first choice of a mechanism to incentivise companies to reduce their carbon dioxide emissions so that the EU could meet its targets under the Kyoto Protocol (Braun, 2009). Taxes are one method of turning externalities into real costs that enter financial accounting calculations of profits and so can have an immediate impact on corporate behaviour. A tax on damage to biodiversity would bring biodiversity loss within financial accounting calculation, but there does not appear to be any feasible way to implement such a tax.

4.2.4. Market construction

Another way to bring an externality into financial accounting is to somehow construct a market in which some derivative of that externality is traded. One example of this is the introduction of individual transferable fishing quotas

(Holm and Nielsen, 2007). The fish swimming in the sea were previously a public good, available to anyone. Profits in the fishing industry were made simply by extracting these natural assets from the sea and selling them to consumers. The hidden cost of the depletion of numbers of living fish was not recognised in any accounts. As a result, those stocks were diminishing fast. When governments imposed restrictions on the rights to extract fish, and issued individual transferable quotas that bestowed upon their bearers the right to extract a specific quantity of fish, a *de facto* market in quotas was created. Quotas have a real financial price that is linked to the environmental cost of extraction of living fish from nature. What was once an externality – the depletion of the populations of fish swimming in the sea – has now entered the financial accounting calculations of profit in the fishing industry.

Similarly, MacKenzie (2009a) describes carbon markets as being a way to bring greenhouse gas (GHG) emissions in from being an economic externality to something 'within the frame of economic calculation by giving them a price' (p. 441). The construction of new markets in GHG emissions credits, permits and offsets provided a new source of income for companies and organisations that reduced their GHG emissions, and resulted in new costs for companies that had to buy the rights to emit carbon dioxide. These new inflows and outflows of financial resources as a result of GHGs had to be recognised in those companies' income statements in their annual financial reports.

> A carbon market is thus an attempt to change the construction of capitalism's central economic metric: profit and loss, the 'bottom line' (p. 441).

The legal regulation from the Kyoto Protocol, enforced by a collective of governments, has resulted in the real flows of economic benefits between economic entities. These flows have consequently been recognised in the financial accounting of those companies concerned (Cook, 2009). This financial accounting thus makes visible the real cost – the effect on net profits – to companies of emitting carbon dioxide into the atmosphere.

4.2.5. Black boxes

Markets are characterised by the generation and circulation of numbers amongst actors. Most of these numbers will be regarded by market actors as artefacts – simply the result of some process undertaken by the number's author. Net profit figures, published by companies, are a good example of artefact numbers where market actors are normally interested, inquisitive and often sceptical about the particular procedures used by the number's author in its production. Some numbers in the market, though, do become largely divorced from their authors and from the methods of their production in such a way as to move from a status of artefact to a status of fact. MacKenzie (2009b) offers the example of the London inter-bank offered rate (LIBOR). LIBOR is a benchmark interest rate that is designed to give an accurate representation of the state of the money markets. It is calculated by asking a panel of banks to submit estimates of the rates at which they are able to borrow money, in a number of different currencies and for various durations, from other banks on those inter-bank money markets. The average of the second and third quartiles of these submissions is then published by the British Bankers' Association, and is used to index around $800 trillion-worth of financial instruments (The Economist, 2012). Even though all the individual submissions of the banks on the panel are also available for anyone to see, it is the LIBOR rate itself that is used to determine the flow of enormous sums as dictated by those instruments. Very few people whose finances and lives are affected by LIBOR will have any interest in how any particular rate was calculated. LIBOR, then, to the vast majority of market actors is regarded as a fact: 'an acceptable representation of the market of which it speaks, and not subject to manipulation' (MacKenzie, 2009b, p. 66). The production of the LIBOR rate has therefore been "black-boxed", in that there is little interest in the technical details of its production, only in the output. These kinds of "black-box mechanisms" are described by (MacKenzie, 2005) as 'devices, practices, or organizations that are opaque to

outsiders, often because their contents are regarded as 'technical'' (p. 555). A scandal over LIBOR rocked the City of London in 2012 because, through collusion between panel members, banks had succeeded in manipulating LIBOR to their own advantage. Thus the facticity of LIBOR – its status as a true representation of the position of the market – was widely called into question and became a matter of controversy. Suddenly, outsiders – market actors not directly involved in LIBOR's production – were keen to open the lid of the LIBOR black-box to see how the rate had been constructed, and then to demand changes to that construction in order to restore faith in LIBOR's facticity.

Similarly, MacKenzie's (2009a) analysis of the Clean Development Mechanism (CDM) found black-box mechanisms produced the facts upon which market actors relied in their interactions with each other. In order for reductions in different types of greenhouse gas (GHG) by different projects in the CDM to be made commensurable, the Intergovernmental Panel on Climate Change (IPCC) – an organisation set up by the United Nations and the World Meteorological Organisation to provide an authoritative scientific view on the state of knowledge regarding climate change – systematically reviewed the scientific literature on the global warming potentials (GWPs) of different GHGs and produced a table of conversions for emissions of each recognised GHG to their equivalent in emissions of tonnes of carbon dioxide (tCO_2e). This table of conversions then became a black-box mechanism because project proponents could input the reductions in some GHG from their project and get an unequivocal factual output of the number of tCO_2e credits that such a reduction would generate. This black-boxing means that all the technical details of the underlying calculations, such as all the scientific research that went into calculating the GWPs for all the different GHGs, can be ignored by those who are only interested in what it means for their own financial position. A black-box mechanism produces facts that all parties to a market transaction can agree upon without having to question and negotiate over the way that fact has been constructed.

4.2.6. Calculable goods

The array of black-box mechanisms that were constructed to constitute the CDM allowed emissions credits earned from many very different types of projects to be effectively sold at a single market price. In the language of Callon and Muniesa (2005), GHG emissions reductions have been made a "calculable good". A good is calculable if a buyer in a market can bring it into account when making market calculations. This idea of calculability has its roots in actor-network theory, which places calculations squarely at the centre of accounting research (Justesen and Mouritsen, 2011). Calculation, in this sense, requires that the entities to be taken into account must be detached from their origins, arranged and ordered in a single space, subjected to manipulations and transformations in such a way that those entities are associated with one another, and then a new entity – a result – is extracted from that space (Latour, 1987). A calculable good, therefore, is a product that has been framed in such a way that a buyer can establish a distinction between the product and others on the market so that they can imagine and estimate possible courses of action associated with the product and the consequences of a decision to buy the product rather than another on the market. In order for a buyer to be able to make such a calculation, the product will have had to be constructed in such a way as to make it meaningfully comparable with other calculable goods on the market. To achieve this, a product must undergo a simultaneous process of "objectification" and "singularisation" (Callon and Muniesa, 2005). Objectification is the framing of the product so that it becomes a thing that can be owned. If the product is bought, then the ownership of this thing will be transferred. The thing must therefore be detachable from the world of the seller. Singularisation is the process of mutual adjustment between the objectified thing and the potential buyer, such that the thing can enter and become attached to the buyer's world. The properties of the objectified thing will therefore undergo refinements to shape it into a good that a buyer can

meaningfully compare with other calculable goods available on the market. The buyer may also reshape their own world so as to be able to accommodate the integration of the good into it.

This theoretical perspective provides the framework for an examination of how a REDD project brings biodiversity conservation into financial accounting. The perspective opens up a number of specific questions about how financial accounting calculation communicates and constructs an economic relationship between humanity and nature. How is the protection and conservation of a forest ecosystem objectified such that it becomes a thing? How can that thing be detached from the world of that ecosystem so that ownership of it can be transferred? How are the properties of this objectified thing refined so that it is singularised and becomes a calculable good? In addition, how might buyers have to adjust their world to accommodate the integration of a REDD calculable good into it? The first step in answering these questions will be to briefly discuss some of the literature that explores the world of buyers in the OTC carbon markets.

4.2.7. The buyer's world

Every market transaction requires a seller and a buyer. The transaction will involve the detachment of the good from the seller's world (objectification) and attachment to the buyer's world (via singularisation). In order to understand this process though, it is first important to have some understanding of this world into which the product will be entangled. Who might buy emissions offsets from a REDD project on the OTC carbon markets? Why might they do it? What properties might such a product have that would give it value in that buyer's world?

Ecosystem Marketplace (2011b) reports the results of a survey of forest projects producing carbon offset credits. It found that 95% of buyers of such credits were for-profit firms. The most common motivations were found to be purchases for re-sale to third parties (45%), purchases to offset a firm's own

emissions (32%), and purchases to build a firm's competence in dealing with carbon markets in anticipation of a future compliance regime (17%).

The purchase of emissions offsets allows the end-users (as opposed to re-sellers) to net the emissions credits against their own GHG emissions. Offsets therefore allow firms to report a net GHG emissions figure that is lower than the gross GHG emissions the firm actually generates. Firms report GHG emissions as part of wider environmental and sustainability reporting (Rankin *et al.*, 2011), to demonstrate to institutional investors how a firm is managing risks to its brand image and reputation that arise from the impact the firm has on the environment (Bebbington *et al.*, 2008).

Solomon, Solomon, Norton and Joseph's (2011) analysis of private climate change reporting reveals that institutional investors ask for further information from firms than is presented in their public reporting. Firms are pressed to spell out their strategies to reduce their exposure to risks derived from climate change, such as new costs from regulatory regimes imposed in attempts to tackle climate change. It is also found that institutional investors increasingly push to see climate change strategies being integrated into a firm's wider corporate strategy. Carbon neutrality by itself, obtained merely by purchasing carbon offsets to net against a firm's own unmanaged emissions, leaves that firm open to a damaging impression of making fraudulent, or at least dubious, claims regarding its environmental credentials. The firm risks being seen to be using a mere accounting trick to 'window dress their climate change information' (Solomon *et al.*, 2011, p. 1137) rather than undergoing any serious attempt to confront the changing risk profile facing firms as a result of climate change (Bebbington and Larrinaga-Gonzalez, 2008; McNicholas and Windsor, 2011).

Risk management, particularly with respect to a firm's reputation, and the integrity of its environmental reporting (both public and private), is a very large part of the world of the buyer of carbon offsets on the OTC markets. The properties of a good on these markets must be defined and refined in

such a way as to hold value in that world. This means the good must be capable of being attached to that world.

4.3. Case Study Methodology

The empirical material used to inform the discussion in this chapter is drawn from a single embedded (Yin, 2009) case study of a REDD project that constructs and sells certified GHG emissions offsets on the OTC carbon markets. Even though the project is pioneering, in the sense that it was the first ever project to do this, it is presented here as a representative case study that highlights the accounting problems faced by REDD projects, and the REDD concept in general.

The primary sources of data are the documents that have been submitted by the project to the certification bodies. These documents are publicly available on the internet via the project databases of the certification bodies. Additional data was also extracted from other internet-based sources relevant to the project.

Within the context of the REDD concept, the project itself was the main unit of analysis. Individual components of the calculations made in order to construct the REDD offset product form embedded subunits of analysis. The analytical strategy was to develop a coherent description of the construction of the REDD offset product. The key practices represented in the data were extracted and synthesised so as to be able to test and develop the explanatory power of the theoretical underpinnings, presented above, of the market construction approach to accounting for biodiversity.

The presentation of the findings of the case study, and the discussion that follows it, both seek to remain impartial with respect to any judgement as to the efficacy or rationality (Vollmer *et al.*, 2009) of the project's calculations, of the REDD concept, or of market construction as an approach to accounting for biodiversity.

4.4. A Description of the Findings of the Case Study

4.4.1. The ecosystem

The Kasigau Corridor is 199,910 hectares of land that is 87% forested and 13% grassland. This represents only 0.3% of the land area of Kenya, where 6% of Kenya's land is classified as forest (World Bank, 2012d). However, the Kasigau Corridor's relatively small size belies its importance as a natural resource because it connects the Tsavo West and Tsavo East National Parks (which have a combined area of 2.2 million hectares) and acts as a migratory conduit between them.

> The project ecosystem is home to a fantastic diversity of mammals (over 50 species of large mammal, more than 20 species of bats), birds (over 300 species) and important populations of IUCN [International Union for Conservation of Nature] Red List species such as Grevy's zebra (Equus grevyi), Cheetah (Acinonyx jubatus), Lion (Panthera leo) as well as over 500 African elephants (Loxidonta africana) seasonally (Wildlife Works, 2011e, p. 3).

The forest itself is comprised of 53 species of indigenous trees (Wildlife Works, 2011a).

4.4.2. The threat

The threat to the Kasigau Corridor ecosystem is primarily from slash and burn agriculture. The Taita tribe have traditionally farmed the fertile cloud forest hills to the north-west of the Kasigau Corridor, growing mostly maize. As their population grew to exceed the capacity of those lands (Kenya's total population has risen steadily from 16.3 million in 1980 to 40.5 million people in 2010 (World Bank, 2012d)), many relocated to the dryland forests below. Unfortunately, the climate at these lower elevations is much hotter and drier

and the extremely low average rainfall makes it impossible for them to use their traditional agricultural practices. This means they are forced to clear more and more land as the soil quickly becomes infertile. This pattern of slash and burn deforestation has spread outwards from the hills and now threatens to invade the Kasigau Corridor.

4.4.3. The organisation

In 1996, an American management consultant called Mike Korchinsky, who had recently sold his firm, Axiom Consulting, to Cambridge Technology Partners for approximately US$19 million in shares (Computer Business Review, 1995), took a safari holiday in Africa. This exposed Korchinsky to the scale of the devastation of natural habitats there (Encyclopaedia of World Biography, 2004). He concluded that the cause of the problem was the lack of jobs for local people, which meant that they had to engage in destructive practices in order to survive. His response was to found Wildlife Works Inc., a company registered in California, which then bought a 30,000 hectare piece of land in Kenya's Kasigau Corridor called the Rukinga Ranch. The company employed local people to build a clothing "Ecofactory". The Ecofactory was designated an Export Processing Zone by the Kenyan government so that it could export its goods duty-free to its main markets in Europe and the United States. Clothing is sold both wholesale to existing brands such as Loomstate and EDUN (Wildlife Works, 2010c) as well as directly on the company's own branded website where t-shirts and hoodies retail around US$30-70 (Wildlife Works, 2012b). EcoFactory workers are paid approximately US$90 per month (Wildlife Works, 2007) where the average salary in Kenya is about US$60 per month and most of the population live on less than a dollar a day (BBC, 2010).

The Rukinga Ranch was renamed the Rukinga Sanctuary and men and women from the local area were recruited to patrol as unarmed rangers, to deter poaching and other illegal use of the protected land. At the end of

2010, 18 rangers were employed (Wildlife Works, 2012a), earning salaries of approximately US$90 per month (Wildlife Works, 2007). The company also engaged in a school construction project, building 18 classrooms by 2010, at a cost of US$37,250 (Wildlife Works, 2012a).

The Wildlife Works stated mission is

> to bring market based solutions to conservation of biodiversity by providing benefits to rural communities so they can feed their children and put them through school without damaging the environment in which they live (Wildlife Works, 2010b).

Unfortunately, even before the costs of rangers and school buildings, the Ecofactory was making consistent net losses totalling US$165,000 over the six year period 2005-10 (Wildlife Works, 2012a), which was a net loss percentage of 59%. This business model, by itself, was clearly not sustainable.

4.4.4. A new business model

In 2007, in response to a call from the United Nations Framework Convention on Climate Change negotiation process, the UN and World Bank began setting up pilot projects to test different ways of establishing a possible future REDD market. Thus the "REDD" idea became a well-known and credible concept amongst developers of the carbon markets, as well as amongst conservationists as a possible way to finance their work. Wildlife Works became aware that its efforts to conserve the Kasigau Corridor ecosystem should be eligible to earn REDD credits for the GHG emissions savings that result from the avoidance of deforestation there. Wildlife Works therefore commissioned a technical services company called EcoPartners to devise a REDD "methodology" to be submitted to the leading issuer of quality-assured voluntary over-the-counter (OTC) carbon credits, Verified Carbon Standard (VCS). Each VCS methodology is a set of rules and procedures that a

particular type of project must follow and comply with in order to be issued credits. Methodologies may be submitted for new types of project but each methodology must be assessed and approved as meeting the requirements of the principles-based VCS Standard. Wildlife Works' new REDD methodology was assessed by two VCS-approved validators, Det Norske Veritas Climate Change Services AS, and Environmental Services Inc, and judged to comply with the VCS Standard.

A new company, Wildlife Works Carbon LLC, was registered in California to manage this new side of the Wildlife Works business. The company entered into carbon easement agreements with landowners, under which it held the rights to carbon credits generated from the land in exchange for payment of a share (approximately one third (World Bank, 2012a)) of the revenues from the sale of those credits. The easements also require landowners to manage their land in a 'conservation-friendly way' (Wildlife Works, 2010c) so they cannot convert it for agriculture.

The project was implemented in two phases. Phase 1 covered only the Rukinga Sanctuary, which is owned directly by Wildlife Works Inc. To finance the setting up of the project, Wildlife Works Carbon LLC entered into an agreement with a banking group based in South Africa called Nedbank. Nedbank position themselves as innovators in developing Africa's green economy. They invite their clients to 'Improve your profitability the green way' (Nedbank, 2012c) as well as declaring that 'You too can make things happen for the environment and climate change by simply banking with us' (Nedbank, 2012b). In addition, Nedbank asserts that there is 'strong growth potential [in carbon offset trading] as sustainability receives growing focus from a wide range of corporations around the world' (Nedbank, 2011b). In particular, Nedbank recognises that 'there is extraordinary demand for good quality African offsets, and prices are good' due to a scarcity of carbon projects in Africa (Global Carbon Exchange, 2012). Nedbank agreed to purchase 1.16 million credits (Reuters, 2011) from phase 1 for approximately US$2.6 million (Nedbank, 2011a) on a pre-issuance basis (Wildlife Works,

2010a), with a first stage payment being made in December 2009 and then a second at VCS verification of the project, which was achieved in February 2011. Of these purchased credits, 214,000 were used to fulfil Nedbank's own pledge to be Africa's first carbon neutral bank (Nedbank, 2011a) and the remainder served as investment products for Nedbank to sell on to its clients. For example, in 2011, 98,000 of these credits were resold by Nedbank to PPR Group, which owns luxury brands Gucci, Yves Saint Laurent, Sergio Rossi, and PUMA (Nedbank, 2011b).

Phase 2 of the project covered the remainder of the Kasigau Corridor and required Wildlife Works Carbon LLC to enter into carbon easement agreements with 13 Indigenous Community Ownership Groups. Each of these groups had been granted legal title to their land by the Kenyan government after independence from the British in 1963. Altogether, these groups are comprised of some 3000 Kenyan shareholders (Wildlife Works, 2010a).

4.4.5. Carbon accounting

The project's "baseline scenario" is the calculation of the annual GHG emissions that would occur if deforestation was allowed to take place in the project area without any intervention from Wildlife Works (it is also referred to as the "without project" scenario). The calculation of the projected reduction in GHG emissions as a result of the project therefore equals: *"Baseline (without project) GHG emissions" minus "Actual (with project) GHG emissions".*

The project activities in the Kasigau Corridor means there is no actual deforestation there, and Wildlife Works confidently assert that that will continue to be the case throughout the project timeframe (Wildlife Works, 2011b). The "Actual GHG emissions" are therefore assumed to be zero. The accounting challenge for this project, then, lies with calculating the "Baseline GHG emissions" by establishing a model of the "without project"

scenario – the deforestation, and resulting GHG emissions, that would occur if the project activities were not implemented.

Any model for forecasting baseline GHG emissions from deforestation requires two basic elements: firstly, the forecast deforestation rate for the area and, secondly, the carbon stock that will be lost as a result of that deforestation.

4.4.6. Forecasting the deforestation rate

Citing a long list of academic literature on deforestation patterns (see Wildlife Works, 2011d), it is asserted that deforestation in any one area follows a logistic function over time:

$$\text{Proportion of cumulative deforestation} = 1/(1+\exp[-\eta])$$

where η is the linear predictor defined by $\eta = \alpha+\beta t$, where t is the number of days since the start of the project. The values of the parameters α and β, for this particular predicted deforestation rate, are found by fitting the logistic model to some relevant empirical data. To obtain such data, Wildlife Works defines a reference area that has been subject to the same drivers of deforestation that would now threaten the project area. This reference area is the land described above as having been subjected to slash and burn agriculture from the Taita people who relocated from their traditional lands on the hills situated to the north-west of the Kasigau Corridor. The reference area therefore provides a stark illustration of what would very likely happen to the Kasigau Corridor project area in the absence of the Wildlife Works project. The reference area is bounded by the Tsavo West and Tsavo East national parks, and the Kasigau Corridor project area.

In order to measure what has happened in the reference area, satellite images taken at different points in time are analysed to calculate forest cover at each point for which images are available. The period over which images are collected is chosen based on local histories describing the movements of

the Taita people into the reference area, and on the availability of satellite images of the reference area (specifically, one being available from February 1987). In total there are 10 images covering the reference period from February 1987 through to the phase 1 project start date in January 2005 and a further 7 images leading up to the phase 2 project start date in January 2010.

Over each satellite image of the reference area, a grid of 2000 evenly spaced sample points is laid. An analyst then looks at each point and categorises it as one of (i) no image, (ii) built-up (i.e. a settlement), (iii) cloud or shadow, (iv) non-forest, or (v) forest. However, the analyst must draw a distinction between natural grassland (which has not been deforested and so for these purposes counts as forest), and anthropogenically deforested land. This distinction needs to be made by studying the context of the land in which the sample point falls.

> When classifying the points in the grids it is very important to evaluate the area around each point to get a clear understanding of the land cover features and classification type, not just the area directly under the point. Points will often land on transition areas so a thorough review must be done to evaluate the relative proximity to the various land covers (Wildlife Works, 2011a).

An algorithm is then run on the data to highlight unlikely transitions at each point, such as going from non-forest to forest in a short time. Flagged points are then re-examined in the light of the identified inconsistencies and points reclassified where considered necessary.

This historic data regarding forest cover in the reference area at numerous points in time over the reference period can then be fit, using statistical software, to the logistic function. For the Kasigau Corridor project phase 1, the linear predictor is calculated to be:

$$\eta = \alpha + \beta t = -1.0804558 + 0.0003792t$$

These values of α and β are the parameters that define the predicted “without project” rate of loss of the Kasigau Corridor tropical forest ecosystem using the logistic model of deforestation.

Then, in order to simplify the calculations, and spread the offset credits that the project earns evenly over the project period, a linear rate of deforestation is chosen to act as the projection of deforestation in the “without project” scenario in the project area going forwards. This begins at zero proportion of the area deforested at the project start date and ends at the proportion of area deforested predicted by the logistic model at the project end date. For the Kasigau Corridor project area phase 1 (the Rukinga Sanctuary), then, the linear model predicts a “without project” deforestation rate of 0.031649t.

Thus the project has calculated a hypothetical forecast for the amount of deforestation that would occur in the project area over the project period if the project activities were not in place to prevent it. If actual deforestation in the project area remains at zero, then this is also a calculation of the avoided deforestation in the project area as a result of the REDD project.

4.4.7. Carbon stock

Now that a model of avoided deforestation is established, what is required is a calculation of the carbon that would be emitted as carbon dioxide as a result of that deforestation. This first requires the identification of the various pools of carbon that comprise the forest ecosystem. The main pools of carbon to be included in the model are trees, shrubs, and soil. Each of these three pools requires different approaches to assess the total carbon content that would be emitted as a result of deforestation.

4.4.8. Trees

Trees are defined as:

> A woody perennial with a single main stem, or in the case of coppice with several stems, having a more or less definitive crown (IPCC, 2006, p. 4.78).

Trees comprise the trunk and branches above ground, and the root system below ground. The above-ground biomass is calculated using allometric equations, which have the form:

$$\text{Biomass} = a[\text{DBH}]^b$$

where DBH is the diameter of the tree at breast height, and a and b are parameters specific to the species of tree. Wildlife Works employed EcoPartners to develop allometric equations for all dominant tree species found in the Kasigau Corridor. This is done by choosing a sample of trees of each species, with differing breast height diameters, and then cutting those trees down, cutting them into pieces and weighing them. The diameters and biomass weights for each species are then fit, using statistical software, to the allometric equation form to find the parameters a and b for each species.

For each of these species, the below-ground biomass is estimated using a root-to-shoot ratio taken from the IPCC (2006) guidance of 0.4 for 'tropical shrubland' (Wildlife Works, 2011c, p. 6). Carbon stock is calculated using the 'IPCC default value of 0.5' (Wildlife Works, 2011d, p. b23) of carbon per unit mass of forest biomass. A total carbon stock content of all trees in the ecosystem is calculated based on the percentages of each tree species identified in the sample areas.

4.4.9. Shrubs

Shrubs are defined as:

> Woody perennial plants, generally more than 0.5 meters and less than 5 meters in height at maturity and without definite crown (IPCC, 2006, p. 4.77).

Shrubs comprise the stems above ground, and the root system below ground. The above-ground biomass is calculated differently depending on the type of shrub. For shrubs with clearly defined individual stems, a standard weight per stem is obtained for each of three shrub size classes (named small, medium, and large) by cutting down the stems and 'weighing one representative stem of the average diameter from each size class' (Wildlife Works, 2011b, p. 77). Shrubs of that species in sample plots are then classified by size class and number of stems, and its total biomass weight is then calculated from these standard values. For shrubs without clearly defined individual stems, a standard weight is obtained for each of three shrub sizes by cutting down the whole shrub and weighing it. Shrubs of that species in sample plots are then classified by size class and its total biomass weight is then calculated from these standard values.

For all shrub species, the below-ground biomass is estimated using a root-to-shoot ratio of 0.4 from the IPCC (2006) guidance for 'tropical shrubland' (Wildlife Works, 2011c, p. 7). Carbon stock is calculated using the 'IPCC default value of 0.5' (Wildlife Works, 2011d, p. b23) of carbon per unit mass of forest biomass. A total carbon stock content of all shrubs in the ecosystem is calculated based on the percentages of each shrub species identified in the sample areas.

4.4.10. Soils

Whereas the carbon contained in trees and shrubs is all assumed to be lost immediately upon deforestation, the carbon held in soil is modelled as being lost over time from the date of deforestation, as an exponential decay function:

$$\text{Proportion of soil carbon lost} = 1 - \exp(-\lambda t)$$

where λ is the exponential soil carbon decay parameter, which determines the rate at which the soil is losing carbon, and is obtained by fitting a sample

of measurements of carbon content in soils in deforested plots in the reference area. Local knowledge of when each plot was cleared of forest is used to provide a value of "time since deforestation", t, for each sample. Soil from each sample is sent to the *Soil Laboratory* in Nairobi for them to measure bulk density and carbon percentage. A number of samples of soil from forested areas inside the project area are also tested for carbon content, so allowing for the calculation of an average soil carbon content at t=0. This data can then be fit to the exponential decay function to provide a value for λ and so predict the carbon loss from soil as a result of deforestation in the "without project" scenario.

4.4.11. Offsets

The calculation of the projected "without project" rate of forest ecosystem loss, combined with the calculation of the total carbon stock stored the in trees, shrubs, and soils that comprise the forest ecosystem, allows for the calculation of the baseline "without project" GHG emissions. Since the conservation project has halted all deforestation activity within the project area, the actual GHG emissions from deforestation are zero. Therefore, the GHG emissions reductions as a result of the project, which equals the offset credits that can be sold on the OTC carbon markets, are equal to the modelled baseline "without project" GHG emissions.

4.4.12. Biodiversity accreditation

In addition to the VCS accreditation of the quantity of offset credits generated, Wildlife Works has also secured accreditation for its project by the Climate, Community and Biodiversity Alliance (CCBA). CCBA have developed a standard that will allow purchasers of offset credits to 'identify land-based projects that are designed to deliver robust and credible

greenhouse gas reductions while also delivering net positive benefits to local communities and biodiversity' (CCBA, 2008, p. 7).

In order to achieve accreditation, projects must devise and implement a monitoring plan containing indicators of climate impact, community impact, and biodiversity impact and demonstrate that the project has had a net positive effect on each. In respect of biodiversity, the project must also demonstrate that no High Conservation Values (HCVs) are negatively impacted by the project. HCV areas are those that 'include the presence of rare or endemic species, sacred sites, or resources harvested by local residents ... where these values are considered to be of outstanding significance or critical importance' (HCV Resource Network, 2007). Wildlife Works declares that the whole Kasigau Corridor project area is a HCV area as it contains five species of mammal on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, and the area acts as a migratory conduit between the Tsavo East and Tsavo West National Parks, and 'is home to a complete dryland ecosystem' (Wildlife Works, 2011a, p. 29). The majority of Wildlife Works' indicators in the biodiversity section of their CCBA monitoring plan (Wildlife Works, 2011c) relate to the activities they are undertaking to try to protect biodiversity in the area. These include the number of rangers employed and the number of poaching arrests made and snares or traps found. A 'species population statistics' (Wildlife Works, 2011b, p. 54) indicator refers to the number of reported daily sightings of animals by the rangers, with each sighting resulting in a record of date, GPS location, species, number of males, number of females, number of young, and the name of the ranger recording the sighting.

CCBA also have a Gold-level certification. To achieve Gold-level with respect to biodiversity, a project must demonstrate that they 'conserve biodiversity at sites of global significance for biodiversity conservation' (CCBA, 2008, p. 35). The Wildlife Works project has achieved this by demonstrating that the project area meets the criteria by having 'at least a

single individual' (CCBA, 2008, p. 35) of Grevy's Zebra and of African Hunting Dogs, both of which are classed as endangered by the IUCN Red List. In addition, it meets the criteria by having 'at least 30 individuals' (CCBA, 2008, p. 35) of cheetah and lion, both of which are classed as vulnerable by the IUCN Red List.

4.5. Discussion

Wildlife Works' goal is to protect and conserve the biodiversity of the Kasigau Corridor. They are seeking to prevent the conversion of the complex forest ecosystem to a biologically baron patch of land in which virtually nothing can grow in the degraded soils. The accounting model, whose construction has been described here, is a forecast of that very scenario. It is the scenario in which all of the diversity of life that comprises the Kasigau Corridor forest is lost, leaving an empty land that offers next to nothing in ecosystem services. Using data gathered by satellite images that clearly demonstrate what happened to a similar ecosystem after succumbing to the very same threats to its existence that now threaten the Kasigau Corridor, the model forecasts a near total conversion from forest ecosystem to wasteland over a period of 30 years.

4.5.1. Objectification of biodiversity conservation

Wildlife Works have engaged in innovative and radical activities to tackle the drivers of deforestation, but these are not, themselves, brought into account in any of the calculations that contribute to the construction of the carbon offset product. These activities are, however, essential for conserving the forest ecosystem and so for holding the actual deforestation rate at zero. The objectification of the product begins with this realisation that those conservation activities are acting to hold off the counter-factual "without-project" scenario of devastation. Framed in this way, the results of those

activities become quantifiable. The project can point to an identifiable output of its work, over which it has ownership.

In order for ownership of the biodiversity conservation project's quantified output to be transferred, that output must be transformed into a thing that can then be detached from this world of conservation. This is achieved by combining the quantified conservation output with the quantified measures of carbon stocks in order to extract a result that expresses the conservation in terms of GHG reductions. This result is a new entity – an objectified thing – that can be detached from its origins in biodiversity conservation such that ownership of it can be transferred elsewhere.

The work that produced the carbon stock element of this calculation was not straightforward. A simplifying, reductive model for each dominant tree and shrub species in the Kasigau Corridor forest ecosystem had to be devised in order to model first volume of biomass and then carbon-content. Each sampled member of each tree species was modelled based only on the trunk's diameter at breast-height. Each sampled member of each shrub species was modelled based on the number of stems it has in each of three size categories. The models for each species were constructed from empirical work specific to this conservation project area. The mix of species in these environmental conditions is specific to the Kasigau Corridor forest ecosystem. The sampling work done by the Wildlife Works conservation project allows them to build a biomass model and, using a standard carbon-content ratio, a carbon storage model for the Kasigau Corridor forest ecosystem.

However, this approach of empirical modelling was used only for the above-ground biomass. To calculate the below-ground biomass, a standard root-to-shoot ratio of 0.4 was applied to all species of tree and shrub in the ecosystem biomass model. This 0.4 figure was taken from the IPCC *Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006) and refers to the figure presented for "tropical shrubland". However, the table from which this figure was taken shows that the root-to-shoot ratio for ecosystems

classified as 'tropical dry forest' (p. 4-49) can range from 0.27 up to 0.68. For the Kasigau Corridor project, the choice of a root-to-shoot ratio between these two extremes would result in a difference in total project avoided GHG emissions of just less than 4 million tCO_2e. The average price of a VCS certified credit on the OTC market in 2010 was US$5.20 (World Bank, 2011). Assuming this price, then, the choice of a root-to-shoot ratio within the range that the IPCC say is found in dry tropical forests could mean a difference in revenues of a little under US$21 million over the life of the project. It is clear that small changes to technicalities of construction of the accounting model, on which the objectification of this biodiversity conservation is based, can have a large impact on the revenues generated by selling the objectified product in the market.

4.5.2. Singularisation of biodiversity conservation

If a project had to explain its accounting procedures and modelling to potential buyers then technical matters, such as the choice of which root-to-shoot ratio to use, might well be a matter for dispute and negotiation. Potential buyers might be wary that a high root-to-shoot ratio, for example, would inflate the claimed emissions reductions of the project. This could leave buyers (now the owners of the offset credits) open to possible reputational risk were the choice of ratio later disputed by environmental activists or journalists. Fortunately for both parties, however, such choices are not a matter of negotiation between them. The whole calculative process has been black-boxed by the VCS. Wildlife Works has subscribed to an approved VCS methodology – a methodology, in this case, that Wildlife Works themselves paid to have written and accredited – and then VCS has issued offset credits with their seal of approval on them. Buyers, such as Nedbank, feel they can rely on that seal of approval and therefore have no need to delve deeply into the calculations that lie within the black-box. The black-boxing has made the number of tCO_2e credits generated by the REDD conservation project a statement of fact in the eyes of market actors. The

use of the VCS to black-box the offset product is an act of singularisation because the certification makes the product considerably more attractive to potential buyers, who can confidently bring the required quantity of offset products into their world. The products are detached from their method of production and can be entangled with the GHG emissions claims of companies (e.g. Nedbank's claim to be carbon neutral) without fear that those claims might be at risk of being undermined.

Wildlife Works' mission is to conserve the biodiversity of the Kasigau Corridor. In order to capitalise on this and make their offset product more attractive to a wider range of potential buyers, they have had their project certified by the Climate, Community and Biodiversity Alliance (CCBA). The CCBA certification requires projects to demonstrate "net positive impact" on biodiversity and on local community well-being. However, it does not lay down any agreed standard metric of biodiversity (or, indeed, of community well-being). Instead, individual projects define their own metrics in their monitoring plan. Without any degree of actual standardisation, then, the CCBA certification allows projects to black-box their biodiversity and community benefits. Buyers of CCBA certified offsets can simply point to the seal of approval of the CCBA as unequivocal proof of the fact that their offsets were generated in an environmentally and socially responsible way. This fact, now detached from any physical benefits to biodiversity or to people's lives on the ground, is owned by the corporation who buys the certified credits. They can now use this fact without having to lift the lid of the black-box to show how the certification was actually achieved.

On its website, Nedbank parades the purchase of the Kasigau Corridor offsets under the headline 'Good, Clean Carbon Credits' and prominently cites the gold-level CCBA certification, describing it as 'the most rigorous standard for ensuring that communities and biodiversity benefit from climate change projects' (Nedbank, 2011a). The CCBA certification fits Nedbank's desire to present itself as a responsible corporate citizen. The CCBA certification further reduces Nedbank's reputational risk, as it cannot be

accused of meeting its carbon neutrality target at the expense of biodiversity or local communities, and it makes the credits it plans to sell on to its clients more desirable than other offset products that do not have it.

The black-boxing of the calculations of both the quantity of carbon offsets by the VCS, and the biodiversity and community benefits by the CCBA, are processes of singularisation. The properties of the objectified offset product are now defined in terms of having met these certification standards. This not only makes the offset product more attractive to buyers because it reduces their reputational risk, but also makes the offsets straightforwardly comparable with other offset products on the market. The black-boxing of the objectification calculations by the VCS and CCBA standards turns the offset product into a calculable good.

Singularisation is a mutual adjustment between the properties of the good in order to make it calculable, and the properties of the buyer's world in order to be able to incorporate the good into it. This adjustment of the buyer's world is evident in the Kasigau Corridor case. Nedbank presents itself as Africa's only green bank and cites its status as Africa's only carbon neutral bank as proof (Nedbank, 2012a). By drawing this much attention to its carbon neutral claim, Nedbank exposes itself to the risk that it is seen as just trying to buy its green credentials. Carbon neutrality is often attacked by environmental activists as "greenwash" as it allows companies, rather than dealing with their own GHG emissions, to simply pay for the appearance of being green by funding projects that may well have happened anyway (L. Gray, 2009). Nedbank appears to try to head off this potential accusation by telling a small part of the story of how these credits came about. Nedbank proudly presents the Kasigau Corridor REDD forest conservation project as a completely new kind of African initiative that acts as an exemplar for tapping 'into the global green economy while simultaneously conserving our continent's rich natural heritage' (Nedbank, 2011a) that has only been made possible through Nedbank's early financing. Nedbank's presentation of itself, as an innovative leader in green banking, has therefore opened up a space onto which these

particular Kasigau Corridor REDD offsets can be attached. Even though the VCS and CCBA certifications have black-boxed the calculations that constructed this calculable good, Nedbank have decided to lift the lid just a little to explain how they think this product is distinctive.

4.5.3. Bringing all tropical forest biodiversity conservation into financial accounting calculation

The construction of a calculable good in the OTC carbon markets has brought the tropical forest biodiversity conservation from which it was derived into the financial accounting calculations of Wildlife Works, of Nedbank, and of many of Nedbank's clients who purchase the REDD offsets second-hand. Nedbank paid approximately US$2.25 per tCO_2e for the phase 1 credits it bought in 2009. However the project plan shows that, with the annual sales of phase 1 and phase 2 credits going forwards, Wildlife Works expects to generate revenues of around US$7.5 million per year from carbon credit sales (Allianz, 2012). This works out at around US$6.25 per credit (in 2010, the average price paid for an OTC carbon credit generated in Africa was US$9.1, and all such credits sold for above US$6 (Ecosystem Marketplace, 2011a)). Of these revenues, generated from the Wildlife Works REDD project, approximately one third will go to the Indigenous Community Ownership Groups to fulfil the carbon easement agreements. In addition, the revenues help to finance the employment of local people as rangers (a recruitment drive as part of the implementation of phase 2 of the project saw ranger numbers increase about 200% to 75 in March 2012), Ecofactory workers (in 2011, a second Ecofactory building was constructed resulting in a near doubling of the number of Ecofactory employees to 28 people in March 2012), and other jobs (in March 2012 Wildlife Works employed 186 people). The revenues also provide funds for community development programmes such as an education bursary scheme that has granted sponsorships to 700 students in 2012 for secondary school, college, or university (Wildlife Works, 2012a). These distributions of the carbon credit revenues are vital for

making the biodiversity conservation project a success. The project offers local people alternative livelihoods to the slash and burn agriculture that has been identified as the primary threat to the continuing existence of the forest ecosystem.

In some respects, REDD represents payments for the maintenance of the ecosystem service of carbon sequestration and storage by forests. However, since the REDD offsets generated by the Kasigau Corridor project are calculable goods on the OTC carbon markets, the most significant factor in determining their price is the price of other calculable goods available on that market. Whilst the REDD product itself is generated from the conservation of a natural ecosystem, the valuation of that product is not based on any intrinsic value of the biodiversity that comprises this ecosystem. Instead, the valuation of the product depends largely upon the dynamics of supply of carbon offsets from a whole host of different kinds of GHG-reducing projects, and the demand of companies seeking to voluntarily offset their own GHG emissions. This stems from the fact that REDD does not, in its current form, represent a case of construction of a wholly new kind of market. Instead, REDD offsets are constructed to be calculable goods on an already existing market – the OTC carbon market. The price set by this market for a REDD offset is therefore certainly not a calculation of the value of all the ecosystem services provided by the forest being conserved. Indeed, valuations of tropical forest ecosystems, based on the TEEB valuation framework, are frequently used to demonstrate that the costs of financing a REDD scheme are far outweighed by the benefits of conserving the tropical forest, and as an argument in favour of establishing a global REDD mechanism capable of financing the conservation of all the Earth's remaining tropical forest ecosystems.

The post-Kyoto negotiations at the UNFCCC do reflect a general agreement that a global REDD mechanism should be established. The difficulties facing these negotiations are largely controversies over the forms of calculation that will comprise such a mechanism. Rolling out REDD from the project-based

initiatives like the Kasigau Corridor case, to a globally-agreed system of national REDD programmes, presents a whole raft of accounting challenges.

Firstly, the establishment of baseline scenarios becomes highly controversial. If purely historic rates of deforestation are used to establish a baseline, as was done in the Kasigau Corridor case, then this would benefit countries that have deforested more in the past and would punish countries that have already worked to reduce their deforestation rates. The use of purely historic rates of deforestation to establish the baseline deforestation rate therefore provides perverse incentives for countries to deforest more now so they can earn more REDD credits by reducing that deforestation in the future. Other possible methods of establishing a baseline scenario include the use of economic forecasting to calculate a country's development and the deforestation that would be expected as a result. Such economic modelling, however, requires many highly subjective judgements to be made and would, therefore, be the subject of intense controversy and negotiations within the mechanism.

Secondly, it is considerably less likely that a national programme, being on a much larger scale, will be able to completely halt deforestation such as has been achieved in the small-scale Kasigau Corridor project. REDD activities in many areas are likely only to slow the rate of deforestation, rather than bring it to zero. This means that ongoing monitoring, using satellite imaging and ground-based measurements, together with appropriate reporting and verification procedures will need to be established in order to provide a reliable "actual deforestation" calculation that can be subtracted from the "baseline deforestation" so that the "avoided deforestation as a result of REDD activities" can be extracted. Accounting for forest inventories on such a vast scale would require huge investment in infrastructure and the establishment of reliable governance regimes.

Both the establishment of baselines and the development of ongoing monitoring, reporting and verification systems are made all the trickier by the fact that no two tropical forest ecosystems are really alike. Any one area of

tropical forest is constituted by its own combination of tree and shrub species (Groombridge and Jenkins, 2002). This makes calculating carbon stocks from allometric equations, as was done in the Kasigau Corridor case, an extremely daunting task. An alternative might be to use a standard multiplier for converting areas of different classes of forest ecosystem into measures of carbon stock. The values of these standard multipliers, the design of the classification system, and the classifying of any particular forest as falling into a particular class, all then become matters of controversy and negotiation.

The Kasigau Corridor REDD project constructed a calculable good on the OTC carbon markets. The demand on such markets comes from companies that want to voluntarily offset their GHG emissions. Such markets could never produce enough demand to support REDD on a scale large enough to finance the conservation of a globally significant area of tropical forest. Some kind of regulatory regime would be required to raise that kind of finance. The demand for a global REDD mechanism comes from the recognition that preventing deforestation is the quickest and cheapest method of reducing GHG emissions and mitigating the effects of climate change (Stern, 2007). Whilst the viability of REDD lies in this demand for GHG emissions reductions, there is considerable concern that a global REDD mechanism based only on emissions reductions may be detrimental to biodiversity. If only carbon stocks are taken into account in the calculations that construct a REDD product then this could lead to perverse outcomes, such as the systematic replacement of primary tropical forests with plantations that may be more carbon-dense. This would be devastating from a biodiversity standpoint as the forest would no longer be a natural ecosystem. The matter of what safeguards should be in place to prevent a global REDD mechanism from inflicting damage to biodiversity remains a matter of controversy in the UNFCCC negotiations.

These accounting difficulties are being explored and interrogated at present in the pilot REDD projects established in forested countries around the world with grant funding from the UN-REDD Programme and World Bank's Forest

Carbon Partnership Facility. These pilots are testing different approaches to the implementation of REDD mechanisms in areas with different types of tropical forest ecosystems and with different types of threats that drive those ecosystems' destruction. These experiments in market construction (Callon, 2009) are shaping the discourse of the UNFCCC negotiations. Just as with any act of market construction, however, the technical details are not merely problems purely for scientists or for accountants. They are deeply political. The calculative mechanisms that are eventually agreed upon – the calculations contained within the black boxes that will comprise the REDD market – have the potential to affect the transfer of vast sums of wealth from rich industrialised countries to poorer forested countries. Whilst the case of the Kasigau Corridor REDD project has illustrated some important aspects of the market construction approach to bringing tropical forest biodiversity conservation into financial accounting, further investigation by accounting researchers, into the ongoing controversies discussed here, is clearly required.

4.6. Conclusions

The case study presented in this chapter has shown how a small scale project has brought the conservation of the biodiversity of the Kasigau Corridor tropical forest ecosystem into financial accounting calculation by constructing a calculable good on the OTC carbon markets derived from that conservation. If a large-scale REDD market could be established in such a way as to finance the conservation of a great deal more of the planet's tropical forests, then it could go a long way towards stemming both climate change and the current mass extinction of species. Bringing biodiversity conservation into the financial accounting calculations of the world's organisations, in this way, has the potential to radically alter humanity's economic relationships with the myriad of species that comprise Earth's global ecosystem.

Chapter 5.

The Performativity of Financial Accounting Calculations in the Construction of Markets for Tropical Forest Carbon

5.1. Introduction

The activity of market construction is an innovation that seeks to reorganise the economic activities of a culture or society in order to achieve some specific purpose (Callon, 2009; MacKenzie, 2009a). The construction of markets requires actors to design and build material assemblages that embed calculations (Muniesa *et al.*, 2007) which recognise and measure tradable products that can be extracted from a world of supply, mobilised and then combined with a world of demand (Callon and Muniesa, 2005). This chapter seeks to examine the performativity of the financial accounting calculations which define market transactions. It will do so by analysing a case study of the experimental construction of a market in tropical forest carbon. Carbon trading is a market innovation to mitigate global climate change, requiring the construction of new accounting objects (Hopwood, 2009a). This analysis will trace the experimental translation of the calculative practices (Vollmer *et al.*, 2009) of the world of carbon trading markets that seek to extract and mobilise a combinable product – an accounting inscription (Robson, 1992) – from the world of tropical forests.

Through analysis of this case study, this chapter will seek to address the research sub-question regarding the role of financial accounting calculation in building markets for the purpose of addressing specific environmental problems (such as, here, destruction of tropical forests). The next section will seek to explain the theoretical conception of the performativity of financial

accounting calculation. Section 5.3 will set out the case study methodology and the methods employed in data collection and analysis. Section 5.4 will present, analyse and discuss the findings of the case study in detail. Finally, section 5.5 will draw conclusions in relation to the performativity of financial accounting calculation in market innovations.

5.2. Theory

This section will review first the ontology of inscriptions constructed from accounting calculations, followed by the performativity of economic theories in markets, and then finally these two strands will be brought together to define the performativity of financial accounting calculation in the construction of market innovations.

5.2.1. Accounting inscriptions

Accounting inscriptions are results extracted from specific calculative practices such that they become detached, delineated objects (Samiolo, 2012), quite separate from the processes that constituted their construction.

> Accounting calculations are understood to be inscriptions that are contingent effects of specific procedures rather than a more or less precise mirroring of the world. Inscriptions are interesting not because of what they say, but because of the kind of action they enable, by being material, mobile and combinable (Justesen and Mouritsen, 2011).

Within the framework of actor-network theory, then, accounting inscriptions are actors (Power, 1996). They contribute, working in hybrid with other actors, to the construction of all manner of organisational activities. As actors they can be enrolled – combined – within actor-networks such that they reconfigure the interests of other such actors. This process of combination of

accounting inscriptions is a translation. Translation occurs whenever accounting objects travel between two previously separate actor-networks. Thus two previously independent "worlds" can be connected by the translation of accounting inscriptions (Malsch, 2013). For example, where the implementation of a budgeting system can connect a world of hospital care with that of a government department (Preston *et al.*, 1992), or the instalment of activity-based costing can connect the world of a manufacturing line with that of a board of directors (Briers and Chua, 2001). These connections facilitate action at a distance by bringing into a calculative space objects that represent categories and quantities outside of it, such that they can be manipulated and sent out again to instigate long distance control (Robson, 1992). However, actions undertaken based on these representations of a world may have unanticipated effects as the real physical world will contain complexities that have not been captured by the inscriptions (Preston and Oakes, 2001).

The success or otherwise of a translation depends on actors configuring the network by building alliances such that actors' interests align (Latour, 1987). The translation of accounting inscriptions thus requires the configuring of the network such that the inscriptions are seen to represent – to speak for (Callon, 1986) – specific actors. They are extracted from one world and combined with another such that they form a unique material connection between those worlds.

5.2.2. Performativity of economics

Economics is concerned with producing models to describe and explain the behaviour of markets. The concept of performativity suggests that, far from merely elucidating pre-existing market phenomena, economic theories actually have a role in configuring markets and bring about specific market behaviours (MacKenzie, 2008b). That is not to say that such theories are self-fulfilling prophecies, but rather that they have material interactions with

the actors participating in markets (Callon, 1998; Callon, 2008). Economic theories can become crystallised in the technologies utilised by market actors in the calculations they use to make market decisions. An example of this is the way that option pricing theory became embedded in the valuations of financial derivatives products made by traders and other market actors such as clearing houses and regulators (MacKenzie and Millo, 2003). Furthermore, the options pricing theory assumes that markets are comprised of uniformly rational, independent agents. This was an unrealistic assumption when the model was first created. However, the embedding of the model in the technologies used by market actors actually changed the configuration of the markets and behaviour of actors such that the assumptions of the model became more accurate. Thus the theory was "performed" by the markets (MacKenzie, 2008a).

In this way, the performativity of economics is seen to operate to define the calculative agencies at play in the markets. However, the results of such performative effects cannot always be straight-forwardly predictable. Actors do not fully take on the forms of life prescribed by the economic models. They do retain (at least some) connections within the specific cultures of the markets in which they participate. Such connections are not taken into account in the economic models and so market behaviours that are not predictable by them, such as catastrophic market crashes, can occur (Millo and MacKenzie, 2009). Whilst calculative agencies are thus partially defined by their connections to economic theory, by explicitly or implicitly utilising the calculative technologies in which those theories are embedded, those are not the only connections the actor has within their network. And an actor's identity is constituted by all of their connections within their network (Callon, 1986; Latour, 2005).

5.2.3. Performativity of financial accounting calculations

Financial accounting is an economic practice (Hopwood, 1992). Just as economic theories are seen to be performative in the construction of calculative agencies, so the economic practice of financial accounting calculation can be seen to be performative in the construction of transactions that occur between calculative agencies. The domain of financial accounting includes all the calculations that comprise the recognition and measurement of value (Hines, 1988). This certainly includes the practice of financial reporting, in which organisations construct statements, from the inscriptions in their books and records, that present an account of their financial performance (Jones, 2010a). However, financial accounting calculation is also required to frame and quantify (recognise and measure) the transactions that make up the inscriptions in those books and records in the first place. These calculations construct the inscriptions that represent the exchanges of value between calculative agencies (Callon and Muniesa, 2005). Thus financial accounting calculations are designed and built to travel from the worlds of supply to the worlds of demand, therefore constructing the material connections between those worlds that constitute a market. This is the performativity of financial accounting calculation.

The carbon trading markets stand as an example of the performativity of financial accounting calculation. The calculations made to recognise and measure the carbon emissions, and carbon emission reductions, actually create new economic entities (tradable goods), such as credits and offsets, that can be bought and sold on the markets (MacKenzie, 2009a). These goods are not, of course, the physical tonnes of carbon dioxide, but rather they are financial accounting inscriptions that represent those tonnes. The inscriptions are extracted from the world of, say, hydroelectric power generation and brought into – combined with – the worlds of banking, or of corporate compliance, or even sustainability reporting. The connections that are thus established between these worlds define the markets and the transactions that take place within them.

> A carbon market is thus an attempt to change the construction of capitalism's central economic metric: profit and loss, the 'bottom line' (MacKenzie, 2009a, p. 441).

Indeed, the carbon markets can be viewed as a collection of *in vivo* economic experiments, seeking to identify configurations of market actors – 'the framing and qualification of goods, the elaboration of rules of the game, the delimitation of agents' (Callon, 2009, p. 540) – that have positive effects on the mitigation of climate change. They are "experiments" because it is not possible to judge in advance, *a priori*, what the resulting market behaviour of any particular market configuration will be.

> Experiments are a particular instance of performativity. The experimenter performs, in a quite basic sense. She brings things into being by assembling them in a particular manner (Muniesa and Callon, 2007).

When the ideas of an experimenter, for the construction of particular financial accounting inscriptions, actually meet the complexities of the real physical world (*in vivo*) there will undoubtedly be unexpected, perhaps surprising, interactions that will force reconfiguration of the market design (Callon, 2009). These complex agencies of the real physical world need to be "pacified" (Caliskan and Callon, 2009; Caliskan and Callon, 2010) such that an inscription can represent – can speak on behalf of – those agencies (Latour, 2005), and a tradable good can be extracted. When markets stabilise, the financial accounting calculations that define the transactions – the connections between calculative agencies comprising worlds of supply and worlds of demand – become crystallised such that they become black-box mechanisms (MacKenzie, 2005) which are non-controversial and so are relied upon to connect market actors entering into mutual transactions. Black-box mechanisms allow markets (such as the carbon trading markets) to grow rapidly by providing a means for extracting inscriptions from diverse origins (hydroelectric plants in India, chemical factories in China, eucalyptus plantations in Tanzania, etc.) that can then be standardised such that they

are made commensurable – “the same” (MacKenzie, 2009a) – so they can be traded as commodities on the markets.

The study of financial accounting calculations as performative market inscriptions has the potential to connect the academic worlds of accounting and finance (Hopwood, 2009b). What is clear, though, from the above review is that such a connection will not be straightforward. All calculation is deeply embedded in the specific forms of life – the cultures (Van Maanen, 2011) – of those actors doing the calculating (Miller, 1992; Miller and O'Leary, 2007; Miller, 2008). Such a study will therefore need to elucidate the interactions between financial accounting calculations and these ‘hybridising knowledges’ (Vollmer *et al.*, 2009, p. 628) of the actors they encounter. The following study will indeed seek to examine the interactions that occurred when the (black-boxed) financial accounting calculations of the carbon trading markets were experimentally translated into the world of tropical forests, where they encountered complex agencies that were highly resistant to pacification.

5.3. Methodology and Methods

The data and analysis section presents an embedded case study (Yin, 2009) that seeks to represent the roles of financial accounting inscriptions in the design and organisation of market innovations. The primary unit of analysis was the experimental tropical forest carbon market mechanism, with individual events in the construction of that mechanism forming embedded sub-units of analysis. The analytical strategy was to develop a coherent narrative description of the experimental translation of carbon market accounting technologies that took place in the design and organisation of the mechanism. This case was chosen because it represents a stage in market innovation where the configurations of the calculative mechanisms are highly contentious and controversial. They have not yet been crystallised to form black-boxes that are undisputed by market actors (MacKenzie, 2009b).

The empirics are drawn from publicly available online sources. These include official agreed texts (and draft texts at various stages of negotiations) of United Nations bodies, as well as statements, press releases, web pages, presentation slides, and published reports of intergovernmental and nongovernmental organisations. Such internet mediated research has the potential to provide immediate and unobtrusive access to rich sites of primary data (Jeacle and Carter, 2011), which would often be very difficult to obtain by more traditional methods (Kozinets, 2010). In this instance, the case study covers a period of several years and draws from sources in distant locations around the world. Without using the internet as an intermediary, the collection of such data would have been unfeasible because of the time and financial resources required. This data collection method also provides a window on the organising communications (Scott and Orlikowski, 2012) of the actor-network under study, and provides the researcher with a view of that network as seen by actors operating within it (Garcia *et al.*, 2009). Significant events were identified, extracted and synthesised so as to illustrate and develop the explanatory power (Kornberger *et al.*, 2011) of the theoretical conception of performativity of financial accounting calculations and thus contribute to the advancement of knowledge within the accounting research network (Joannides and Berland, 2013). The narrative is heavily populated with direct quotations from market actors. This is a deliberate tactic to ensure that the narrative is directly informed by the words of the actors involved in those events (Jonsson and Macintosh, 1997) and so the analysis will remain tight to the data (Toren, 1996). Such a tactic also has the effect of holding the researcher accountable to the reader (Marcus, 1995), who will be in a position to consider their own interpretations of these quotations. This accountability is enhanced by the fact that readers will have access to the online source materials. Footnotes are used, as sparingly as possible, for additional information which may interest the reader but, if included in the main text, would break up the flow of the narrative.

The analysis seeks to adhere to the principles of actor-network theory, especially with regard to maintaining symmetry and free association of actors

(Callon, 1986) such that there is no distinction between natural and social events, and maintaining a flat ontological landscape (Latour, 2005) such that there is no distinction between "global" and "local" actors. This means that the narrative will mobilise actors in whatever way they define themselves through their relations within the network. Thus large and small intergovernmental and nongovernmental organisations are seen to be actors in the same network as individual people, as non-human living systems, and as accounting technologies and inscriptions (Pollock and D'Adderio, 2012). Qualification for "actorhood" is granted only on the basis of an entity's (any entity's) ability to transform relations within the network – to represent and speak for a set of interests in the negotiations over a network's assemblage and arrangement (Latour, 1987).

5.4. Data, Analysis and Discussion

Following adoption by the United Nations Framework Convention on Climate Change (UNFCCC) of the Kyoto Protocol (UN, 1998), the details of the mechanisms that countries could use to meet their agreed emissions commitments were negotiated and agreed in the Marrakesh Accords (UN, 2002). The two most important of these mechanisms were emissions trading, which allowed industrialised countries to buy and sell permits each representing the right to emit a tonne of carbon dioxide (Braun, 2009; Cook, 2009; Engels, 2009; Hopwood, 2009a; McNicholas and Windsor, 2011), and the Clean Development Mechanism (CDM), which enables a developing country to generate emissions offset credits by undertaking projects to reduce their greenhouse gas emissions, which can then be sold to industrialised countries to count towards fulfilling their commitments under the Kyoto Protocol (Bebbington and Larrinaga-Gonzalez, 2008; Lohmann, 2009). Whilst the rules of the CDM did allow for credits to be earned from projects that created carbon sinks by establishing new plantation forests (Lansing, 2011), projects that sought to reduce greenhouse gas emissions from deforestation of natural forests were specifically excluded. This was

mainly because of concerns regarding how to monitor, with sufficient accuracy, emissions reductions arising from forests spanning vast and largely inaccessible land areas (IPCC, 2007). The exclusion of natural forests from the mechanisms of the Kyoto Protocol meant that around 20% of global greenhouse gas emissions (World Bank, 2010) were not being brought into account.

5.4.1. Translation

On 12 May 2005, the Prime Minister of Papua New Guinea gave a speech at Columbia University in the U.S. arguing that the exclusion of tropical forests from the Kyoto Protocol meant that 'developing countries like Papua New Guinea must bear the primary economic burden of conserving these global assets ALONE!' (Papua New Guinea, 2005, p. 3). He argued that, given the crucial role that these forests play in global climate stability, 'this gaping hole in the Kyoto Protocol DEFIES LOGIC and brings the efficacy of the entire framework into question!' (p. 2). He called for the formation of a *Coalition of Rainforest Nations* to stand together and 'focus our collective leadership upon effecting CHANGE' (p. 4). Two months later, the governments of Papua New Guinea and Costa Rica submitted a proposal, on behalf of this newly formed Coalition[3], for a new agenda item for the next UNFCCC Conference of the Parties (COP).

> As developing nations, we are prepared to stand accountable for our contributions toward global climate stability, provided international frameworks are appropriately modified, namely through fair and equitable access to carbon emissions markets (UN, 2005a, p. 7).

The proposal claims that 'robust solutions are within reach' (p. 8) to the technical problems that led to deforestation's exclusion from Kyoto because, by using 'present satellite technology, remote-sensing technologies may be

[3] The countries named as being supporters of the document are Bolivia, Central African Republic, Chile, Congo, Democratic Republic of the Congo, Dominican Republic, and Nicaragua.

applied with the necessary accuracy and cost effectiveness' (p. 9). Thus, as a result of technological developments, the rainforest nations argued that the carbon accounting at the heart of the Kyoto Protocol could now be translated so as to disentangle and mobilise tropical forest carbon such that it could contribute to the mitigation of global climate change.

The COP referred the matter to their *Subsidiary Body for Scientific and Technological Advice* (SBSTA), asking for it to report back with technical recommendations (UN, 2005b). The SBSTA held two workshops (UN, 2006b; UN, 2006a; UN, 2007c), to which they invited representatives of all national governments, as well as experts from selected environmentally-concerned intergovernmental and nongovernmental organisations (IGOs and NGOs) (UN, 2006d; UN, 2007d). One point of agreement at the workshops was that 'the only practicable approach for monitoring changes in forest and vegetation cover at the national scale is through the interpretation of remotely sensed imagery (including airborne and satellite monitoring)' (UN, 2006c, p. 18). This view was backed up by a workshop presentation from an expert from an IGO called Global Terrestrial Observation System (GTOS)[4].

> Analysis of remotely sensed data from aircraft and satellite is the only practical approach to measure changes in forest area at national and international scales. **Since the early 1990s, changes in forest area can be measured from space with confidence.** (GTOS, 2006, p. 7, emphasis in original)

Thus, with the SBSTA in agreement that 'the available methods and tools are robust enough to allow for emissions from deforestation to be estimated with an acceptable level of certainty' (UN, 2007c, p. 11), a considerable alliance of actors had lined up behind the belief that remote monitoring could indeed be utilised to translate carbon accounting such as to bring tropical forest carbon into this form of calculation. Here can be seen the hybridisation, then, of

[4] The governing co-sponsors of GTOS are the Food and Agriculture Organisation, the International Council for Science, the United Nations Environment Programme, the United Nations Education, Scientific and Cultural Organization, and the World Meteorological Organization.

scientific technology – the Landsat range of satellites that could record images of large swathes of land from above – and financial accounting calculation. Viewed from orbit, the forests could be represented as pixels of colour on a screen. The collective belief of the SBSTA was that these images would comprise sufficient inputs for the calculations to construct carbon offset credits that would be commensurable with those already trading on the carbon markets.

The SBSTA recommended that the next step should be to establish 'pilot projects to assist developing countries in building the necessary capacities' (UN, 2007c, p. 18). That is, *in vivo* experiments should establish concrete connections with actual tropical forests. The World Bank responded to this call for such experiments by setting up a *Readiness Fund* under which countries could apply for funding to prepare a national plan to prepare them for participation in a 'system of positive incentives post-2012' (World Bank, 2007a, p. 16). The Kyoto Protocol commitments were due to expire in 2012, so the World Bank chose to work under the assumption that a new post-Kyoto climate change treaty would be agreed by then. The task at hand was to get developing forested countries to a point where they were capable calculative agencies of supply that could be brought into account in the carbon trading mechanisms post-2012. The World Bank prescribed a format for the national plans that required countries to set out how they will calculate baseline emissions, their strategies for reducing emissions below this baseline, and the system they will employ for monitoring (World Bank, 2007b). Thus the World Bank, as the sole source of funding for this initial experimental phase of the market, imposed the format of the CDM for framing and quantifying the goods to be extracted. The World Bank held that national governments were the best actors to specify the precise calculations required for extracting inscriptions from their own tropical forests as they would already have a number of existing connections that could be utilised for the purpose (World Bank, 2009). The Bank was content to outline the format of a black-box mechanism, whose output would be measures of carbon emissions reductions that would be commensurate with credits

generated from CDM projects. Individual national governments could devise the specific calculations that would go into this black-box. This approach was in keeping with the World Bank's stated mission of 'poverty reduction through an inclusive and sustainable globalization' (World Bank, 2012b). Whilst demand for tropical forest carbon arose out of a need for industrialised countries to (be seen to) mitigate climate change, the World Bank saw the potential for such a mechanism to develop the integration of poorer countries with lucrative global markets.

> Knowledge combined with capital has made the most difference in solving the problems of growth and poverty reduction (World Bank, 2012c).

Tropical forest carbon could therefore transform the economies of poor forested countries, such that they could sustainably exploit their natural capital assets. All that was needed was to construct inscriptions that would be commensurable with the carbon markets and the worlds of forested country economies and of industrialised economies would establish a new connection that could benefit both. It stood to reason, then, that national governments would be regarded as the calculative agencies of supply, constructing goods (accounting inscriptions representing carbon emissions reductions) to meet a pre-existing demand from industrialised countries. National governments could be expected to behave like rational economic agents and leap at the chance to take advantage of the flows of funds that could arise from exploiting their forest assets on the carbon markets.

5.4.2. Resistance

The announcement by the World Bank of its plans to work to connect tropical forests to future carbon trading markets prompted strong responses from actors who had hitherto been excluded from all negotiations. One of the first to respond was an NGO called *The Forest Peoples' Programme* (FPP) who argued that since the World Bank and SBSTA had only thus far consulted 'a

closed group of big conservation NGOs' (FPP, 2007, p. 4), they had devised a mechanism that 'will be used by the State to equip forest protection agencies with jeeps, walkie talkies, arms, helicopters and GPS in an outdated and anti-people 'guns and guards' approach to forest protection'(p. 11)(p. 11)(p. 11)(p. 11)(p. 11)(p. 11)(p. 11)(p. 11)(p. 11) (p. 11). The FPP recognised, in the World Bank's plans, a threat to those it seeks to represent[5] and speak for. The threat is that, by treating national governments as the calculative agency responsible for extracting and mobilising tropical forest carbon, this mechanism would act to crystallise States' claims of ownership and control over tropical forests at the expense of the indigenous peoples[6] who inhabit them. This view was backed up by a letter responding to the Bank's consultation, co-signed by 81 NGOs.

> As the World Bank Group positions itself to become the lead agency on climate change mitigation … we are concerned that the Bank risks losing sight of its central mission of reducing poverty as it adopts a narrow focus on carbon accounting (FPP, 2007, p. 1).

At a COP meeting in Bali in December 2007, to which the SBSTA reported their recommendations, protesters outside the conference centre were waving placards declaring the World Bank's mechanism to be "CO_2lonialism" (FERN, 2007). Inside the conference centre, the Chair of the *United Nations Permanent Forum on Indigenous Issues* (UNPFII) was seeking to hold participants to the commitments they had recently made in their adoption of

[5] The Forest Peoples' Programme (FPP) is a UK-based charity whose mission is 'to work to create political space for forest peoples to secure their rights, control their lands and decide their own futures' FPP (2012) *About Forest Peoples Programme*. Available at: http://www.forestpeoples.org/background/about-forest-peoples-programme (Accessed: 13 August 2012).

[6] There remains some controversy over the acceptable style and terminology to use when referring to indigenous peoples. This chapter replicates that used by the *United Nations Permanent Forum on Indigenous Issues* (UNPFII) by not automatically capitalising the word "indigenous" UNPFII (2013) *History of indigenous peoples and the international system*. Available at: http://social.un.org/index/IndigenousPeoples/AboutUsMembers/History.aspx (Accessed: 8 April 2013)., and by referring to "peoples" rather than "people" because 'the "s" in peoples means that indigenous peoples have the right to self-determination … and have collective rights' UNPFII (2008) *Statement of the United Nations Permanent Forum on Indigenous Issues (UNPFII)*. Available at: http://tebtebba.org/index.php/all-resources/category/84-redd-and-ad-and-indigenous-peoples?download=417:unpfii-statement-on-agenda-item-2 (Accessed: 14 August 2012)..

the *UN Declaration on the Rights of Indigenous Peoples* (UN, 2007a) to recognise their collective rights 'as distinct peoples' (UNPFII, 2007a, p. 3). This meant, she argued, recognising that the tropical forests were 'the home of around 160 million indigenous persons who are custodians and managers of forest biodiversity' (UNPFII, 2007b, p. 1). It is, therefore, the indigenous peoples who should be considered the appropriate calculative agencies in any mechanism aimed at reducing deforestation.

> The reality is that most governments or corporations have not played positive roles in preserving these remaining tropical and sub-tropical forests. We, the indigenous peoples, are the ones who sacrificed life and limb to save these because these are vital for our survival as distinct peoples and cultures (UNPFII, 2007b, p. 2).

The World Bank did agree to hold consultations directly with representatives of indigenous peoples[7] but its own response to their concerns was that they should be raised 'within the Readiness Mechanism at a country level' (World Bank, 2008c, p. 5). For its part, the SBSTA modified their recommended text, which was subsequently adopted by the COP, to stipulate that 'the needs of local and indigenous communities should be addressed when action is taken to reduce emissions from deforestation' (UN, 2007b, p. 8).

Whilst the World Bank felt largely able to disregard the resistance of representatives of indigenous peoples, it did meet resistance from another

[7] Consultations with representatives of indigenous peoples were held in Nepal, Burundi, and Bolivia in February and March 2008 World Bank (2008a) *Forest Carbon Partnership Facility (FCPF): Consultations with forest-dependent indigenous peoples and other forest dwellers*. Available at: http://www.forestcarbonpartnership.org/fcp/sites/forestcarbonpartnership.org/files/FCPF_IP_Letter_English.pdf (Accessed: 28 August 2012).. Previously, a survey of indigenous peoples' views had been commissioned by the World Bank and conducted by the Forest Peoples' Programme FPP (2008) *Some views of indigenous peoples and forest-related organisations in the World Bank's 'Forest Carbon Partnership Facility' and proposals for a 'Global Forest Partnership': A global survey*. Available at: http://www.forestpeoples.org/documents/forest.../fcpf_ip_survey_feb08_eng.pdf (Accessed: 16 August 2012).. However, this was judged by the *International Institute for Environment and Development*, who had been contracted to conduct the World Bank's global external consultation on its plans, not to meet the Bank's own criteria for a 'genuine and meaningful' IIED (2008) *Towards a global forest partnership: consultation assessment and recommendations*. Available at: http://pubs.iied.org/pubs/pdfs/13551IIED.pdf (Accessed: 14 August 2012). consultation of indigenous peoples.

actor that it could not ignore. At a workshop held to discuss issues around calculating reference baselines and methods for measuring emissions, the World Bank reported some early observations from its experimental pilot projects. One such observation was that national governments were unable to 'identify remote sensing or forest inventory systems capable of estimating degradation' (World Bank, 2008b, p. 12). Forest degradation had been identified by the SBSTA in their initial deliberations as an important source of carbon emissions from tropical forests that would have to be included in any viable mechanism, and that the added complication of its inclusion would result in a need 'to further develop monitoring technologies' (UN, 2007c). GTOS, who had championed the remote sensing approach to measuring emissions, now set out some significant limitations.

> Mapping forest degradation with remote sensing data is more challenging than mapping deforestation because the degraded forest is a complex mix of different land cover types (vegetation, dead trees, soil, shade) and the spectral signature of the degradation changes quickly (GTOS, 2008, p. 29).

The participants at the workshop agreed that 'there is a need for further consideration of methodologies to estimate and monitor emissions and changes in carbon stocks from forest degradation' (UN, 2008e, p. 15). A subsequent workshop (UN, 2008c) specifically on forest degradation concluded that, given current technologies, carbon emissions from degradation 'cannot be captured by remote sensing alone' but that 'waiting for replacement by another promising technology will be a time-consuming process' (UN, 2008b, p. 1). The tropical forests themselves are thus seen to be resisting attempts to pacify their complex agencies (such as their behaviour in relation to degradation) to extract a calculable good from them. Neither the World Bank, nor the national governments have the necessary technologies to be able to establish the required connections with the forests to mobilise an accounting inscription that was capable of being combined with the carbon markets.

The attempt to translate the carbon market calculative devices to enable accounting for tropical forest carbon had reached an impasse. The urgency of the threat to tropical forests meant waiting for a new remote sensing technology to be developed and implemented was not a feasible option.

5.4.3. Alliances

At the urging of the *Coalition of Rainforest Nations* (UN, 2008g; UN, 2008d), three UN agencies – the *United Nations Environment Programme* (UNEP), the *United Nations Development Programme* (UNDP) and the *Food and Agriculture Organisation* (FAO) – launched a joint initiative called the *UN-REDD Programme*, where REDD stands for *Reducing Emissions from Deforestation and Forest Degradation,* to address the 'complexities that need to be tackled if countries' efforts to reduce deforestation and forest degradation are likely to be successful and if UNFCCC COP negotiators are to feel comfortable about including REDD in a post-2012 regime' (UN, 2008g, p. 5). The agencies comprising the Programme all had their own missions[8] and long histories of engaging with a diversity of actors in pursuit of those aims. As part of its activities for setting up the organisation of the programme, they held a *Global Indigenous Peoples Consultation,* which resulted in publication of the *Indigenous Peoples and Local Communities' Global Strategy on REDD* (UN, 2008a). The strategy recommends that international organisations involved in REDD recognise 'the close links between traditional knowledge, biodiversity and climate change, [and so] ensure close cooperation and more synergy between the CBD [Convention on Biological Diversity] and UNFCCC on traditional knowledge and climate

[8] UNEP works at 'enabling nations and peoples to improve their quality of life without compromising that of future generations' UN (2012a) *FAO's mandate*. Available at: http://www.fao.org/about/en/ (Accessed: 14 September 2012).. UNDP aims to work 'with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone' UN (2012b) *UNDP: A world of development experience*. Available at: http://www.undp.org/content/undp/en/home/operations/about_us.html (Accessed: 14 September 2012).. The FAO seeks to 'raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy' UN (2012a) *FAO's mandate*. Available at: http://www.fao.org/about/en/ (Accessed: 14 September 2012)..

change' (p. 7). The United Nations University had recently established its Traditional Knowledge Initiative to facilitate 'the development of the capacity of indigenous communities to conserve and apply their knowledge in an increasingly globalised economy' (UN, 2012d). Traditional Knowledge was defined as 'the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment … [and] encompasses all forms of knowledge – technologies, know-how skills, practices and beliefs – that enable the community to achieve stable livelihoods in their environment' (UN, 2012c). Indigenous peoples' cultures – forms of life borne of calculative technologies (material and conceptual)[9] that have been developed over generations of living and in their native environments – comprise calculative agencies that have long been thriving from their interactions with (their connections to) the forests.

The Chair of the UNPFII was made a full-voting member of the UN-REDD Programme's Policy Board. The Programme clearly recognised that indigenous peoples had unique and vital connections with the tropical forests. If the Programme wanted to connect those forests with carbon markets then it made sense to do so through its connections with indigenous peoples. In partnership with a prominent indigenous peoples NGO called *Tebtebba* (whose president was also Chair of the UNPFII), the Programme published a *Guide for Indigenous Peoples on REDD*, setting out the potential opportunities that could arise from such a mechanism.

> If instituted in a manner consistent with Indigenous interests, reduced deforestation could help to protect the biodiversity of plants and

[9] The properties and capabilities of indigenous peoples' calculative technologies, arising from intimate knowledge of their native environments, have been explored in Gallhofer, S., Gibson, K., Haslam, J., McNicholas, P. and Takiari, B. (2000) 'Developing environmental accounting: insights from indigenous cultures', *Accounting, auditing and accountability journal*, 13(3), pp. 381-409., Graham, C. (2009) 'Accounting and subalternity: enlarging a research space', ibid., 22, pp. 309-318., Jayasinghe, K. and Thomas, D. Ibid.'The preservation of indigenous accounting systems in a subaltern community', pp. 351-378., and Craig, R., Taonui, R. and Wild, S. (2012) 'The concept of taonga in Maori culture: insights for accounting', ibid., 25(6), pp. 1025-1047., as well as in Whiteman, G. and Cooper, W. (2000) 'Ecological embeddedness', *Academy of management journal*, 43(6), pp. 1265-1282.. It is not the purpose of this chapter to add to this particular exploration, but rather to examine the role these knowledges played in the struggles over the design and construction of a market seeking to extract tradable goods from this environment.

> animals, help to secure Indigenous lands and livelihoods, and provide for the ongoing culture and community of Indigenous and forest-dwelling peoples. (UN, 2009d, p. 31)

Speaking at the next COP, in Poland in December 2008, the UNPFII Chair asserted that 'undertaking reduced emissions from deforestation and forest degradation without the full and effective participation of indigenous peoples in making the design and in its implementation will lead to failure' (UNPFII, 2008, p. 1).

> Indigenous peoples will continue to oppose the REDD mechanisms if their rights are not recognised by States and the UN, including the UNFCCC and the World Bank' (UNPFII, 2008, p. 1).

It is, however, recognised that the 'climate change crisis, the economic downturn and the destruction of biodiversity and cultural diversity are serious threats to [indigenous peoples'] existence' (p. 2) and REDD may offer a way to mitigate these threats. If implemented correctly it could also represent 'an opportunity for indigenous peoples to further enhance their traditional knowledge on forest and biodiversity conservation' (UNPFII, 2008, p. 1).

> Indigenous peoples should be involved in the development of methodologies related to REDD. Their traditional knowledge on forests and biological diversity cannot be under-estimated. Measures should be undertaken to involve them in developing these methodologies and their capacities should also be enhanced (p. 1).

Lining up behind this position, the Secretariat to the *United Nations Convention on Biological Diversity* (UNCBD) submitted a written representation to the SBSTA, urging it to take seriously 'the broader context of the interrelationship between forests and indigenous peoples' (UNCBD, 2009, p. 1). The UNFCCC must, it is suggested, adopt the approach of the UNCBD, which 'views indigenous peoples and local communities as essential partners in achieving the goals of the Convention (p. 6).

> In addition to preventing deforestation on their lands and territories, indigenous peoples and local communities can also participate in project monitoring of forest degradation, the identification of key indicators and in verifying data collected by other means … Examples of successful approaches to involve local communities in carbon monitoring include training of holders of local traditional knowledge in the use of modern forest inventory methods, including GPS (p. 2).

At this point an alliance of actors had lined up behind a shared interest and shared position. The indigenous peoples (represented by the UNPFII), the UN agencies comprising the UN-REDD Programme, and the UN Convention on Biological Diversity, all had strong interests in a mechanism that could actually stem the loss of tropical forests, but also a strong belief that the only way to make it work was through the calculative agency of indigenous peoples. What was being proposed was a hybridisation of satellite technologies at the disposal of governments and intergovernmental organisations like the World Bank, with the Traditional Knowledge of indigenous peoples. Such hybrid monitoring could, it was proposed, provide the necessary connections with tropical forests to pacify the complexities of degradation and construct an inscription with properties that made it combinable with carbon markets[10]. However, it has also been made clear by this alliance that whilst the calculations constructing a "REDD" product would recognise and measure forests in terms of carbon, the use the inscriptions would need to serve broader interests than just enriching national governments. The market mechanism would have to be designed so as

[10] Despite protests from some NGOs that forest conservation was fundamentally incompatible with carbon accounting and capitalist market principles Dooley, K., Griffiths, T., Leake, H. and Ozinga, S. (2008) *Cutting corners: World Bank's forest and carbon fund fails forests and peoples*. Available at: http://www.forestpeoples.org/sites/fpp/files/publication/2010/08/cuttingcornersreddnov08eng.pdf (Accessed: 8 April 2013)., the UN-REDD Programme maintained that a long-term financing of such work would rely on achieving an adequate accounting: 'Buyers of reduced emissions – whether operating in compliance or voluntary environments – seek assurances that accounting is accurate & precise and can be verified as close to real time as possible. The strength of these assurances will influence the volume of the market, as well as the price that buyers … are going to be willing to pay' UN (2008f) *Role of satellite remote sensing in REDD*. Available at: http://www.unredd.net/index.php?option=com_docman&task=doc_download&gid=940&Itemid=53 (Accessed: 10 August 2012)..

perform the conservation and preservation of the biological diversity of the forests[11] and the cultural diversity of its indigenous peoples. The indigenous peoples were presenting themselves as guardians of this diversity[12] and their cooperation – a necessary requirement for construction of inscriptions combinable with carbon markets – was made contingent on agreeing a market design that safeguarded it.

5.4.4. Mobilisation (and Betrayal)

On 22 April 2009 there were two international gatherings taking place, discussing the issue of global climate change. In Anchorage, Alaska, the *Indigenous Peoples' Global Summit on Climate Change* was drafting its *Anchorage Declaration*, calling for 'an immediate end to the destruction and desecration of the elements of life' (IPGSCC, 2009, p. 1) and setting out their own 'vital role in defending and healing Mother Earth' (p. 1).

> We offer to share with humanity our Traditional Knowledge, innovations and practices relevant to climate change, provided our fundamental rights as intergenerational guardians of this knowledge are fully recognised and respected. (p. 4)

In New York, the UN General Assembly was voting to adopt a resolution to declare that day *International Mother Earth Day*, so acknowledging 'that the Earth and its ecosystems are our home' and recognising 'the interdependence that exists among human beings, other living species and the planet we all inhabit' (UN, 2009a, p. 1). The Assembly President drew an explicit link between the two meetings and declarations.

[11] Tropical forest ecosystems contain half of all species on Earth Lindsey, R. (2007) *NASA Earth Observatory: tropical deforestation*. Available at: http://earthobservatory.nasa.gov/Features/Deforestation/ (Accessed: 21 December 2011)..

[12] See also the Union of Concerned Scientists (2011) *The root of the problem: what's driving tropical deforestation today?* Available at: http://www.ucsusa.org/assets/documents/global_warming/UCS_RootoftheProblem_DriversofDeforestation_FullReport.pdf (Accessed: 23 October 2012). for an analysis of the roles indigenous peoples play in conserving tropical forests.

> Let us become good stewards again. Let us listen to the wisdom of indigenous peoples who, despite all odds, have sustained their profound links to nature. (UN, 2009b, p. 4)

At the next COP, in Copenhagen in 2009, the UNFCCC adopted text that recognised 'the need for full and effective engagement of indigenous peoples and local communities in, and the potential contribution of their knowledge to, monitoring and reporting activities' (UN, 2009c, p. 11). In addition to this acknowledgement of indigenous peoples' knowledge as a necessary technology for extracting the required accountings from the forests, the UNFCCC also sought to directly address the concerns indigenous peoples had raised regarding modelling forests simply as pools of carbon, by laying down a number of social and environmental safeguards that must be adhered to in activities to reduce tropical deforestation and forest degradation.

> Actions … are consistent with the conservation of natural forests and biological diversity, ensuring that actions … are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services … [and] taking into account the need for sustainable livelihoods of indigenous peoples and local communities and their interdependence on forests in most countries, reflected in the United Nations Declaration on the Rights of Indigenous Peoples and the International Mother Earth Day' (UN, 2009c, p. 3).

Thus the UNFCCC had moved to position indigenous peoples such that they were seen to speak for – to represent – the tropical forests in their dealings with the carbon markets. Indigenous peoples' knowledge would be a key calculative technology for extracting the required accounting inscriptions – the products – to be combined with the carbon markets, and the safeguards should ensure that indigenous peoples' interests, including the conservation of the forests as natural ecosystems, were protected. The UNFCCC had conceded that whilst commensuration was necessary for the combining of

inscriptions with the carbon markets it was not sufficient, in of itself, for the extraction and mobilisation of those inscriptions from the forests. An additional condition, that the activities undertaken to reduce forest emissions, and thus enable extraction of commensurable inscriptions, comply with specific safeguards to ensure ongoing protection of natural ecosystems and the forms of life of indigenous peoples. These safeguards were to form a mandatory element to be brought within all financial accounting calculations to extract tropical forest carbon offset products. Indeed, indigenous peoples were finally to be recognised, alongside national governments, as calculative agencies with power to shape the future of the tropical forest carbon market mechanisms. By enrolling indigenous peoples, the UNFCCC appeared to have successfully charted a way forwards for mobilising tropical forest carbon.

Unfortunately for all the actors in this case, the apparent success of potentially mobilising a supply of tropical forest carbon products was undermined by a collapse in the mobilisation of demand for them. The Copenhagen COP was meant to produce the post-2012 agreement that would replace the Kyoto Protocol and agree binding targets for industrialised countries that would ensure a continuing demand for carbon offsets into the future. In a well-documented chain of events (e.g. see Carter *et al.*, 2011) the Copenhagen talks dramatically failed to come to any such agreement[13]. A hastily arranged alternative text called '*The Copenhagen Accord'* asked countries to set their own voluntary targets (UN, 2009e). On the issue of tropical forest carbon, the Accord commits signatories to providing 'substantial finance to reduce emissions from deforestation and forest

[13] The UNFCCC began a new negotiating process called the Durban Platform UN (2011a) *Report of the conference of the parties on its seventeenth session, held in Durban from 28 November to 11 December 2011*. Available at: http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf (Accessed: 31 August 2012). to try to achieve a post-Kyoto agreement by 2015, to come into effect from 2020. At the COP where this was launched, the President of the UNFCCC told the Centre for International Forestry Research that the 'governments of the world are doing nothing less than writing a global business plan for the planet' and that tropical forest carbon was its 'spiritual core' CIFOR (2011) *Countries draft "global business plan" for planet at climate summit, Figueres says*. Available at: http://blog.cifor.org/5782/countries-draft-%E2%80%9Cglobal-business-plan%E2%80%9D-for-planet-at-climate-summit-figueres-says/ (Accessed: 15 August 2012)..

degradation' (p. 6) but makes clear that 'funding will come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance' (p. 7). Thus, not only was the world of demand a significantly smaller one than had been anticipated, but no agreement had been made to allow for the combination of the future supply of tropical forest carbon goods with the wider carbon trading markets. For the foreseeable future, tropical forest carbon projects would have to seek out *ad hoc* purchasers for their newly mobilised goods, such as on the voluntary carbon trading markets (see Cuckston, 2013).

5.5. Conclusion

The construction of markets in tropical forest carbon was an innovation that actors sought to use to mitigate climate change, to enrich and transform developing country economies towards sustainability, to conserve biological and cultural diversity, and to empower indigenous peoples. It has thus been seen that the struggles to define the purpose of market innovations are fought in terms of the framing of the calculative agencies of supply, and the recognition and measurement of the goods (the accounting inscriptions) to be traded. The outcomes of such struggles are determined by the formation of alliances that establish specific configurations of the actor-network. Such alliances must include the complex agencies that the market is seeking to pacify in its extraction of inscriptions to represent them. The enrolment of those complex agencies in the alliance is contingent upon the hybridising knowledges of the calculative agencies seeking to mobilise them. These knowledges, when embedded in the material assemblages comprising the market, will then be capable of extracting and mobilising goods that can be successfully combined with the worlds of those calculative agencies that constitute market demand. Thus the struggles over the objectives and ambitions of market innovations – of the transactions connecting disparate worlds of supply and demand – are fought on the basis of the performativity of financial accounting calculations.

Chapter 6.

Calculation and Emergent Computation in Markets and in Nature

6.1. Introduction

The main purpose of this chapter is to explore the third research sub-question identified in chapter 2: what kind of ontological relationship exists between financial accounting calculation and nature? The chapter will draw on the case studies presented in chapters 4 and 5 and on the principles of actor-network theory set out in chapter 3, to seek to describe a flat ontological landscape (Latour, 2005) upon which both financial accounting calculation and nature can be placed.

6.2. Markets as quasi-natural entities

Neoclassical economics can be seen to regard markets as being like natural entities, which can be analysed using the techniques of the physicist. Markets are considered to be extensions of the basic human desire to maximise personal utility. With each market agent acting independently, market behaviour can be analysed as the linear sum over all these individual actions. Thus, in exactly the same way that statistical mechanics can be used to sum over all the individual actions of particles of a gas to derive the laws of thermodynamics, so neoclassical economics sums over all the actions of individual agents to derive physics-like laws for the behaviour of the market as a whole. These laws, like the laws of thermodynamics, are based on equilibria between variables. The efficient markets hypothesis, for example stipulates that the price of equities will be the centre of the equilibrium between total supply and demand for those equities and thus will move rapidly to incorporate new information affecting supply and demand as

that information becomes available to all market agents (Fama, 1965). In the same way, then, that physics describes natural phenomena in terms of equilibria between variables, so neoclassical economics holds that market phenomena can be described using physics-like laws of equilibria between variables.

The conceptualisation that has emerged from chapters 4 and 5, of markets as being networks of *interacting* components implies that, rather than turning only to physics for insight into analysing the behaviour of markets, it might be fruitful to turn instead to biology. Biological systems are comprised of components that interact in heterogeneous, diverse ways. These components and the interactions change and evolve over time. One change by one component will, because of the web of interactions among components, change the environment in which other components are operating and so force them to adapt. The system is never truly in equilibrium because change is always occurring. The behaviour of the system as a whole cannot be determined by summing over the behaviours of the components because of the heterogeneous interactions between them, resulting in a non-linear relationship between component actions and system behaviour. The behaviour of the system emerges from the actions of the components.

6.3. The markets in tropical forest carbon as networks of interacting components

This sub-section will draw on the analysis of chapters 4 and 5 to explain how the experimental construction of markets in tropical forest carbon demonstrate that the ANT perspective is consistent with the conceptualisation of markets as networks of interacting components.

Both case studies of the markets in tropical forest carbon deployed a diversity of actors. Under ANT, an actor is ‘any thing that does modify a state of affairs by making a difference’ (Latour, 2005, p. 71). Thus the actors

deployed in describing and explaining the narratives included non-governmental organisations, intergovernmental organisations, national governments, the clean development mechanism, treaties and international agreements, satellite technologies, and tropical forest ecosystems. All these things were attributed agency by other actors to which they were connected. They are defined within the network in terms of their relations with – their connections to – other actors. As centres of calculation, actors draw in information from those connections, then manipulate and transform it, so to extract a new result. The heterogeneity of transformations of information performed by actors is a consequence of the diversity of their specific forms of life. The calculations that each actor performs in their interactions in the network are certainly "rational", but this is defined endogenously with respect to their form of life and not, as in the neoclassical conceptualisation of markets, as an *a priori* imposition of an external standard of rationality applied homogeneously to all actors.

Both case studies demonstrated change and evolution of the markets in tropical forest carbon over time. The mechanism for change is the innovations of market actors (and of actors whose innovations connect them to the markets for the first time). Actors' forms of life determine their objectives and the calculations they perform in their pursuit of these objectives. Innovations occur when actors "discover" new calculations in their pursuit of their objectives. Innovations, and the calculative actions that result from them, are historically contingent. For example, in chapter 4 Wildlife Works' objective was to preserve the biodiversity of the Kasigau Corridor ecosystem. It had been pursuing this through the activities of its ecoFactory, transforming labour and materials into clothing products to connect to demand for fashion in richer countries. Wildlife Works discovered the possibility of connecting its efforts to the voluntary carbon markets. This calculative innovation provided a new way for it to pursue its objectives, but it had been contingent on previous innovations, by many other actors, leading to the emergence of REDD as a UNFCCC agenda item and therefore a well-known and legitimate mechanism. Actors build upon the innovations of other

actors such that the sequence of change is chaotically unpredictable and fundamentally nonlinear. Markets are certainly constructed by actors, but that construction is not (and cannot be) accurately planned out *a priori* in advance and implemented by a centrally controlling actor. The construction is a haphazard collaboration by a network of actors with differing objectives and methods – differing forms of life – whose actions and innovations accumulate nonlinearly such that the market configuration evolves and develops over time. As seen in chapter 5, whilst actors such as the World Bank might seek to lead the process, they could not control the direction of change as alliances of actors formed around innovations that ran contrary to that attempted leadership. The organisation of the markets in tropical forest carbon depended on the actions and innovations of multiple diverse and distributed actors. This distributed process of change in markets is akin to the natural evolution of living systems. As such, the emergence of specific configurations is neither centrally controlled nor simply spontaneous. Specific configurations emerge over time from the distributed interactions of networks of actors.

Finally, both case studies highlighted that there existed significant conflicts and controversies amongst actors as to how specific configurations of actor-networks would result in different emergent behaviours of the markets. The actors apparently shared a desire for the markets to exhibit a behaviour of mitigating the loss of tropical forests, but there were strong disagreements – indeed, bitter struggles – over what configuration of market actors would successfully result in this behaviour emerging. It is the emergent character of market behaviour that means markets will always be experimental (Callon, 2009) in the sense that configurations must always be tested to determine their behaviours because it cannot be determined *a priori*.

Latour (2005) points to an apparent analogy between actor-networks and biological systems such as a colony of interacting ants, noting that 'the acronym A.N.T. was perfectly fit for a blind, myopic, workaholic, trail-sniffing, and collective traveller' (p. 9). The ANT perspective stands in contrast to the

neoclassical approach of analysing markets in the same way that physicists would analyse a gas, because 'the actor is not an atom' (Justesen and Mouritsen, 2011, p. 176) and cannot be treated as if it were. Instead, ANT leads to a view of markets comprised of simple components (relative to the whole system) interacting such that their individual actions accumulate in unpredictable ways, from which emerges particular forms of organisation and market behaviour. Having established this conceptualisation, what does this mean for the research question regarding the relationship between financial accounting calculation and nature? The key to answering this lies in the role of calculation in markets and in natural systems.

6.4. Economic markets as calculative collective devices

Callon and Muniesa (2005) seek to propose a theoretical framework that allows for the calculative character of markets.

> If markets calculate, it should be possible to identify the entity or entities effectively responsible for calculation, in order to answer the simple question: who (or what) actually calculates (and how) when we say that 'the market' calculates? (p.1229)

To address this, they formulate a general definition of calculation.

> First, in order to be calculated, the entities taken into account have to be detached. A finite number of entities are moved, arranged and ordered in a single space … Once they have thus been sorted out, the entities considered (taken 'into account') are associated with one another and subjected to manipulations and transformations … [then] a result has to be extracted … [that] has to be able to leave the calculative space and circulate elsewhere (p. 1231).

It is this broad definition of calculation that has been employed in the empirical investigations of financial accounting calculations in chapters 4 and 5. The new entity produced, as a result of financial accounting calculations,

was a tradable good, extracted from a world of supply and combined with a world of demand. Callon and Muniesa (2005), however, propose that there is 'a specific calculative dimension of markets that is distinct from the calculability of goods or the constitution of calculative agencies' (p. 1241). This, they say, is the microstructure, or algorithmic configurations, that regulate the encounters between calculative agencies and their exchanges of calculable goods.

> A market can be described (at least partially) as a collective device for the evaluation of goods. This calculation is possible only if goods can be calculated by calculative agencies whose encounters are organized and stabilized (p.1245).

Under Callon and Muniesa's (2005) conceptualisation of markets, then, there is actually no clear distinction drawn between the calculations of individual agencies and the calculations of a market as a whole system. The answer given to the question posed about what it means for a market to calculate is that the agencies calculate, utilising the formatting of the market's micro-architecture. This is why markets are described as being "devices" because they are effectively tools, or equipment, of the individual agencies. It is a well-established notion that calculation is distributed across a hybrid of a human actor and their equipment (Latour, 1987; MacKenzie, 2009b). Market calculation, then, according to (Callon and Muniesa, 2005) is distributed across a hybrid of a human agent and the algorithmic configurations that they utilise.

6.5. Calculation in natural systems

Having considered Callon and Muniesa's (2005) conceptualisation of market calculation, this subsection will now consider the role of calculation in biological systems. Living systems are routinely analysed as information processing networks (Mitchell, 2006), referred to as "complex systems" because their components interact with one another, causing complex

behaviours to emerge. Information processing, or computation, is 'what a complex system does with information in order to succeed or adapt in its environment' (Mitchell, 2009, p. 170). Computation in living systems is not sharply defined but does have some qualitative principles common to all natural information processing networks. A first principle concerns the role of information in the system. Information is 'encoded as statistics and dynamics of patterns over the system's components' (Mitchell, 2006, p. 1208). So the information is somehow distributed across the whole of the system. A consequence of this is a second qualitative principle that no one component of the system gets to see the whole of the state of the system. Rather, each component receives and communicates bits[14] of information via spatial and temporal sampling. A third qualitative principle is that there will always be random elements to individual component behaviours. Components will react to their own interactions with other components and with their environment in probabilistic ways based on their – relatively simple (compared to the system) – forms of life. This random element of behaviour allows room for innovation within the system.

It could be said, then, that this emergent computation is a property of the system that comes from the accumulation of many individual calculations of the system's components. Computation is decentralised and distributed across the whole system, with no central control. There is no component of the system "leading" the computation, or even able to perceive the computation.

Returning to the example of an ant colony, each component ant reacts to the pheromones of other ants it encounters and to things it encounters in its environment such as food or a perceived threat. No single ant is aware of the state of the whole colony and yet the colony as a whole system computes optimal arrangements of foraging trails and apportionment of tasks (Gordon, 1999). These are not calculations made by any controlling or central agency, but are emergent computations of the whole system that allow the colony to

[14] I use this term informally, rather than in its technical sense from digital computing.

thrive in its environment (Gordon, 2010). The activities of individual component ants fit quite well into Callon and Muniesa's (2005) general definition of calculation. An ant will take into its account a finite number of entities, including the types and concentrations of pheromones it has encountered, the number of fellow ants it has encountered recently and what they are doing, the types and sizes of any food sources it encounters, and many other factors such as temperature and light intensity at their location (Gordon, 2002). These entities will be arranged and sorted in the calculative space that is the ant's brain and subjected to specific manipulations and transformations according to a combination of instructions encoded in the ant's genetics and learned behaviour from its life in the colony so far. The extracted result is encoded in the chosen behaviour of the ant – the specific task it decides to perform. This will be determined probabilistically as a causal consequence of the calculation made. This behaviour then, of course, going forwards in time, exists independently of the calculation and becomes a new part of the information circulating within the network.

Emergent computation is by no means peculiar to ant colonies, but rather is a general feature of biological systems (Gell-Mann, 1994). Emergent computation is seen in mammalian immune systems to compute optimal strategies for neutralising invading pathogens (Ahmed and Hashish, 2006), in plant metabolic systems to compute optimal distributions of branches and leaves for sunlight absorption (Grimm *et al.*, 2005), and indeed in networks of neurons comprising animal brains (Singer, 2009).

Whereas the calculations of individual components are discrete events that occur at a particular point in time as a result of reaching thresholds of particular stimuli (Gordon, 2007), computation is a continuous, ongoing process. The calculations of components will change the environments of other components, thus affecting their calculations, and so on. So the whole system will be constantly undergoing fluid, dynamic changes in state. With individual components reacting to both external and endogenously generated stimuli, the system is able to adapt and evolve to changes in its environment.

Occasionally the system will stumble across a state that opens up new calculative opportunities for its components – new successful forms of life. An example might be an ant colony discovering a state where it builds nests in trees rather than on the ground. This discovery of new states – of new forms of life – is part of the mechanism for the evolution of natural systems through time (Gell-Mann, 1994).

6.6. Conclusion: Equivalence of Calculation/Computation in Natural and Market Systems

This thesis holds that two basic principles of actor-network theory demand an equivalence of analysis between markets and natural systems. The first of these is the principle of generalised symmetry.

> We know that the ingredients of controversies are a mixture of considerations concerning both Society and Nature. For this reason we require the observer to use a single repertoire when they are described (Callon, 1986, p. 200).

The second is the principle of free association.

> The observer must abandon all a priori distinctions between natural and social events. He must reject the hypothesis of a definite boundary which separates the two (Callon, 1986, p. 200).

Thus if we are prepared to speak of emergent computation in biological systems then we should be equally prepared to speak of it in market systems as well. If actors can be human or non-human (Latour, 2005) then surely actor-networks can comprise (i) all human actors, (ii) some human actors and some non-human actors, or indeed (iii) all non-human actors. Natural living systems can be conceived to be actor-networks with no human actors. The same analyses of these all non-human actor-networks – such as emergent computation – should be equally available to an observer of networks with humans in the mix.

What, then, might represent emergent computation in markets? The most obvious example is market prices. The calculations of individual market actors will each value particular goods based on their own sampling of available information and utilising their own material equipment and conceptual models (constituting their own "form of life" within the market). The activities of individual market actors (buy, sell, hold) will be extracted from each personal calculation. The market computation of market prices emerges from the dynamics of all these component calculative activities. It could be argued that the very existence of a market price, that all agents can see, means that each agent can see the state of the whole system. However, the market price is only one small aspect of the state of the market. Other aspects include price volatility, geographical spread of market actors and traded goods, exposures to systemic risks, and much more besides. Any omnipotent market actor who could see the state of the whole system would be able to make perfect rational calculations, but real market actors can only calculate based on the partial information available to them.

The idea of emergent computation in markets can be traced back to Adam Smith's (1776) *Wealth of Nations*, which proposed that a free market was a way of devising (computing) the most efficient allocation and use of resources to maximise the wealth of society as a whole (Beinhocker, 2007). This argument is often put forward – particularly from a neoclassical perspective – to argue in favour of market-based solutions to problems. More generally, though, market structures and patterns emerge from the aggregate behaviours of individual market participants. In turn, market participants react to these emergent structures and patterns. There is thus a continual feedback loop in markets that causes calculative activity to be constantly revised and reformed (Arthur, 2013). Just as in natural systems, then, the components of market systems are able to adapt their own forms of life to their own changing environments within it. The calculations and emergent computations of networks of interacting actors that form both natural and market systems may be analysed such that they are placed on a flat ontological landscape. The consequences of this kind of analysis for

understanding the relationship between financial accounting calculation and nature will be examined in Chapter 7.

Chapter 7.
Financial Accounting Calculation in relation to Nature

7.1. Addressing the Controversies in Accounting in relation to Nature

What has come out of the theoretical discussion in chapter 6 is that market computation is something that emerges from the aggregate calculative practices of the network of individual market actors. Chapters 4 and 5 described some of the characteristics of these financial accounting calculations which define the recognition and measurement of market transactions. Chapter 6 then explored the way that these feed into the development and evolution of the whole market computation, which in turn feed back into the financial accounting calculations of individual market actors. In this sense, then, financial accounting calculations are akin to the pheromone interactions of individual ants in a colony, or the firing of individual neurons in a brain. Financial accounting calculation is placed here on a flat ontological landscape with the individual calculative practices of the components of natural systems. The market computations that emerge from financial accounting calculations are akin to the emergent computations of nature in all its complex forms.

Having established this kind of relation between financial accounting calculation and nature, what can this contribute to the specific controversies set out in chapter 2? What, then, are the answers to the sub-questions these controversies have raised? Finally, what do these answers contribute to the main research question regarding the relationship between financial accounting calculation and nature?

7.2. Communication and Construction of Economic Reality

Controversies over different financial reporting treatments were seen to be struggles over competing economic visions for, in this case, emissions markets. This was grounded in a belief, common to all sides of the controversy, that financial reporting has a role in both communicating and simultaneously constructing economic reality. This controversy led to the specification of a research sub-question asking: how does financial accounting calculation communicate and/or construct the reality of humanity's economic relationship with nature? The conceptualisation described in chapter 6 holds that markets are constructed out of a myriad of financial accounting calculations of market actors. However, what is clear is that this relationship is not straightforward. It would not appear to be the case that reporting transactions in one particular way will cause the market to behave according to the corresponding economic vision behind that reporting treatment. Particular reporting treatments may well have an effect on market behaviour – on whole market computation – but this will be a nonlinear, complex, relationship.

Chapter 4 described some of the standards that formatted the calculations which objectified and singularised a calculable good in the voluntary carbon emissions trading markets. These standards can be seen to be both attempts at prescribing the best possible communication of an underlying economic reality and also a construction of a new economic reality by market actors, in that the standards enable the extraction of new kinds of calculable goods. These kinds of market structures – what Callon and Muniesa (2005) call algorithmic configurations – that format the calculations of market actors, are constructions of other market actors who are filling niches that open up within markets. Establishing oneself as a centre of calculation that provides the service of standardisation is a successful calculative strategy within a market. Such organising structures can therefore be said to emerge endogenously within the market as it evolves over time. An analogy could certainly be made with, say, an ant's nest. Many species of ants build

physical structures to house their colony. Nests may comprise chambers, passageways, and entrances that regulate the behaviours and interactions of individual ants. The nest has certainly been constructed by the ants, but not as a conscious planned decision to regulate the lives of the ants in the colony. Rather, the structure of the nest emerges from a large number of small innovations that give the colony some advantage in their environment. Each innovation changed the environment within which individual ants calculated and thus laid the groundwork for further innovation and change. The emergent computation view of markets holds the same idea. Market structures, such as the Voluntary Carbon Standard (VCS) and the Climate, Community and Biodiversity Alliance (CCBA) Standard seen in chapter four, are innovations built on the groundwork of previous innovations, such as the rules of the Clean Development Mechanism (CDM) and the syntheses of Intergovernmental Panel on Climate Change (IPCC). These standards continue to evolve. It was seen in chapter four that Wildlife Works were forced to develop their own written methodology for VCS accreditation of a tropical forest carbon project because they were the first such project in existence. This innovation developed the calculative structure of the voluntary carbon markets and, again, laid the groundwork for further calculative innovations and the emergence of further new calculative strategies within those markets.

In terms specifically of financial reporting treatments, it seems reasonable to consider financial reporting standards similarly (on the same ontological landscape) as those standards discussed in chapter 4. They are part of the market architecture that shapes and formats the financial accounting calculations of market participants – particularly, in the case of financial reporting standards, with respect to financial capital markets. Just as the VCS and CCBA standards define the recognition and measurement of a calculable good in the shape of an emissions offset credit derived from tropical forest carbon, so financial reporting standards define the recognition and measurement of calculable goods in the shape of company equity products derived from the financial performance and position of those

companies in their respective markets. This strongly implies that financial reporting treatments cannot be reasonably imposed upon equity markets as a way to bring about particular behaviours in companies with respect to the natural environment. Instead activists could, and do (e.g. all the NGOs and IGOs mentioned in chapter 5), focus their attentions on shaping the ontologically equivalent standards for shaping the goods traded in companies' direct interactions with the natural environment.

7.3. Markets

The second controversy was over the desirability or otherwise of using markets as a way to address environmental issues. The main criticism of using markets to try to solve problems like global climate change or tropical forest loss is that such approaches are grounded in oversimplified neoclassical economic thinking, and that bringing nature inside the economic sphere will not, by itself, solve the problem but will instead have destructive consequences. If markets are the problem, so the argument goes, then they cannot also be the answer. This led to the specification of a research sub-question: what is the role of financial accounting calculation in building markets for the purpose of addressing specific environmental problems? The conceptualisation of markets as being on a flat ontological landscape with natural systems allows for a different kind of perspective on this debate. Systems comprising networks of interacting actors can themselves interact with each other. A natural ecosystem is a network comprised of a diversity of interacting systems. A market can similarly be analysed as a system interacting with the ecosystems of the Earth. The question then becomes how to influence the individual financial accounting calculations of market actors such that the emergent interactions of the market system with natural ecosystems are not, in aggregate, destructive. Networks of natural systems of tremendous diversity have dynamically co-existed over hundreds of millions of years on Earth, so it does not seem reasonable to assume that a market system will somehow *always* be inherently destructive.

The recognition amongst the "international community" (UN, 1999) that global climate change represents an existential threat to humanity that needs to be addressed, and their acceptance that market-based mechanisms were the most feasible way to do this, opened up possibilities for many new successful calculative strategies for market actors. Because of the value now placed on carbon emissions offsets, calculable goods could be extracted from activities where they could not have been extracted before. The introduction of tropical forest carbon into negotiations over appropriate activities for extracting offset products led to the viability of the Wildlife Works activities to safeguard and conserve the tropical forest ecosystem of the Kasigau Corridor. Before this, no valuable (in a financial sense) good could be extracted from such activities. The only activity that generated valuable goods from interactions with the tropical forest ecosystem was clearing the land for agriculture. All market interactions with natural ecosystems involve the extraction of goods from the ecosystem, but the advantage of the tropical forest carbon market activities is that the ecosystem remains intact following the extraction. Indeed, the ecosystem is actively protected by the market activities. What is extracted is an accounting inscription effectively representing a derivative of the service, provided by the tropical forest ecosystem, of carbon sequestration and storage[15].

Tropical forest ecosystems are networks whose component trees and shrubs do calculate in the Callon and Muniesa (2005) sense of mobilising and transforming information and extracting a result – a result, in this case, encoded in growth patterns, seasonal activities, etc. The markets in tropical forest carbon – the mechanisms of Reducing Emissions from Deforestation and Forest Degradation (REDD) – can be seen as a way of connecting the networks of tropical forest ecosystems and of markets in a way that is conducive to the survival and continuing development of both. The

[15] Thinking about emissions credits as derivatives of ecosystems services could indeed solve the financial reporting problem from chapter 2, regarding the treatment of emissions credits, by allowing for them to be classified as financial instruments, so opening up the option of hedge accounting.

calculative practices/strategies of both trees and market actors could be made to operate in some hybrid – symbiotic – manner in which both thrive.

A great many species of ant have been found to have co-evolved with particular species of plants (Gordon, 2010). The plant species provides seemingly custom-made homes for colonies of a particular species of ant and, in return, the ant colony provides protection for the plant by attacking the plant's predators such as caterpillars or grazing mammals. Thus both ant and plant have evolved calculative strategies that depend upon, and operate in hybrid with, the other. They act in symbiosis with each other. It is this kind of relationship, between markets and tropical forest ecosystems, that REDD seeks to create. Chapter 5 describes the position of the representatives of forest-dwelling indigenous peoples who believed that they were best placed, as 'custodians and stewards of forests' (UNPFII, 2008, p. 1), to facilitate the emergence of this kind of relationship. Indeed, it was seen that it was only by aligning with the Traditional Knowledges of indigenous peoples that a sufficiently accurate accounting was able to be made with regard to forest degradation. The vision of the United Nations Permanent Forum on Indigenous Issues (UNPFII), and indeed of the UNFCCC text that, before negotiations collapsed at Copenhagen, referred to the principles of International Mother Earth Day, was of a symbiotic relationship in which markets, indigenous peoples, and tropical forest ecosystems could all operate symbiotically. That is, the emergent computations of these cultural and natural complex systems could co-evolve and thrive together into the future. The true controversy here, then, should not be about whether nature should be brought into markets. It should, rather, be about how the emergent computations of markets and of natural ecosystems can be made to co-evolve in a hybridising, symbiotic, relationship. This leads to consideration of the third identified controversy regarding accounting in relation to nature: the ontological mismatch between them.

7.4. Ontological Mismatch

The third controversy discussed in chapter 2 was the ontological mismatch between accounting and nature. This identified ontological mismatch led to the specification of a research sub-question: what kind of ontological relationship exists between financial accounting calculation and nature? Through the examinations in chapters 4 and 5 of the construction of markets in tropical forest carbon, the characteristics of financial accounting calculations in recognising and measuring transactions specifically meant to instigate a new non-destructive economic relationship with nature were traced. This led towards the discussion in chapter 6, conceptualising financial accounting calculation as existing on the same ontological landscape as the calculative practices of individual components of nature. The problem, then, in aligning financial accounting calculation and nature, is not in bringing together the boundaries that delineate both systems so as to introduce accountability, but rather in seeking to regulate the interactions along the diversity of boundaries between market and natural systems. As Callon (2009) and MacKenzie (2009a) have pointed out, the practical questions regarding how that can be done are the subject of ongoing experimental market constructions, such as witnessed in chapters 4 and 5.

Part of what this thesis seeks to provide is a kind of meta-theorisation called for by Spence *et al.* (2010) that can move ideas in environmental accounting and sustainability accounting 'beyond accountability' (p. 76). Placing financial accounting calculation and emergent market computation onto the same flat ontological landscape as calculation and emergent computation in nature presents an opportunity for this. Specifically, it offers a way of conceptualising a kind of pluralism. Pluralism in general seeks to recognise, equally, multiple perspectives on reality (Deegan and Unerman, 2011). Whereas agonistic pluralism highlights conflict between these perspectives, the construction of markets requires the emergence of (at least temporary) agreement between market actors such that the market can operate.

> A market that works correctly … is a market which welcome[s] and recognise[s] as one of its most central constituent elements all the

> actors who demand to be taken into account, including those who are considered as marginal or on the verge of exclusion, with their points of view, their matters of concern, their proposed tools, framings and models. It is this dynamic tension, in which constant unexpected concerns are expressed and ask to be heard and to be taken into consideration, that defines a 'good' market (Callon, 2009).

Chapter 5 provided an account of this dynamic tension in the construction of markets in tropical forest carbon. This account witnessed the confrontation of opposing theorisations regarding the role and purpose of such markets and the coming together of those theorisations to form agreement on a way forwards. Key actors in this negotiation were representatives of indigenous peoples and the tropical forest ecosystems themselves. Indeed, it was resistance to pacification on the part of those ecosystems that led to the need for negotiation over the methods of recognition and measurement of tropical forest carbon transactions, rather than an imposed accounting.

The very existence of tropical forest ecosystems is a result of the emergent computation of a network of forms of life that, using sunlight from the sky and water from the ground, extract and store carbon from the atmosphere. By constructing a market in tropical forest carbon, humanity is recognising and measuring the value of this ecosystem service in terms of its usefulness in tackling global climate change. By recognising the services of the tropical forest ecosystem, humanity is recognising the agency of the ecosystem in the same way that the agency of a firm providing a service would be recognised. In return for provision of this service, the tropical forest ecosystem gets protection from the threats to its existence (logging, clearance for agriculture) that it faced before such recognition. Tropical forest ecosystems – nature – has thus been given a voice in the organisation of markets and, indeed, in the organisation of the global economy.

Chapter 5 also demonstrated the inherent instability of the agreements of market actors underpinning the organisation of markets. The withdrawal of a market actor from this agreement was seen to cause the market to fail.

Although tropical forest carbon market construction is explicitly presented as a form of “sustainable development” (UN, 2013), this does not mean that particular configurations of the market can continue indefinitely. Rather, the relationship between humanity and nature is continually evolving. A sustainable relationship may be one in which the financial accounting calculations of humanity do not require the destruction of nature to recognise and measure value in it. If the emergent computations of markets and natural ecosystems can continue to co-exist and develop symbiotically for mutual benefit then this, surely, is as close as humanity will get to accounting for sustainability and to a pluralistic engagement with nature.

7.5. Thesis Conclusion

This thesis has sought to make a number of original empirical and theoretical contributions to knowledge with regards to the relationship between financial accounting calculation and nature.

The empirical contributions are evident in chapters 4 and 5. Although carbon emissions trading markets have been previously examined in the accounting literature, it is believed that this thesis comprises the first accounting research on the markets in tropical forest carbon. This new empirical material has offered opportunities to explore ideas from the application of actor-network theory to the construction of markets. One of these was the role of standards in the objectification and singularisation (Callon and Muniesa, 2005) of goods, particularly with respect to the tension between black-boxing (MacKenzie, 2009a) to make the good calculable and promoting the good as a distinctive and innovative new product. Another was the kinds of negotiations that take place over translation of calculative mechanisms/devices, particularly with respect to the role of natural non-human actors (Callon, 1986) as part of an alliance of resistance.

Following through from these empirical contributions, the thesis has sought to develop financial accounting theory by bringing together ideas from market

construction research and environmental accounting research. The construction of calculative devices in markets was linked to the performativity of financial accounting calculation that defines the recognition and measurement of market transactions. This conception of financial accounting calculation in markets was then linked to the idea of emergent computation in natural systems, to provide an alternative theoretical frame for the question of how markets calculate. This theoretical frame was then utilised to explicitly place the financial accounting calculations of market actors and the emergent computations of markets upon the same flat ontological landscape as the calculations of components of natural systems and the emergent computations of nature. The use of this ontological connection allowed for new conceptualisations of identified controversies regarding accounting in relation to nature. The tension between the communication and construction of reality by accounting was conceptualised in terms of endogenous calculative innovations that caused evolution of the emergent computations of the market system over time. The controversy over the desirability of bringing nature inside the sphere of economics and markets was reconceptualised as a question regarding the interaction of two networks, whose relationship was defined by the respective calculations of their components. The ontological equivalence provided a new way of conceptualising the notions of pluralism and sustainability in environmental accounting. The recognition of the agency of ecosystems, and the measurement of the value of the services they provide, offers a new form of pluralism of accountings. The vision of a relationship between the emergent computations of markets and nature, co-evolving in a mutually beneficial – symbiotic – dynamic, offers a new form of sustainability accounting. These contributions to accounting theory are each ultimately derived from a single conviction that humanity is one species among many. What is the relationship between financial accounting calculation and nature? This thesis finds that humanity's forms of life, reflected and created (at least in part) by our financial accounting calculations, exist as a component of the emergent computation of the whole of the natural world. Surely, then, within this global

actor-network we call home, we can configure our calculations so as to find peace with the rest of the diversity of nature.

People are part of nature, aren't they? (Hines, 1991b, p. 27)

Appendix: Documents used in the research

The following three tables set out the documents from which data was extracted for use in the research. There were two main datasets from which documents were extracted: these were the databases of the voluntary carbon market certification bodies (table 1) and the database of the UNFCCC (table 2). The documents from these two datasets frequently led the research to other documents that were of interest to the thesis. These additional documents are shown in table 3.

Table 1: Voluntary Carbon Market Certification Bodies (VCS and CCBA)

Year	Author (Organisation)	Title
2007	Wildlife Works	Wildlife Works EPZ: Community Evaluation
2008	CCBA	Climate, community and biodiversity project design standards
2011	Wildlife Works	The Kasigau Corridor REDD project phase II – the community ranches: project design document
2011	Wildlife Works	The Kasigau Corridor REDD project phase II – the community ranches: project implementation report
2011	Wildlife Works	The Kasigau Corridor REDD project phase II – the community ranches: project monitoring plan
2011	Wildlife Works	Project document (PD) for validation: the Kasigau Corridor REDD project phase II – the community ranches
2011	Wildlife Works	VCS monitoring report: the Kasigau Corridor project phase I – Rukinga Ranch

2012	Wildlife Works	The Kasigau Corridor REDD project phase I – the Rukinga Sanctuary: project implementation report: monitoring period 2.

Table 2: United Nations Framework Convention on Climate Change (UNFCCC)

Year	Author (Organisation)	Title
1998	UN	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2002	UN	Report of the conference of the parties on its seventh session, held in Marrakesh from 29 October to 10 November 2001: The Marrakesh Accords
2005	UN	Reducing emissions from deforestation in developing countries: approaches to stimulate action
2005	UN	Report of the conference of the parties on its eleventh session, held in Montreal from 28 November to 10 December 2005
2006	UN	Background paper for the workshop on reducing emissions from deforestation
2006	UN	Report on a workshop on reducing emissions from deforestation in developing countries
2006	UN	Scientific, socio-economic, technical and methodological issues related to deforestation in developing countries

2006	UN	Workshop on reducing emissions from deforestation in developing countries: list of participants
2007	UN	Report of the conference of the parties on its thirteenth session, held in Bali from 3 to 15 December 2007
2007	UN	Report on the second workshop on reducing emissions from deforestation in developing countries
2007	UN	Workshop on reducing emissions from deforestation in developing countries: list of participants
2007	World Bank	Financing reduced emissions from deforestation and degradation
2008	UN	Informal meeting of experts on methodological issues relating to reducing emissions from forest degradation in developing countries: 20-21 October 2008, Bonn, Germany
2008	UN	Informal meeting of experts on methodological issues relating to reducing emissions from forest degradation in developing countries: agenda
2008	UN	Report on the workshop on methodological issues relating to reducing emissions from deforestation and forest degradation in developing countries
2008	World Bank	REDD methods capacity requirements: early country observations from the Forest Carbon Partnership Facility (FCPF)
2009	UN	Methodological guidance for activities relating to reducing emissions from

		deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
2009	UN	Outcome of the work of the ad hoc working group on long-term cooperative action under the Convention
2009	UN	Outcome of the work of the ad hoc working group on long-term cooperative action under the Convention: draft decision -/CP.15
2009	UN	Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009: decisions adopted by the Conference of the Parties
2009	UN-CBD	Secretariat of the Convention on Biological Diversity: views on issues relating to indigenous peoples and local communities for the development and application of methodologies
2011	UN	Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011

Table 3: Miscellaneous

Year	Author (Organisation)	Title
1995	Computer Business Review	Cambridge Technology to acquire Axiom for $19m in shares

2004	Encyclopaedia of World Biography	Mike Korchinsky
2005	Papua New Guinea	Statement by Sir Michael T. Somare, GCMG Kst.J CH, Prime Minister of Papua New Guinea.
2006	Global Terrestrial Observation System	Reducing greenhouse emissions from deforestation in developing countries: considerations for monitoring and measuring
2006	Intergovernmental Panel on Climate Change	Guidelines for national greenhouse gas inventories
2007	FERN	EU Forest Watch: December 2007
2007	Forest Peoples' Programme	Seeing 'RED'? 'Avoided deforestatino' and the rights of Indigenous Peoples and local communities
2007	HCV Resource Network	What is the high conservation value approach?
2007	Intergovernmental Panel on Climate Change	Contribution of working group iii to the fourth assessment report of the intergovernmental panel on climate change
2007	UN	Declaration on the Rights of Indigenous Peoples
2007	UNPFII	Statement of Victoria Tauli-Corpuz, Chair of the UN Permanent Forum on Indigenous Issues on the occasion of the adoption of the UN Declaration on the Rights of Indigenous Peoples
2007	UNPFII	Statement on the announcement of the World Bank Forest Carbon Partnership Facility

2007	World Bank	The Forest Carbon Partnership Facility: The Readiness Mechanism
2008	Forest Peoples' Programme	Cutting corners: World Bank's forest and carbon fund fails forests and peoples
2008	Forest Peoples' Programme	Some views of indigenous peoples and forest-related organisations in the World Bank's 'Forest Carbon Partnership Facility' and proposals for a 'Global Forest Partnership': a global survey
2008	Global Terrestrial Observation System	Reducing greenhouse gas emissions from deforestation in developing countries: a sourcebook of methods and procedures for monitoring, measuring and reporting
2008	International Institute for Environment and Development	Towards a global forest partnership: consultation assessment and recommendations
2008	UN	REDD letter day for forests: UN and Norway unite to combat climate change from deforestation
2008	UNPFII	Statement of the United Nations Permanent Forum on Indigenous Issues (UNPFII)
2008	UN-REDD	Role of satellite remote sensing in REDD
2008	UN-REDD	UN Collaborative programme on reducing emissions from deforestation and forest degradation in developing countries (UN-REDD): framework document
2008	UNU-TKI	Global indigenous peoples consultation on reducing emissions from deforestation and forest degradation (REDD): Summary report

2008	World Bank	Forest Carbon Partnership Facility (FCPF): Consultations with forest-dependent indigenous peoples and other forest dwellers
2008	World Bank	Summary of comments from regional consultations with forest-dependent indigenous peoples and other forest dwellers in Africa, Asia and Latin America
2009	Indigenous Peoples' Global Summit on Climate Change	The Anchorage Declaration
2009	UN	General Assembly, sixty-third session, 80th plenary meeting
2009	World Bank	Forest carbon partnership facility: demonstrating activities that reduce emissions from deforestation and forest degradation
2010	Wildlife Works	Kasigau Corridor, Kenya: an African REDD project
2010	Wildlife Works	Why REDD?
2010	Wildlife Works	Wildlife Works Blog: October 2010
2010	World Bank	Convenient solutions to an inconvenient truth: ecosystem-based approaches to climate change
2011	CIFOR	Countries draft "global business plan" for planet at climate summit, Figueres says
2011	Ecosystem Marketplace	Back to the future: state of the voluntary carbon markets
2011	Ecosystem Marketplace	State of forest carbon markets
2011	Nedbank	Good, clean carbon credits

2011	Nedbank	Nedbank helps Gucci, PUMA and other luxury brands achieve carbon neutrality
2011	Reuters	Kenyan project issues first REDD credits
2011	Union of Concerned Scientists	The root of the problem: what's driving tropical deforestation today?
2011	UN-REDD	UN-REDD Programme: supporting countries to get ready fro REDD+
2011	World Bank	State and trends of the carbon market
2012	Allianz	Code REDD for environmental protection
2012	FAO	FAO's mandate
2012	Forest Peoples' Programme	About Forest Peoples' Programme
2012	Global Carbon Exchange	Green dollars pour into Africa on back of pioneering carbon offset deal
2012	Nedbank	As Africa's first carbon neutral bank, we've learnt that little changes can make a big difference
2012	Nedbank	Nedbank green affinity
2012	Nedbank	Nedbank green leadership: displaying Nedbank's commitment to all things green
2012	UNDP	UNDP: A world of development experience
2012	UNEP	United Nations Environment Programme: what is indigenous knowledge?
2012	UNU-TKI	Traditional Knowledge Initiative
2012	Wildlife Works	Wildlife Works: shop collection
2012	World Bank	Benefit sharing schemes: a Kenyan perspective
2012	World Bank	The World Bank: history
2012	World Bank	The World Bank: knowledge
2012	World Bank	World Databank

2013	FERN	EU ETS myth busting: why it can't be reformed and shouldn't be replicated
2013	UNPFII	History of indigenous peoples and the international system
2013	UN-REDD	REDD+ and the green economy

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