

## Chapter 4: Critical Review of Related Literature

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Through the chapter, I seek to examine the existing literature on carbon trading and forest management, focusing on their conceptual frameworks and the challenges faced within the carbon trading business. The chapter presents a review of key theories and models underpinning both carbon trading and forest management. It further investigates the obstacles encountered in the operation of carbon trading enterprises. Additionally, the chapter highlights perspectives from various scholars on achieving sustainability in carbon trading and forest management.

The carbon trade originated with the 1997 Kyoto Protocol. It was meant and to reduce overall carbon dioxide emissions to 5% below 1990 levels between 2008 and 2012. The Brundtland Report of 1987 triggered carbon trading. The report posited “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). It was adopted in Kyoto, Japan, on 11 December 1997. It came into force in 2005. It commits State Parties to reduce greenhouse gases emissions, based on the premise that:

- (a) Global warming exists and
- (b) Man-made CO<sub>2</sub> emissions have caused it.

Currently there are 192 parties belonging to the protocol, responsible for about 60% of GHG emissions. The objectives behind the concept of carbon trading were:

- The reduction of carbon emissions.
- A better environmental situation and to mitigate global warming.
- Provide a financial incentive for companies to pollute less.
- Promotion of sustainable production processes and also sustainable lifestyles across the Globe.

Carbon trading, sometimes called “emissions trading”, is a market-based tool to limit the release of greenhouse gases (GHG) in the atmosphere which are believed to be the significant driver of observed climate change (Chemuliti, 2012; Martinello, 2015).

Carbon markets are markets in which buyers and sellers trade in ‘carbon offsets’ or ‘carbon credits’. A “carbon credit” is a unit of carbon emissions reduced at source (for example, by reducing consumption of fossil fuels) or a unit of carbon dioxide that have been absorbed by forests from the atmosphere (Chemuliti, 2012). There are two types of carbon markets, namely, (i) regulatory compliance market and (ii) voluntary markets. The regulated market is used by companies and governments that by law have to account for their GHG emissions. It is regulated by mandatory national, regional or international carbon reduction regimes. Voluntary markets represent voluntary attempts by individuals and organisations to reduce their carbon emissions (Bayon *et al.*, 2007; Fairhead *et al.*, 2012).

A carbon market is initially established by setting a cap on allowable greenhouse gas emissions, with that cap declining as the years go on to gradually meet greenhouse gas emissions reduction goals. The government creates emissions allowances (also called emissions credits), measured in units of greenhouse gases per year, and issues enough of these credits to add up to the cap on allowable emissions (Büscher, 2013). Carbon markets operate under the assumption that by gradually limiting the amount of emissions credits available, the market can lower greenhouse gas emissions overall. Covered entities (for example, power plants, companies, or other polluting entities, depending on the specific market and its confines) can buy and sell emissions credits as necessary, creating a financial incentive for them to pollute less and a financial burden for them if they pollute more. Some carbon markets can also function as revenue generators for the governments that run them from the buying and selling of emissions credits. This revenue can be invested

in projects that support climate change adaptation and mitigation (Sheats, 2017).

Carbon Emission Trading Schemes (ETS) aim at realizing emission reduction targets proposed in the 1997 Kyoto Protocol (Huber, 2013). ETS were also proposed to counter climate issues raised during the 2015 Paris Climate Summit and 2016 Marrakech Climate Summit. Countries or enterprises use ETS as a platform to sell redundant allowances or buy deficient ones to fulfil their carbon reduction duty. According to the polluter-pays principle, under an ETS, emitters must incur external costs that negatively affect others (Diaz, Hamilton and Johnson, 2011). Numerous countries and regions have employed ETS to mitigate climate change, including the European Union (European Union Emission Trading Scheme [EU ETS]), the United States (Regional Greenhouse Gas Initiative [RGGI]), China, Korea, and Japan. A complete ETS comprises mechanisms such as cap determination and market trading. However, owing to the lack of experience and macro-economic environment changes, the carbon market faced low carbon prices, allowance oversupply, and low marketization (Newell, Pizer and Raimi, 2013).

In cap-and-trade schemes such as KP or CCA, pre-compliance carbon “credits” can be generated from activities that reduce CO<sub>2</sub> emission or enhance carbon sequestration. Credits for reduced emissions or enhanced sequestration can be sold to partners wishing to offset their own emissions and to avoid topping the mandatory emission caps (Low and Lin 2015; Hamrick and Goldstein, 2016). One offset credit corresponds to an emission reduction of 1 Mg of CO<sub>2</sub> equivalent (Ximenes *et al.*, 2012).

On top or in the absence of binding government agreements (“compliance markets”), individual entities can commit to generate additional voluntary credits and sell them on a free (“over the counter”) or regulated market, e.g., the InterContinental Exchange. Such voluntary market of carbon credits has grown to a cumulated volume of 990 Tg

CO<sub>2</sub>e in emission reductions, worth US\$ 4.6 billion as of 2015 (Hamrick and Goldstein 2016).

Three types of forestry activities may generate carbon credits: (a) afforestation on non-forested lands or reforestation, where carbon is sequestered and offsets are generated through the creation or reestablishment of forest land use; (b) avoiding emissions from deforestation and degradation, i.e., retaining forest as forest; and (c) improved forest management (IFM), i.e., forest management that increases the carbon stocked in the forest (by better logging practices, longer rotation, or other means) and/or in wood products (by producing more durable assortments), relative to business as usual (Alberdi *et al.*, 2016).

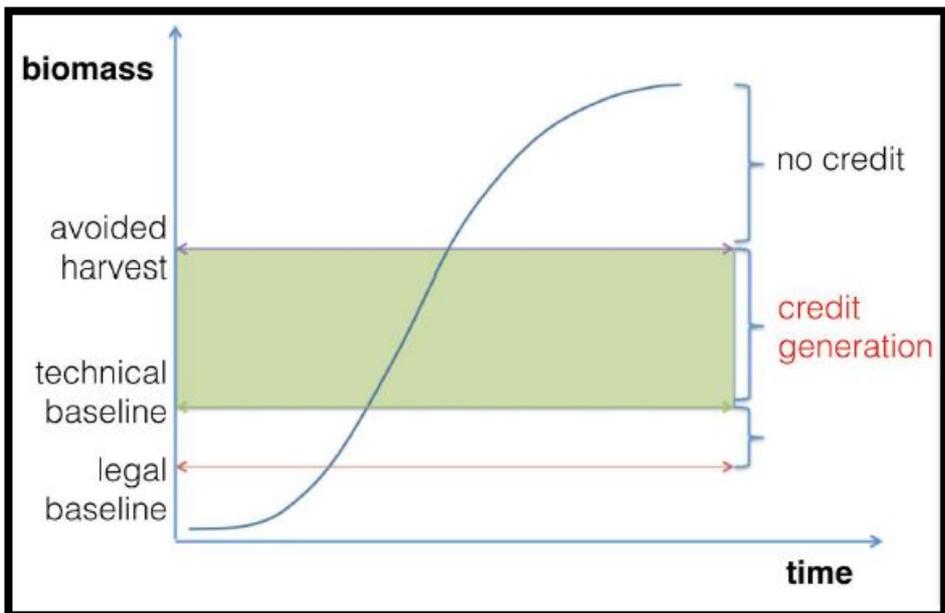
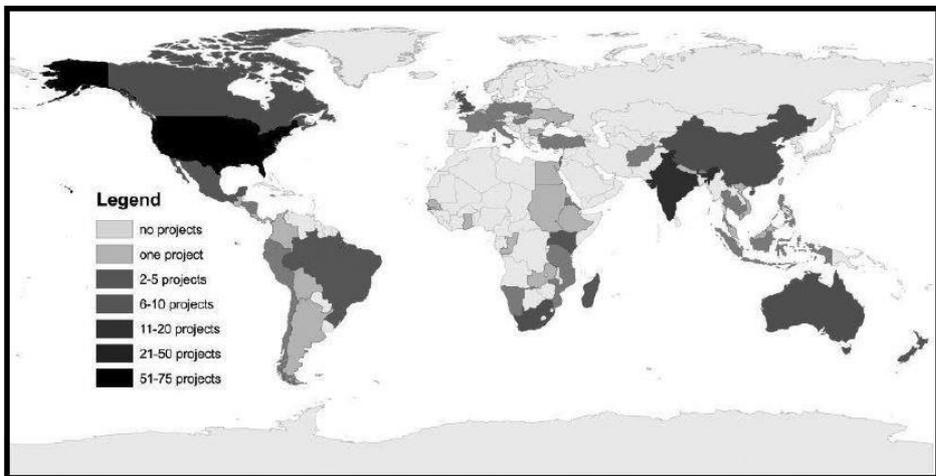


Figure 4.1: The generation of carbon credits (Alberdi *et al.*, 2016).

IFM credits are the most promising for the regional forestry sector, because they can provide income to public and private forest owners, and increase the economic interest in carrying out sustainable forest

management activities (Sartor, Palliere and Lecourt, 2014; Low and Lin, 2015).

Carbon offsets provide the basis for two of the Kyoto Protocol's primary mechanisms for reducing GHG emissions in the context of an international environmental agreement. Under Joint Implementation (JI), industrialised nations can purchase carbon credits (effectively offsets) from emission-reducing projects located in other industrialised nations or nations with transition economies (Conte and Kotchen, 2010). Under the Clean Development Mechanism (CDM), industrialised countries can purchase offsets in much the same way, though CDM credits are acquired through the finance of projects in developing nations.



*Figure 4.2:* Global distribution of carbon trading projects (Schroeder and McDermott, 2014).

Offsets are based on the idea that agents need not reduce their own emissions to reduce the amount of GHGs in the atmosphere; instead, they can pay someone else to reduce emissions and achieve the same effect on atmospheric concentrations (Conte and Kotchen, 2010). Agents prefer offsets, of course, if the payment required is less than their own abatement costs. Though often controversial for reasons that have been

discuss below, offsets work in principle because GHGs are uniformly mixed pollutants in the global atmosphere, and the location of emissions (or reductions) has no effect on the impact of climate change (Bondevik, 2013).

Only the net effect on overall GHG emissions is what matters. Typically, offsets arise through investments in renewable energy, energy efficiency, reforestation, or other projects that reduce emissions or sequester GHGs. Though usually referred to as “carbon offsets”, many projects focus on other GHGs, such as projects based on biomass and industrial methane capture, and emission reductions are measured in carbon dioxide equivalent units (CO<sub>2</sub>e) (Conte and Kotchen, 2010; Bondevik, 2013; Dibley and Wilder, 2016). Carbon offsets provide the basis for two of the Kyoto Protocol’s primary mechanisms for reducing GHG emissions in the context of an international environmental agreement (Jonsson, Mbongo and Felton, 2012). Under Joint Implementation (JI), industrialised nations can purchase carbon credits (effectively offsets) from emission-reducing projects located in other industrialised nations or nations with transition economies.

Under the Clean Development Mechanism (CDM), industrialised countries can purchase offsets in much the same way, though CDM credits are acquired through the finance of projects in developing nations (Fairhead, Leach and Scoones, 2012). Questions about offsets are also playing a pivotal role in determining the future of emission regulation in the United States. Recent drafts of such legislation, for example, allow businesses to offset up to 30% or 63% of their emissions (Jonsson *et al.*, 2012).

Many ostensibly transformative solutions to climate change and environmental degradation are associated with strategies that simultaneously involve privatisation and the direct or indirect valuation of natural capital and the characteristics and functions of ecological

systems. Fundamentally this is meant to bring the natural environment into line with the logic of the global economic system (Huff and Tonui, 2017). These concepts and mechanisms are based in the paradigm of market environmentalism, a mode of resource regulation that promises market-based solutions for addressing both economic and environmental problems (Huff and Tonui, 2017).

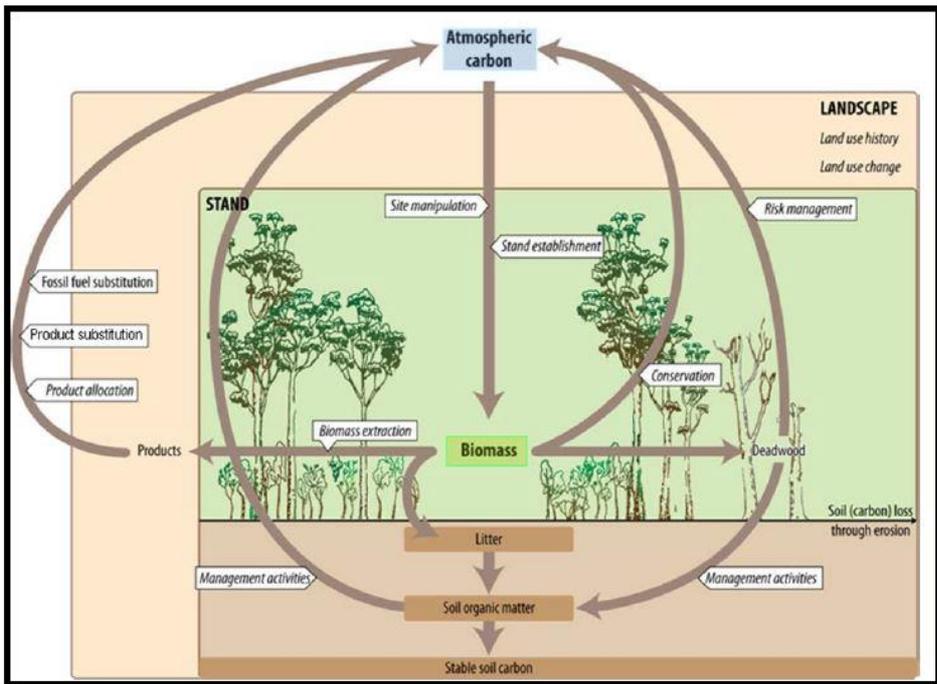
In this framing, without private property rights and monetary valuation, resource users have neither the incentive nor the value information available to appropriately weigh the trade-offs of resource use (Blasch and Farsi, 2012; Parenteau and Cao, 2016). This makes natural resources and ecosystems vulnerable to pollution and degradation through over-exploitation. Coupled governance and market failures are thus conceptualised as the primary cause of environmental problems, and corrective market techniques and governance transformations, brought about through new transformative multi-stakeholder alliances, as their potential solution (Death 2014; Koch, 2014; Lyons, Westoby and Nel, 2017).

Chang (2015) evaluates different types of carbon emissions reduction policy and concludes that a cap-and-trade mechanism can decrease CO<sub>2</sub> emissions more effectively and at a lower compliance cost than a carbon tax or setting industry standards. A carbon tax imposes a fixed price on carbon emissions for certain sources that allows companies to project the marginal cost of compliance and eliminates fears of carbon price volatility. While a carbon tax provides more certainty for compliance costs, the policy's environmental goals can be easily compromised compared to that of cap-and-trade policy. The actual quantity of emissions reduced by a tax is unknown until the tax has been implemented for some time (Chang, 2015; Fairhead *et al.*, 2012; Martinello, 2015).

Literature has also emerged outlining local level impacts of the expanding carbon economy, including injustice related to land tenure and access rights, and local natural resource rights, with indigenous and local communities especially impacted (Lyons and Westoby 2014; Mbatu 2016; Okereke and Dooley 2010; Schroeder and McDermott 2014; Suissey and Caplow 2013). Literature also identifies the erosion of biodiversity, the militarization of conservation and associated violence by the state (Benjaminsen and Bryceson 2012; Bottazzi *et al.*, 2013; Büscher 2013; Cavanagh *et al.*, 2015; Fairhead *et al.*, 2012; German *et al.*, 2014; Martinello 2015; White *et al.*, 2012).

The design of climate-change policy involves underappreciated ethical dimensions. Greenhouse gas emissions might be reduced by several main approaches, each of which raise different considerations of ethics and justice (Caney and Hepburn, 2011). For instance, governments might provide information about the science and economics of climate change, price greenhouse gas emissions through a 'carbon tax', subsidise clean technology, establish a 'cap-and-trade scheme' in which a limit is placed on total emissions which declines over time and/or implement 'command-and-control' regulation requiring firms and individuals to take certain action, such as using specific cleaner technologies (Okereke and Dooley, 2010).

These approaches have various levels of effectiveness (that is, of successfully reducing emissions) and of efficiency (in terms of reducing emissions at least cost). They also have distributional implications (in that there can inevitably be losers and winners). Implementing climate-change policies is also likely to, and indeed need to, change relationships with the natural environment (Caney and Hepburn, 2011). Only activities that count towards emissions target under the Kyoto Protocol can be used to offset emissions of a business with a liability under the Clean Energy Act 2011 (Ximenes *et al.*, 2012).



**Figure 4.3:** The production and use of carbon in the ecosystem (Ximenes *et al.*, 2012).

Zhang, Liu and Su (2017) compared the mechanisms of ETS in the European Union with those in China and indicated similarities in cap determination, the coverage and calculation method of allowance allocation, trading participants and allowance category, offset credit, and MRV. On the other hand, the allocation method and supervision of allowance allocation, allowance formats and trading methods, market risk management, market linkage mechanism, and legislation security evidently appeared to vary (Zhang, Liu and Su, 2017). However, the results were unable to identify which ETS is absolutely good or bad due to the political, economic, and institutional contexts and the varying developmental phases (Zhang, Liu and Su, 2017; Ximenes *et al.*, 2012).

Too little attention is given to the multiple functions that are potentially or effectively fulfilled by community-based resource systems, and to

how local institutions regulate trade-offs between the related outcomes (Cavanagh, Vedeld and Traedal, 2015). Carbon sequestration projects that focus on forested areas often overlook local stakeholders' interactions with adjacent pastoral and agricultural areas. In classical REDD+ policy assessments, opportunity cost baselines are defined based on annual returns per hectare derived from regional or national secondary data that are then compared to carbon market offset prices (Bottazzi *et al.*, 2016; Cavanagh *et al.*, 2015). There is very little empirical knowledge about how local stakeholders actually depend on forests and agriculture for their livelihood and how this translates to reliable carbon emission estimates.

Indigenous peoples in Africa are disproportionately impacted by climate change due to their vulnerability that stems from their total dependence on the environments in which they live. Indigenous people are among "the first to face the direct consequences of but the least able to respond to climate change." Numerous writers have highlighted the potential negative impacts of carbon credit schemes on indigenous peoples' rights to their lands and resources (Lyons and Westoby, 2014; German, Mandondo, Paumgarten and Mwitwa, 2014). These negative impacts are the consequence of designing climate change policy responses without incorporating a human rights dimension (Olson, Mahdi, Al-Kaisi and Lowery, 2013).

These projects harness the carbon market to compensate developed countries' excess carbon emissions with tree plantations in developing countries. The projects' contribution to mitigating climate change seems very modest, and they have been criticized for promoting large monoculture tree plantations (Kill *et al.*, 2010), and involving problems of additionality, leakage and permanence (Plantinga and Richards, 2008). The other prominent approach is payments for ecosystem services (PES) that are payments to communities, individuals, or governments for safeguarding and maintaining ecosystem services like clean water (Sena, 2015). They are considered beneficial for the involved partners

(Tacconi *et al.*, 2009) but unlikely to replace other conservation instruments (Olson *et al.*, 2013). They must be carefully designed to avoid focusing excessively on one resource (e.g. water) or reproducing and even strengthening power asymmetries and social inequalities (Hufty and Haakenstad, 2011; Büscher, 2013).

Despite the theoretical potential for carbon markets to work, carbon markets worldwide and in the U.S. have largely failed to reduce greenhouse gas emissions and, in some cases, have also failed to bring in revenue, among other problems. Governments determine how many emissions credits are made available in a carbon market, and setting this number is critical. If there are too many emissions credits available, covered entities have less incentive to reduce emissions because the credits are so easy to attain. Alternatively, if there are too few emissions credits available, covered entities are forced to adapt their operations and technologies to less emissions which can be expensive and can sharply increase prices for consumers.

The price of emissions credits follows the principle of supply and demand: the more credits, the lower the price; the fewer credits, the higher the price. Most governments have erred on the side of having too many credits available on the market to effectively reduce emissions, and they have often given these credits to polluters for free. In Europe's case, prices dropped as low as .1 euros per ton in 2007, rose for several years, and then dropped back down to under four euros per ton in both 2013 and 2016. Such low prices render a carbon market essentially useless at incentivising emissions reductions (White *et al.*, 2012).

Problems can also arise during the process of distributing emissions credits at the outset of the market. Some markets have used auctions, where covered entities purchase their initial share of credits. On-going auctions allow for covered entities to buy and sell additional credits. However, in most cases, the carbon market's governing body has determined a fair share of credits for each entity and given some at no

cost at all. This method of distribution removes the incentive to reduce emissions since the credits to pollute are free (McAfee, 2012).

Vacchiano *et al.* (2018) illustrate the steps taken to design guidelines for the generation of voluntary carbon credits by improved forest management in Piemonte, Italy. They show how to compute the baseline and the additionality of credit-generating forest management activities, and how to reconcile the generation of forest carbon credits with law requirements, technical limitations, and the provision of other ecosystem services (Vacchiano *et al.*, 2018). Their model resulted in an avoided harvest of 39,362 m<sup>3</sup> for a net total of 64,014 MgCO<sub>2</sub>e after subtracting harvest emissions, or 38 Mg ha<sup>-1</sup> throughout the permanence period of 20 years and they suggest that these steps can be replicated in other mountain regions where there is interest in promoting this ecosystem service as an alternative or an addition to production-oriented forest management (Vacchiano *et al.*, 2018).

Literature points to the failing of carbon markets, including REDD and REDD-type projects in particular, and highlighting the urgent need to address the social (and ecological) justice gaps in global carbon market and forest governance. Watson, Mourato and Milner-Gulland (2013) focused on emission reductions from forest conservation (REDD) in the Bale Mountains, Ethiopia and suggested that the environmental integrity of a mechanism rewarding Reduced Emissions from Deforestation and Degradation (REDD) depends on appropriate accounting for emission reductions. Their study used primary data estimate area-weighted mean forest carbon stock of 195 tC/ha ± 81, and biome-averaged data reported by the Intergovernmental Panel on Climate Change underestimate forest carbon stock in the Bale Mountains by as much as 63% in moist forest and 58% in dry forest (Watson *et al.*, 2013).

Largely stemming from a lack of forest data in developing countries, emission reductions accounting contains substantial uncertainty as a result of forest carbon stock estimates, where the application of biome-

averaged data over large forest areas is commonplace (Watson *et al.*, 2013). Watson *et al.* (2013) argue that a Reduced Emissions from Deforestation and Degradation (REDD) mechanism can help address market failure by financially rewarding greenhouse gas (GHG) emission reductions from conservation, sustainable management, and forest enhancement activities. Watson *et al.* (2013) suggest that by using REDD, potential revenues over the 20-year project ranged between US\$9 million and US\$185 million and make the conclusion that strong financial incentives exist to improve forest carbon stock estimates in tropical forests, and the environmental integrity of REDD projects.

Ximenes *et al.* (2012) argue that current policy prescriptions support conversion of production forests to conservation forests, provide disincentives for use of native forest residues for energy and discourage the establishment of production focused plantations. Action to reduce logging in forests, with the objective of increased carbon storage, could have perverse global GHG outcomes (Ximenes *et al.*, 2012). Converting multiple use production forests to conservation forests will reduce access to wood and may lead to increased harvesting in other countries where forests are not managed sustainably, with resultant deforestation or forest degradation in those countries. Harvesting of these forests can lead to significant GHG emissions, an example of 'leakage' (Huber, 2013).

Several funding models have been proposed (Karsenty, 2008), including a specialised public fund (Brazil's proposal in 2006, also discussed by the Stern Review) (Benjaminsen and Bryceson, 2012) and a private, carbon market-based approach (ICF International, 2009; Loisel, 2008). A third option is to include both public and private funds in a hybrid or "basket" approach (Mbatu, 2016). Other concerns have involved prospects for long-term funding, phases of implementation, distribution and safeguards, and sensibility to carbon market variations (Brown *et al.*, 2009; Minang and Murphy, 2010). Under the current negotiations, it appears that the framework would use a hybrid approach, with

capacity-building funds available for start-up and financial links with the carbon market for scale-up (Sheats, 2017).

Governance must include the design of the mechanism at all levels, norms-setting procedures, related legal and informal institutional arrangements, and interactions between involved state and non-state actors. Additionally, governance encompasses horizontal (within a given level of government) and vertical (across levels of government) links with other issue areas (e.g. biodiversity, finance, trade, etc.), existing policies and institutions at the international, national, or local levels (Forsyth, 2009; Minang and Murphy, 2010; Suiseeya and Caplow, 2013). In general, governance of forests is notoriously bad (Benjaminsen and Bryceson, 2012). During the last 10 years, efforts to slow deforestation rates globally have had little success (Pfaff *et al.*, 2004). Estimates contend that deforestation rates will continue in all geographic areas (Bryceson, 2012).

Manley and Maclaren (2012) carried out research to evaluate the potential impact of the Emissions Trading System (ETS) on forest management decisions. This included an evaluation on whether to erect new forests, the choice of species and forest rotation period. Their findings were that carbon trading has the potential to improve forest profitability and influence the choice of silviculture. In addition, the results showed that forest rotation length increases with expected carbon price. However, they noted that there is substantial risk arising from carbon prices. Consequently, they recommended strategies that hedge against carbon price risk at both the stand level and the forest estate level. At the stand level, the strategy is to grow a valuable crop and trade only a portion of units received whereas at the forest level the strategy is to manage forest structure through age-class composition and mix.

Robinson *et al.* (2007) researched on the environmental effects of increased atmospheric carbon dioxide. The authors reviewed research

literature pertaining to the environmental consequences of increased levels of carbon dioxide in the atmosphere. The research sought to establish whether the production of greenhouse gases, chiefly, carbon dioxide, would result in “human-induced global warming,” which would then cause severe increases in temperatures coupled with disastrous consequences. Their findings were that the concentration of carbon dioxide in the atmosphere has escalated over the past century, rising to a current level of 4 gigatons per annum. They also noted that the aggregate of human industrial carbon dioxide production emanating from the use of coal, oil, gas and cement manufacturing was about 8 gigatons per year. It was also noted that humans exhaled 0.6 gigatons annually which had been sequestered by plants from atmospheric carbon dioxide. They concluded that there was no experimental data to support the hypothesis that increases in atmospheric carbon dioxide could be expected to cause unfavourable global temperatures.

Porter and Brown (2009) embarked on a study to assess the impact of carbon emissions on economic growth; referred to as the economic environment. They noted that emissions from fossil fuels do have a negative substantial impact on economic growth. In their assessment, they concluded that the unfavourable impact is as a result of low productivity of land and labour caused by a rise in carbon emissions. They recommended that there was need for carbon emissions to be reduced. On a different study, Leo (2011) sought to assess the impact of carbon emissions on economic growth. His findings were that there was a positive relationship between carbon emissions and growth. He avers that the positive relationship is because carbon emissions are a product of industrial activities that increase and enhance growth. He recommended that countries should increase industrial activities to enhance growth but noted that the by-product was carbon emissions. To reduce the emissions, he said there was need to come up with mitigating measures.

Thomas (2013) embarked on research to establish whether carbon offsets work. In the study he explores the role of forest management in greenhouse gas mitigation. His findings included the following:

- Managing forests in a sustainable manner can provide greater greenhouse gas mitigation benefits than unmanaged forests. In the process, a multiplicity of environmental and social benefits accrues.
- Energy from fossil fuels releases carbon that has resided in the earth for millions of years while energy from forests results in no net release of carbon as long as forest inventories are stable and increasing.
- The use of wood products instead of steel, plastic, aluminium and concrete as sources of energy reduces net emissions. This is when compared to fossil fuels which release new atmospheric carbon.

He concluded that forest management is paramount in carbon emissions reduction and that there was need to manage forests vigorously in addition to avoiding the use of fossil fuels as they release net carbon which would have been trapped for millions of years.

Woodcock *et al.* (2009) sought to assess the public health benefits of strategies to reduce greenhouse gas emissions focusing on urban land transport. The settings used were London, UK and Delhi, India. In both cases, the researchers noted that reduction in carbon emissions through an increase in active travel and less use of motor vehicles had greater health benefits per million population than from the use of lower-emission motor vehicles. It was concluded that climate change mitigation in transport would benefit public health substantially. They recommended that policies should discourage travel in private motor vehicles to ensure health benefits accrue to the public.

From the studies presented in the preceding paragraphs, it is apparent that forest management should be encouraged to reduce carbon emissions. Management of forests should include forest structure and

age-class composition. To reduce volatility in the price, there is need for trading only a portion of units received, otherwise trading units not received at the stand could drive down prices and cause volatility.

The chapter has reviewed literature related to the study. It presented various concepts and theories on carbon trading and forest management. It highlighted that there are basically two carbon trading markets which are regulatory and voluntary. It also highlighted three types of forest management strategies which are (1) afforestation/ reforestation, (2) avoiding deforestation and degradation and (3) improved forest management. Under the Kyoto protocol the aim was such that industrialised nations can contribute towards offsetting their carbon footprints through purchase of these credits from countries that manage the forests. From a global perspective it made sense that industrialised nations do not have time to manage forests but concentrate on industrial production which causes pollution. On the other hand, some nations do not have the capacity for industrialisation hence should concentrate on forest management. As such the industrialised nations should compensate by paying those nations or companies managing the forests and the cycle is complete. In the next chapter, the research methodology is presented and discussed.